ELECTRONICS AND COMMUNICATION ENGINEERING

M.TECH(ELECTRONICS AND COMMUNICATION ENGINEERING)

(NON-CBCS)

REGULATIONS,CURRICULUM AND SYLLABUS

(With effect from the Academic Year 2011 – 12)

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 2011)
M.Tech (Electronics and Communication Engineering)

1.0 ELIGIBILITY

Candidates for admission to the first semester of four semester M.Tech(Electronics and Communication Engineering) should have passed B.E / B.Tech in Electronics and Communication Engineering / Communication Engineering / Telecommunication Engineering / Electronics and Telecommunication Engineering 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 specialization will consist of :

(i) Core courses (Compulsory)
(ii) Electives
(iii) Laboratory
(iv) Seminar
(v) 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.

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3.1.8 Each student is required to make a seminar presentation on any chosen topic connected with the field of specialisation. 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 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% University examination. Evaluation of laboratory course shall be based on 50% internal assessment and 50% University examination. In each course, there shall be a 3 hour University examination.

5.2 The seminar will be evaluated internally for 100 marks. The total marks for the project work for M.Tech. programmes 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**

Internal valuation should be done by a committee comprising of not less than 3 faculty members appointed by the Head of the Department and approved by the Head of the Institution.

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 1st to 4th semester should be considered and it is mandatory that the candidate should have passed all the subjects from 1st to 4th 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 (ELECTRONICS AND COMMUNICATION ENGINEERING) –NON-CBCS
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 901	Probability and Stochastic Processes	3	1	0	4	40	60	100
2.	EC 902	Advanced Digital Communication	3	1	0	4	40	60	100
3.	EC 903	Advanced Digital Signal Processing	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 908	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 904	RF Engineering	3	1	0	4	40	60	100
2.	EC 905	High Performance Communication Networks	3	1	0	4	40	60	100
3.	EC 906	Embedded Core Design	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 907	Advanced Communication and Embedded Systems 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 909	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 910	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 Wireless Security
6	EC 926	Multimedia Compression Techniques
7	EC 927	Advanced Information Theory and 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 913	Wireless Communication Systems
15	EC 914	Ubiquitous Computing
16	EC 916	CDMA and OFDM for Wireless Communication
17	EC 934	Adaptive Signal Processing
18	EC 935	Computer Aided Design of VLSI Circuits
19	EC 936	Convergence Technologies
20	EC 937	VLSI System Design

EC 901 PROBABILITY AND STOCHASTIC PROCESSES

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

Unit 1: Random Variables and their Probability Distributions

Random variables, Probability distribution function, Probability density function, Conditional probability, Statistical Independence, Bayes formula.

Moments of random variables: Expected value and moments, Mean and variance of random variable, Coefficients of variation, Skewness and kurtosis, Moments, Covariance and Correlation coefficient, Mean and variance of sum and Product of two random variables. Conditional mean and variance, Application of conditional mean and variance.

Unit 2: Discrete Random Variables and their Distributions

Moment Generation Function, Characteristics Function, Cumulants, Probability generating function, Binomial Distribution, Negative Binomial Distribution, Hypergeometric distribution, Multinomial, Poisson Distributions, 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: Stochastic Processes

Introduction- Classification of stochastic process, Stationary process (SSS and WSS) Stationary process, Ergodic Process, Independent increment Process, Markov Process, Counting Process, Narrow- Band Process, Normal Process, Wiener-Levy Process, Poisson, Bernoulli, Shot noise Process, Autocorrelation Function.

Text Book:

1. Michel K. Ochi , "Applied Probability and Stochastic Processes," John Wiley & Sons . ISSN – 0271-6356, 2008.

Reference Books:

1. Paboulis, A. "Probability, Random variables and Stochastic Processes," Tata McGraw Hill, 1984.
2. Kishor S. Trivedi, "Probability and Statistics with Reliability, Queuing and Computer Science Application," John Wiley & Sons, 2002.

EC 902 ADVANCED DIGITAL COMMUNICATION

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

Unit 1: Introduction

Elements of a digital communication system – Communication channels and their characteristics–Mathematical models for channels. Representation of digitally modulated signals – Performance of memoryless modulation methods – signaling schemes with memory – CPFSK – CPM .

Unit 2: Optimum Receivers for AWGN Channels

Waveform and vector channel models. Detection of signals in Gaussian noise. Optimum detection and error probability for band limited signaling and power limited signaling – Non coherent detection – Comparison of digital signaling methods – Lattices and constellations based on lattices – Detection of signaling schemes with memory – Optimum receiver for CPM – Performance analysis for wireline and radio communication systems. Introduction to partially coherent, double differentially coherent communication systems.

Unit 3: Channel Coding

Introduction to linear block codes, Convolution coding –Tree, Trellis and State diagrams – Systematic, Non-recursive and recursive convolutional codes – The inverse of a convolutional Encoder and Catastrophic codes – Decoding of convolutional codes - Maximum likelihood decoding, Viterbi algorithm and other decoding algorithms – Distance properties – Punctured convolutional codes, Dual-k codes, Concatenated codes – MAP and BCJR algorithms – Turbo coding and Iterative decoding – Factor graphs and sum-product algorithms – LDPC codes – Trellis coded modulation - Performance comparison.

Unit 4: Pulse Shaping and Equalization

Pulse shaping: Characterization of Band limited channels – ISI – Nyquist criterion – Controlled ISI – Channels with ISI and AWGN – Pulse shaping for optimum transmissions and reception.

Equalization: MLSE – Linear equalization – Decision feedback equalization – ML detectors – Iterative equalization – Turbo equalization. Adaptive linear equalizer – Adaptive decision feedback equalization – Blind equalization.

Unit 5: Synchronization

Signal parameter Estimation-Carrier phase Estimation–Symbol timing Estimation – Joint estimation of carrier phase and symbol timing – Performance characteristics of ML Estimators.

Text Books:

1. John G. Proakis and Masoud Salehi, "Digital Communications," 5th edition, Tata McGraw Hill, 2008.
2. Ian A. Glover and Peter M. Grant, "Digital communications," 2nd edition, Pearson education, 2008.
3. Andrea Goldsmith, "Wireless Communications," Cambridge University Press, 2005

Reference Books:

1. Marvin K. Simon, Sami M. Hinedi and William C. Lindsey, "Digital Communication Techniques : Signal Design and Detection" Prentice Hall of India, 2009.
2. Bernard Sklar, "Digital Communications: Fundamentals and Applications," 2nd edition, Pearson Education, 2002.

EC 903 ADVANCED DIGITAL SIGNAL PROCESSING

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

Unit 1: Discrete Time Random Signal Processing

Discrete Time signals- Classification of signals- Correlation of Discrete Time signals-LTI Systems and properties-Discrete Time Fourier Transform(DTFT). Discrete Time Random Processes- Ensemble averages, stationary processes, Autocorrelation and Auto covariance matrices, ergodicity. Parseval's Theorem, Wiener-Khintchine Relation-White noise, Power Spectral Density, Filtering random processes, Low Pass Filtering of White Noise, Spectral Factorization, Parameter estimation: Bias and consistency.

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 filter for filtering and prediction , FIR Wiener filter and Wiener IIR filters, Discrete Kalman filter

Unit 4: Adaptive Filters

FIR adaptive filters -adaptive filter based on steepest descent method-Widrow-Hoff LMS adaptive algorithm, Normalized LMS. Adaptive channel equalization-Adaptive echo cancellation-Adaptive noise cancellation- Adaptive recursive (IIR) filters. RLS adaptive filters-Exponentially weighted RLS- Sliding window RLS.

Unit 5: Multirate Digital Signal Processing

Mathematical description of sampling rate conversion - Interpolation and Decimation, Decimation by an integer factor - Interpolation by an integer factor, Sampling rate conversion by a rational factor, Filter implementation for sampling rate conversion- direct form FIR structures, Polyphase filter structures. Multistage implementation of sampling rate conversion. Applications – Phase shifters – Interfacing of digital systems with different sampling rates - Sub band coding.

Text Books:

1. Monson H.Hayes, "Statistical Digital Signal Processing and Modeling," John Wiley & Sons, 2008.

2. John G. Proakis and Dimitris G.Manolakis, "Digital Signal Processing," 4th Edition, Prentice Hall of India, 2007.

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,"Tata McGraw Hill, 2000.

EC 904 RF ENGINEERING

Unit 1: RF Passive Components and Transmission Line Analysis
High frequency Resistors, Capacitors and Inductors – Transmission Line Analysis – line equation – Micro stripe line – SWR voltage reflection co-efficient propagation constant, phase constant, phase velocity – smith chart – parallel RL and RC circuits – ABCD parameters and S parameters.

Unit 2: RF Active Components and RF Amplifier Design
RF Diode, PIN diode, GUNN diode, RF Bipolar junction Transistor, RF Field Effect Transistor – Modeling of Diode, transistor and FET - RF Amplifier: characteristics, power relational and stability considerations – LNA, Power amplifiers, Differential amplifiers, Distributed power amplifiers and Broad band amplifiers.

Unit 3: RF Circuits Design
RF Oscillator Design, Fixed frequency oscillator – Dielectric resonant oscillator, Voltage controlled oscillator- sun element oscillator – RF mixer design – single ended mixer – double ended mixer – RF filter resonator and filter configuration – Butterworth and chebyshev filters – Design of micro stripe filters.

Unit 4: RF IC Design
Introduction to RFIC – Analog and Microwave design versus RFIC design – noise performance estimate – RF technology – receiver with single IF stage metallization – sheet resistance – skin effect –parasitic capacitance and inductance – current handling – metal capacitors – Spiral inductors – quality factor – layout in IC – mutual inductance – multilevel – measurement – packaging.

Unit 5: RF System Design
Link design – Fading design – Protected and non protected microwave systems – Path calculation – Spread spectrum microwave system – Compatibility – Safety co-ordinate systems – Datam's & GPS – Receiver design – receiver architecture dynamic range – frequency conversion and filtering – examples of practical receivers – FM broadcast, Digital cellular, Multimeter wave point to point, Direct conversion GSM receiver-RF MEMS: Concept, Implementation and Applications.

Text Books:

1. Reinhold Ludwig and Pavel Bretchko, "RF circuit design," Pearson Education, 2007.
2. David Pozar, "Microwave and RF design of Wireless systems," Johnwiley, 2008.

Reference Books:

1. Josn Rogers and Calvin Plett, "Radio frequency Integrated circuit design," Artech house, 2002.
2. Ferri Losee, "RF systems, Components and Circuits handbook," Artech house, 2002.
3. Joseph.J.Carr, "Secrets of RF circuit design," Tata McGraw Hill, 2004.
4. Vivek Varadhan," RF MEMS and their applications", Wiley Eastern edition, 2003.

EC 905 HIGH PERFORMANCE COMMUNICATION NETWORKS

Unit 1: Introduction
Networking principles, Digitalization Service and layered architecture, traffic characterization and QoS, network services; Network elements; Network Monitoring; Network Control; network mechanisms ;Network Element Management

Unit 2: Broadband Networks
Introduction ; Multihop Wireless Broadband Networks: Mesh Networks ; Importance of Routing Protocols ;Routing Metrics ; Packet Scheduling; Admission Control; Classification of Routing Protocols ; MANET Routing Protocols ;

Unit 3: IP Networks
Technology Trends in IP Networks, internet protocol, IP Packet Communications in Mobile Communication Networks ;TCP and VDP, Performance of TCP/IP networks; Circuits Switched Networks- SONET, DWDM, Fiber to home, DSL; Intelligent Network (IN) Scheme; Comparison with Conventional Systems ; Merits of the IN Scheme ; CATV.

Unit 4: ATM Networks
Introduction to ATM; The ATM Reference Model ; The ATM Layer; The ATM Adaptation Layer (AAL) ; AAL1 ;AAL2 ; AAL3/4 ; AAL5; Traffic Classes; Traffic Management and Quality of Service ; Traffic Descriptor ; Traffic Shaping; ABR and Traffic Congestion ;Network Management ; Layer Management; ATM Signalling ; ATM Addressing Format ;; Connection Establishment; IP/ATM Internetworking ;IP Multicast over ATM

Unit 5: High Performance Networking With WiMAX and Ultra Wideband (WPAN)
Introduction ; WiMAX Overview ; Competing Technologies ; Overview of the Physical Layer ; PMP Mode ; Mesh Mode ; Multihop Relay Mode. Introduction; Time-Hopping Ultrawideband ; Direct Sequence Ultrawideband ; Multiband; Other Types of UWB.

Text Books:

1. Jean warland and Pravin Varaiya, "High Performance Communication Networks," 2nd Edition, Harcourt and Morgan Kanffman Publishers, London, 2008
2. Leon Gracia and Widjaja, "Communication networks," Tata McGraw Hill, 2008.

Reference Books:

1. Lumit Kasera and Pankaj Sethi, "ATM Networks," Tata McGraw Hill, 2000.
2. Keiji Tachikawa, "W-CDMA Mobile Communication System," John Wiley & Sons, 2002.
3. David tung chong wong, Peng-yong kong, Ying-chang liang, Kee chaing chua and Jon W. Mark, "Wireless Broadband Networks," John Wiley & Sons, 2009.

EC 906 EMBEDDED CORE DESIGN

Unit 1: Elements of Embedded System

Abstraction levels – Transistors to Programs – Mixed level hardware – Design Specification – Embedded system design flow – Hardware / Software Partitioning – Hardware port – Software Port – Interconnection Specification – Common Hardware / Software Simulation – Hardware Synthesis – Software Compilation – Interconnection Hardware Generation – Design Integrator – Design Tools – Block Diagram Description – HDL and other hardware Simulators – Hardware synthesis tool – Compiler for Machine Language Generation – Software Builder and Debugger – Embedded System Integrator – Hardware design trends – Configurable processors – Standard Bus Structure – Software Programming – Software Utilities.

Unit 2: RTL Design with VHDL

Basic Structures of VHDL – VHDL Overview and Concepts – VHDL Types – VHDL Object Classes – VHDL Design Units – Basic Language Elements – Lexical Elements – Syntax – Types and Subtypes – Attributes – Control Structures – if statement – case statement – loop statement – Drivers – Resolution function – Drivers – Ports – VHDL Timing – Signal Attributes – Wait Statement – Modeling with zero time delays – Inertial / Transport Delay –Elements of Entity / Architecture – Entity – Architecture – Process Statement – Concurrent Signal Assignment Statement – Component Instantiation Statement – Concurrent Procedure Call – Generate Statement – Concurrent Assertion Statement – Block Statement – Subprograms – Subprogram Definition – Functions and Procedures – Packages.

Unit 3: Field Programmable Devices

Read Only Memories – Basic ROM Structure – NOR Implementation – Distributed Gates – Array Programmability – Memory View – ROM Variations – Programmable Logic Arrays – PAL Logic Structure – Product Term Expansion – Three State Outputs – Registered Outputs – Commercial Parts – Complex Programmable Logic Devices – Altera's MAX 7000S CPLD – Field Programmable Gate Arrays – Altera's Flex 10K FPGA – Altera's Cyclone FPGA.

Unit 4: Design with Embedded Processors

Embedded Design Steps – Processor Selection – Processor Interfacing – Developing Software – Filter Design – Filter Concepts – FIR Filter Hardware Implementation – FIR Embedded Implementation – Building the FIR filter – Design of a Microcontroller – System Platform – Microcontroller Architecture.

Unit 5: Design of an Embedded System

Designing an Embedded System – Nios II Processor – Configurability Features of Nios II – Processor Architecture – Instruction Set – Nios II Alternative Cores – Avalon Switch Fabric – Avalon Specification – Address Decoding Logic – Data Path Multiplexing – Wait – state insertion – Pipelining – Endian Conversion – Address Alignment and Dynamic Bus sizing – Arbitration for Multi-Master systems – Burst management – Clock Domain Crossing – Interrupt Controller – Reset Distribution – SOPC Builder Overview – Architecture of SOPC Builder Systems – Functions of SOPC Builder – Integrated Development Environment – IDE Project Manager – Source Code Editor – C/C++ Compiler – Debugger – Flash Programmer- Case Study: Calculator – System Specification – Calculator IO Interface – Design of Calculating Engine – Building Calculator Software – Calculator Program – Completing the calculator System.

Text Books:

1. Zainalabedin Navabi, " Embedded Core Design With FPGAs " , Tata McGraw Hill, 2008.
2. Ben Cohen, "VHDL Coding Styles and Methodologies," Kluwer Academic Publishers, 2007.

Reference Books:

1. Zainalabedin Navabi, "VHDL Analysis and Modeling of Digital Systems," Tata McGraw Hill, 1992.
2. Patterson.D.A, J.L.Hennessy and P.J. Ashenden, "Computer Organization and Design: The Hardware / Software Interface," 3rd Edition, 2004.
3. J.Bhasker, "VHDL Primer," 3rd Edition,Dorling Kindersley (india) Pvt Ltd.,2007.

EC 907 ADVANCED COMMUNICATION AND EMBEDDED SYSTEMS LABORATORY

1. Design, implementation and testing of different stages of a DS-SS system.
2. Design and characterization of antennas using Network Analyzer.
3. Design, implementation and testing of modulators used for mobile communication using Spectrum Analyzer
4. Multiplexing, BER measurement and data transmission through Optical Fiber.
5. Design and implementation of network security algorithm, authentication protocols, firewalls & trusted systems using MATLAB.
6. Simulation and performance evaluation of Ad-hoc routing protocols using Glomosim / NS2.
7. Design and performance analysis of error control coders using MATLAB.
8. Implementation of digital circuits using FPGA.
9. Experiments in embedded system - I
10. Experiments in embedded system - II
11. Characterization of MIC components

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-lightpath 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 subproblems-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, 2008.
2. Rajiv Ramaswami and Kumar N. Sivarajan, " Optical Networks: A Practical Perspective, 2nd Edition, Morgan Kaufmann Publishers, 2007.

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, Quasianalytical 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" ,Tata 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," 4th Edition, Prentice Hall of India, 2005 .
3. Z.Peebles , "Probability, Random Variable and Random Signal Principles," 4th edition, Tata McGraw Hill, 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.

Text Books:

1. X.Wang and H.V.Poor, "Wireless Communication Systems," Pearson Education, 2008.
2. Iti Saha Misra, "Wireless Communications and Networks," Tata McGraw Hill, 2009.

EC 925 CRYPTOGRAPHY AND WIRELESS SECURITY

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

Unit 1: Introduction and Symmetric Key Encryption
Attacks-Services-Mechanisms-OSI Security architecture-Model for Network Security-Symmetric Cipher Model- Substitution and Transposition Techniques- Simplified DES-DES Block Cipher Principles-The Strength of DES-Differential and Linear Cryptanalysis-Block Cipher Design Principles-Block Cipher Modes of Operation- Groups, Rings and Fields-Modular Arithmetic- Euclid's Algorithm-Finite Fields of the Form GF(p)-Polynomial Arithmetic-Finite Fields of the Form GF(2^n)-AES cipher-Triple DES

Unit 2: Number Theory and Public Key Encryption
Prime Numbers-Fermat's and Euler's Theorems-Testing of Primality-The Chinese Remainder Theorem-Discrete Logarithms-Principles of Public Key Cryptosystems-The RSA Algorithm-Key Management-Diffie-Hellman Key Exchange-Elliptic Curve Arithmetic- Elliptic Curve Cryptography.

Unit 3: Message Authentication and Hash Functions

Authentication Requirements- Authentication functions-message Authentication Codes- Hash Functions- Security of Hash Functions and MACs-MD5 Message Digest Algorithm-Digital Signatures-Authentication Protocols-Digital Signature Standard.

Unit 4: Network Security Practice
Authentication Application-Kerberos-Electronic Mail Security-Pretty Good Privacy-S/MIME-IP Security Overview-IP Security Architecture-Authentication Header Encapsulation Security Payload-Web Security Considerations-Secure Sockets Layer and Transport Layer Security-Secure Electronic Transaction.

Unit 5: System Security
Intruders- Intrusion Detection-Password Management-Viruses and Related Threats-Viruses Counter Measures-Firewall Design Principles-Types of Firewalls-Firewalls Configurations-Trusted Systems-Blue Print for Security-Security Policy-Systems Specific Policy-NIST Security Models-VISA International Security Model-Hybrid Framework.

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, 1st Edition, Prentice Hall of India, 2008.
2. David Salomon, "Data Compression – The Complete Reference" 3rd Edition, Springer Verlag New York Inc., ,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" 2nd Edition, IEEE Communications Society, John Wiley & Sons, 2007.
2. Peter Symes, "Digital Video Compression," Tata McGraw Hill, 2004.
3. Mark Nelson, "Data compression," BPB Publishers, New Delhi,1998.

EC 927 ADVANCED INFORMATION THEORY AND CODING TECHNIQUES

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

Unit 1: Information Theory
Introduction to Information theory- Uncertainty and information – average mutual information ,Average self information, Average conditional self information, Measures of information-Information content of a message-Average information content of symbols in long independent sequences – Average information content of symbols in long dependent sequences – Markoff statistical model for information sources, Entropy and information rate of Markoff sources, Information measure for continuous random variables.

Unit 2: Channels and Channel Capacity

Communication channels, Discrete communication channel-Rate of information transmission over a discrete channel-capacity of a discrete memoryless channel-continuous channel – Shannon –Hartley theorem and its implications.
Channel models- channel capacity –BSC ,BEC-cascade channels-symmetric channel –unsymmetric channel and their capacities-Information capacity theorem ,Shannon limit , channel capacity for MIMO system.

Unit 3: Source Coding
Purpose of coding, Uniquely decipherable codes ,Shannon's I and II fundamental theorem- Source coding theorem –Huffman coding – Shannon fano-Elias coding, Arithmetic coding –Lempel-Ziv algorithm-Run length encoding and PCX format-Rate distortion function-optimum quantizer design-JPEG standard for lossless and lossy compression

Unit 4: Channel Coding
Linear block codes and cyclic codes-Galois fields, Vector spaces and matrices, Noisy channel coding theorm, Matrix description of linear blocks codes-Equivalent codes-parity cheek matrix, Decoding of linear block codes , error detection and error correction capability perfect codes,
Hamming codes, Low density parity check (LDPC) codes, Optimal linear codes, Maximum distance separable (MDS) codes-Bounds on minimum distance-space time block codes.
Method fee generating cyclic codes- Matrix description of cyclic codes, syndrome calculation, Error detection and correction quasi cyclic codes and shortened cyclic codes and shortened cyclic codes, Fire codes, Golay codes ,CRC codes, BCH codes, RS codes.

Unit 5: Channel Coding
Convolution codes and Trellis codes-Tree codes and Trellis codes, polynomial description of convolutional codes-Viterbi decoding of convolutional codes-distance bounds-performance bounds, Turbo codes-Turbo decoding-Interleaver design concept of coded modulation, Ungerboecks TCM-Design rules-Decoders, TCM for AWGN channel, TCM for fading channel, Space Time Trellis Codes.

Text Books:
1. J.Das, SK.Mullick and PK Chatterjee, "Principles of Digital Communication," Wiley Eastern
   Limited, 2008.
2. Ranjan Bose, "Information Theory Coding and Cryptography," Tata McGraw Hill, New Delhi, 2010.

Reference Books:
1. K. Sam Shanmugam, "Digital and Analog Communication Systems," John Wiley and 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 1: DIGITAL IMAGE REPRESENTATION AND TRANSFORMS

Introduction – Elements of visual perception, Steps in Image Processing Systems – Image sensing and Acquisition – Sampling and Quantization – Pixel Relationships – Colour Fundamentals and Models. Image Basis Function, Two dimensional DFT, DCT, Discrete Sine ,Walsh, Hadamard transform, Slant, Haar, KLT and SVD.

Unit 2: IMAGE ENHANCEMENT AND RESTORATION

Gray level Transformations, Histogram Processing , Spatial Filtering – Image Smoothing and Sharpening , Fuzzy techniques for intensity transformations and spatial filtering .

Filtering in Frequency Domain – Image Smoothing and Sharpening filters – Homomorphic Filtering. Colour transformations, colour image smoothing and sharpening

Image restoration – image degradation and noise models, Restoration with spatial filtering, Inverse filtering, Wiener filtering, Constrained least squares filtering.

Unit 3: MULTI RESOLUTION ANALYSIS AND COMPRESSION

Multi Resolution Analysis: Image Pyramids, subband coding – Multi resolution expansion –Wavelet Transforms, Fast Wavelet transforms, Wavelet Packets.

Need for data compression, Huffman, Arithmetic, Run Length coding, bit plane coding, predictive coding, Vector Quantization, Transform coding, wavelet coding. JPEG standard, JPEG 2000, SPIHT,Video Compression Standards.

Unit 4: IMAGE SEGMENTATION AND DESCRIPTION

Point and line detection, edge detection – Edge Operators – Edge Linking and Boundary Detection – Thresholding – Region Based Segmentation – Segmentation using morphological watersheds, use of Motion in Segmentation, Image segmentation based on colour.

Representation-boundary following, chain codes, Boundary descriptors, regional descriptors , use of principal components for description, relational descriptors.

Unit 5: PATTERN RECOGNITION

Image Recognition **–** Patterns and pattern classes, Recognition based on decision – theoretic methods - Matching by minimum distance classifier, Matching by correlation- Optimum statistical classifiers- Bayes classifier.Neural networks-Perceptron model- Multilayer feedforward neural network to recognize shapes.Structural methods-matching shape numbers and string matching.Fuzzy system-optimization techniques for recognition-Genetic algorithm- Simulated annealing.

Text Book:

1. Rafael C. Gonzalez and Richard W. Woods, "Digital Image Processing," 3rd Edition, Pearson Education , 2009.

Reference Books:

1. A.K.Jain, "Fundamentals of Digital Image Processing," Prentice Hall of India,2008.
2. S.Jayaraman, S.Esakkirajan and T.Veerakumar,"Digital Image Processing," Tata McGraw Hill, New Delhi, 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 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-WCDMA-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, 2007.
2. T.S. Rappaport, "Wireless Communications," Pearson Education, 2008.

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," 3rd edition, Tata McGraw 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 awreness – 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 916 CDMA AND OFDM FOR WIRELESS COMMUNICATION

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

Unit 1: 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.

Unit 2: Call Processing and Traffic
Call processing states – Initialization, idle, access and traffic states – Forward link and Reverse link analysis - Calculation of E_c/I_0 and E_b/N_0 – Traffic intensity – Grade of Service – Erlang-B and C models.

Unit 3: 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.

Unit 4: Coding, Modulation and Channel Estimation

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.

Unit 5: 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

Text 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.

Reference Books:

1. Lajas Hanzo, "OFDM and MC-CDMA for Broadband Multiuser Communications," 2003
2. Khaled Fazal and Stephen Kaiser, "Multicarrier and Spread Spectrum Systems," 2008

EC 934 ADAPTIVE SIGNAL PROCESSING

Unit 1: Introduction

Adaptive Systems - Definition and Characteristics, Example of an Adaptive System, Areas of Application, Adaptive Linear Combiner, the Performance Function, Gradient and Minimum Mean-Square Error

Unit 2: Wiener Filter and Linear Prediction

Linear Optimum Filtering, Principle of Orthogonality, Minimum Mean Square Error, Winer-Hopf Equation, Error Performance Surface.
Linear Prediction -Forward Linear Prediction, Backward Linear Prediction, Properties of Prediction Error Filters.

Unit 3: Adaptive Algorithms
Method of Steepest Descent - Basic Idea of Steepest-Descent Algorithm, Steepest-Descent Algorithm Applied to Weiner Filter, Stability of Steepest-Descent Algorithm, Limitations of Steepest-Descent Algorithm.
Least-Mean Square Adaptive Filter - Overview, LMS Adaptation Algorithm, Application, Comparison of LMS with Steepest - Descent Algorithm.
Normalized Least-Mean Square Adaptive Filter - Normalized LMS Filter as the Solution to Constrained Optimization Problem, Stability of the NLMS.

Unit 4: Transform-Domain and Subband Adaptive Filters
Block Adaptive Filters, RLS Adaptive Filters **-**Statement of Linear Least-Square Estimation Problem, Matrix Inversion Lemma, Exponentially weighted RLS algorithm.
Kalman Filter - Recursive Minimum Mean-Square Estimation For Scalar Random Variable, Kalman Filtering Problem, Initial Conditions, Summary of Kalman Filter.

Unit 5: Applications of Adaptive Signal Processing
Adaptive Modeling & System Identification - Inverse Adaptive Modeling – Deconvolution – Equalization - Adaptive Interference Cancelling - Adaptive noise cancelling - Adaptive echo cancellation in Telephone channels - Introduction to Adaptive Arrays and Adaptive beamforming.

Text Books:

1. Bernard Widrow and Samuel D. Stearns, "Adaptive Signal Processing," Prentice Hall of India,
2008.
2. Simon Haykin, "Adaptive Filter Theory," Prentice Hall of India, 2007.

Reference Books:

1. D.G.Manolokis, Vinay.K.Ingle and Stephen M.Kogan, "Statistical and Adaptive Signal Processing," Artech House, 2005
2. Cowan C F N and Grant P M, "Adaptive Filters," Prentice Hall of India, 1985.
3. Sayed F," Fundamentals of Adaptive Filters ," Wiley Interscience,2002.

EC 935 COMPUTER AIDED DESIGN OF VLSI CIRCUITS

Unit 1: Design Methodologies
Introduction to VLSI Methodologies - VLSI Physical Design Automation - Design and Fabrication of VLSI Devices - Fabrication process and its impact on Physical Design.

Unit 2: Introduction to Graph Theory and Computational Complexity
A Quick Tour of VLSI Design Automation Tools - Data structures and Basic Algorithms - Algorithmic Graph theory and computational complexity - Tractable and Intractable problems.

Unit 3: General Purpose Methods for Combinatorial Optimization
General purpose methods for combinational optimization – Circuit representation - Wire length estimation - Placement algorithms - Partitioning algorithms -Floor planning - floor planning concepts - Shape functions and floor planning sizing - Pin assignment - Routing - Local routing - Area routing -Channel routing - global routing and its algorithms.

Unit 4: VLSI Simulation, Logic Synthesis and Verification
Simulation-logic synthesis - gate level and switch level modeling and simulation - Introduction to combinational logic synthesis - ROBDD principles, implementation, construction and manipulation -Two level logic synthesis - High-level synthesis-hardware model for high level synthesis - Internal representation of input algorithms - Allocation, assignment and scheduling - Scheduling algorithms – Aspects of assignment - High level transformations -Verification-High level synthesis - Layout Compaction - Design rules - symbolic layout - Applications of compaction - Formulation methods - Algorithms for constrained graph compaction.

Unit 5: Physical Design of FPGA And VHDL Implementation
Physical Design Automation of FPGAs, MCMS-VHDL-Implementation of Simple circuits using VHDL.

Text Books:
1. N.A.Sherwani, " Algorithms for VLSI Physical Design Automation ," Kluwer Academic Publisher, 2007.
2. S.H.Gerez, " Algorithms for VLSI Design Automation ," John Wiley & Sons, 2007.
3. Z.Navabi, "VHDL Analysis and Modeling of Digital Systems," 2nd Edition, McGraw Hill, 2008.

Reference Book:
1. Perry, "VHDL," 3rd Edition, McGraw Hill, 2002.

EC 936 CONVERGENCE TECHNOLOGIES

Unit 1: Introduction
Evolution and Convergence; The Next Generation Network Concept; A Framework for Examining Next Generation Networks- Characteristics of Evolving Networks; Dealing with Complexity; Framework for Evolving Networks; Examples of Application of Framework; Enabling mobile network technologies; Opportunities and threats to the mobile converging service market

Unit 2: IP Telephony and Applications
IP Protocol Suite Overview ; IP Protocol ; IP Addressing and Routing ; Transmission Control Protocol (TCP) ; User Datagram Protocol (UDP) ; Domain Name Service (DNS); Address Resolution Protocol (ARP) ; IP Routing ;Differentiated Services (DiffServ) ; Resource Reservation Protocol (RSVP) ;IntServ versus DiffServ. Internet Protocol Version 6 (IPv6) ; IPv6 Address Representation ; The Transition from IPv4 to IPv6;Tunnelling ;Mobile IP ; Routing; Route Optimization; Mobile IP for IPv6; Mobile IP for CDMA2000 ; Mobile IP for UMTS.

Unit 3: Converged Networks with IMS Technology
IP Multimedia Subsystem (IMS) ; Call Session Control Function (CSCF) ; Application Server (AS) ; Breakout Gateway Control Function (BGCF); Multimedia Resource Function (MRF) ; Media Gateway Control Function and Media Gateway(MGCF and MGW) ; Home Subscriber Server (HSS) ; Session Initiation Protocol (SIP) ; SIP Addressing; SIP Headers ; SIP Call Establishment ; SIP Registration ; SIP Call Routing (Direct, Proxy and Redirect) ; SIP–PSTN Interworking ; SIP Bridging; Conferencing with SIP ; SIP Event Notification ; SIP and Instant Messaging Services ; IP in the Radio Access Network (RAN) ; IP ATM Interoperating; Multiprotocol Label Switching (MPLS) in UMTS.

Unit 4: Software Methodologies for Converged Networks and Services
Development of Software Methodologies for ICT; Software Processes in the NGN Framework; High-level Analysis and Design Methods; Enterprise and Business Modeling Notation; Object and Data Definition Languages; Dynamic Modeling Notations; Component and Interface Notations; Distributed Systems; Creating a Unified Framework.

Unit 5: Convergence of Networks
Introduction: 3GPP/WLAN Interworking; IEEE 802.11u Interworking with External Networks; LAN/WLAN/WiMax/3G Interworking Based on IEEE 802.21;Media-Independent Handoff ; Future Cellular/WiMax/WLAN/WPAN Interworking ; Analytical Model for Cellular/WLAN Interworking

Text Books:

1. Jeffrey Bannister, Paul Mather and Sebastian Coope, "Convergence Technologies for 3G Networks," John.Wiley.Sons, 2008.
2. Hu Hanrahan, "Network Convergence: Services, Applications, Transport, and Operations Support," John.Wiley.Sons, 2007.

Reference Book:

1. David tung chong wong, Peng-yong kong, Ying-chang liang, Kee chaing chua and Jon w. Mark , "Wireless Broadband Networks," John Wiley Sons, 2009.

2. Jyh-Cheng Chen and Tao Zhang, "IP based Next Generation Wireless Networks-Systems, Architecture and Protocols," John Wiley Sons.
3. Willie W. Lu, "Broadband Wireless Mobile 3G and Beyond," John Wiley Sons,2001.
4. Vijay Garg, "Wireless Network Evolution:2G to 3G," Prentice Hall of India,2001.

EC 937 VLSI SYSTEM DESIGN

Unit 1: Combinational Circuit Design
Static CMOS Circuits – Mirror Circuits – Pseudo NMOS – Tristate Circuits - Clocked CMOS – Dynamic CMOS logic Circuits – Domino Logic – Dual rail logic networks – DCVSL – Complementary pass transistor logic.

Unit 2: VLSI System Components
Multiplexers – Binary Decoders – Equality Detectors and Comparators – Priority Encoder – Shift and Rotation Operations – Latches – Flip-flops – Registers – Single bit addition – Carry – Propagate Addition – Carry Generation and Propagation – Manchester Carry Chain – Carry Skip Adder – Carry Look Ahead adder.

Unit 3: System Level Physical Design
Large scale physical Design – Interconnect Delay Modeling – Crosstalk – Interconnect Scaling – Floor planning and Routing – Input and Output Circuits – Power Distribution and Consumption – Low Power Design Considerations.

Unit 4: VLSI Clocking and System Design
Clocked Flip-flops – CMOS clocking styles – Pipelined system – Clock Generation and Distribution – System Design Considerations.

Unit 5: Reliability and Testing Of VLSI Circuits
General Concepts – CMOS Testing – Test Generation Methods.

Text Book:
1. John.P.Uyemura, " Introduction to VLSI Circuits and System" , Wiley India , 2008.

Reference Book:
1. Neil H.E.Weste, David Harris and Ayan Banerjee, "CMOS VLSI Design," Pearson Education, 2008.

INFRASTRUCTURE AND FACULTY REQUIREMENT FOR M.TECH.(ELECTRONICS AND COMMUNICATION ENGINEERING) - Non-CBCS

1. INFRASTRUCTURE

(i) Building Infrastructure

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

(ii) Equipment Infrastructure

S.No.	Facilities/Equipment/Accessories	QTY.
1	Regulated power supply	10
2	CRO (20MHz/30MHz/60MHz/100MHz)	5
3	Signal generator and Function generator	10
4	Fiber optic trainer	2
5	Spectrum analyzer	1
6	Vector Network Analyser	1
7	Arbitrary waveform generator	1
8(a)	**VLSI trainer kit:** <u>List of software required</u> Simulator and Synthesizer tool with down loader (VHDL/Verilog)	5 user license
(b)	No. of FPGA kits required with I/O cards & Add on card for FPGA	5 nos.
9	PC with LAN connection	20
10	Network Simulator Software/ Glomosim	5

11	MATLAB Software	5 users
12.	MIC trainer kits	2 nos.

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