

ELECTRONICS AND COMMUNICATION ENGINEERING

M.TECH(WIRELESS COMMUNICATION)

(CBCS)

REGULATIONS, CURRICULUM AND SYLLABUS

(With effect from the Academic Year 2011 – 12)

**PONDICHERRY UNIVERSITY
PUDUCHERRY – 605 014.**

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PUDUCHERRY -605 014.**

REGULATIONS FOR POST GRADUATE (M.Tech.) PROGRAMMES IN THE DISCIPLINE OF ELECTRONICS AND
COMMUNICATION ENGINEERING (CBCS)
(WITH EFFECT FROM JULY 2011)
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) Three credits for directed study course
- (vi) 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	12
9	Laboratory / Seminar	2
10	Directed study	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. Core courses in a particular specialisation are offered by the department concerned.

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 student can undertake the project work in the department concerned or in an industry/research laboratory approved by the vice-chairperson and chairperson. 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 Directed study is a theory course required to be credited by each student under the close supervision of a faculty member of the department. The title of the course and syllabus are to be formulated by the designated faculty member and approved by the vice-chairperson.

3.1.11 A student who has acquired the minimum number of total credits for the award of Degree will not be permitted to register for more courses for the purpose of improving his /her cumulative grade point average (see Table 1).

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

3.2 Grading

3.2.1 Based on the performance of each student in a semester, letter grades will be awarded to each course at the end of the semester. The letter grades, the corresponding grade point and the description will be as shown in Table – 2.

TABLE 2: Letter Grade and the Corresponding Grade Point

GRADE	POINTS	DESCRIPTION
S	10	EXCELLENT
A	9	VERY GOOD
B	8	GOOD
C	7	ABOVE AVERAGE
D	6	AVERAGE
E	5	SATISFACTORY
F	0	FAILURE
FA	-	FAILURE DUE TO LACK OF ATTENDANCE/ FAILURE BY ABSENCE

3.2.2 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 end-semester examination in a subject to earn a successful grade. A subject successfully completed cannot be repeated at any time.

3.2.3 The letter grades do not correspond to any fixed absolute mark. Each student is awarded a grade depending on his/her performance in relation to the performance of other students taking or have taken the course. For example, S does not mean he/ she has secured 100% or 95%, but, rather that he /she is in the top 5% of all the students who have taken / are taking the course, in the judgement of the teachers. Grades shall be awarded based on the absolute marks in a meeting of the M.Tech Programme Committee to be held not later than 10 days after the last day of semester examination. Normally, not more than 5% of the students in any written/ laboratory course shall be awarded the grade S and not more than one-third awarded A grade. Average marks in the class shall normally be C grade excepting in the case of practical /project where it may be B grade.

4.0 REGISTRATION

4.1 Each student, on admission, shall be assigned a Faculty Advisor, who shall advise the student about the academic programme and counsel him/her on the choice of courses depending on his/her academic background and objective.

4.2 With the advice and consent of the Faculty Advisor, the student shall register for courses he/ she plans to take for the semester before the commencement of classes. No student shall be permitted to register for courses exceeding 30 contact hours per week nor shall any student be permitted to register for any course without satisfactorily completing the prerequisites for the course, except with the permission of the teacher concerned in the prescribed format.

4.3 If the student feels that he/she has registered for more courses than he/she can handle, he/she shall have the option of dropping one or more of the courses he/she has registered for, with the consent of his/her Faculty Advisor, before the end of 3rd week of the semester. However, a student to retain his/her status should register for a minimum of 10 credits per semester.

4.4 Students, other than newly admitted, shall register for the courses of their choice in the preceding semester by filling in the prescribed forms.

4.5 The college shall prescribe the maximum number of students in each course taking into account the physical facilities available.

4.6 The college shall make available to all students a bulletin, listing all the courses offered in every semester specifying the credits, the prerequisites, a brief description or list of topics the course intends to cover, the faculty offering the course, the time and place of the classes for the course.

4.7 In any department, preference shall be given to those students for whom the course is a core-course, if, the demand for registration is beyond the maximum permitted number of students.

4.8 Normally, no course shall be offered unless a minimum of 3 students are registered.

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

<u>Internal valuation</u>		
	Guide	50 marks
	First Evaluation	50 marks
	Second Evaluation	50 marks
	Total	150 marks
<u>External valuation</u>		
	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

<u>Internal valuation</u>		
	Guide	100 marks
	First Evaluation	50 marks
	Second Evaluation	50 marks
	Total	200 marks
<u>External valuation</u>		
	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 Vice-Chairperson.

5.3 The directed study shall be evaluated internally and continuously as detailed below:

Test I	: 15 Marks
Test II	: 15 Marks
Assignment	: 10 Marks
Final test covering the whole syllabus	: 60 Marks
Total	: 100 Marks

5.4 The end-semester examination shall be conducted by the department for all the courses offered by the department. Each teacher shall, in the 4th week of the semester, submit to the Vice-Chairperson, a model question paper for the end-semester examination. The end-semester paper shall cover the entire course.

5.5 The department shall invite 2 or 3 external experts for evaluating the end-semester examinations and grading. Each expert will be asked to set the question paper(s) for the course(s) he/she is competent to examine for the end-semester examination based on the model question paper submitted by the teacher concerned. The teacher and the expert concerned shall evaluate the answer scripts together and award the marks to the student. If, for any reason, no external expert is available for any paper, then, the teacher concerned shall set the question paper(s) for the end-semester examination, and the teacher himself/herself shall evaluate the papers and award the marks.

5.6 In the department, after the evaluation of the end-semester examination papers, all the teachers who handled the courses and the external experts together shall meet with the M.Tech. Programme Committee (see 7.0) and decide the cut-offs for grades in each of the courses and award the final grades to the students.

5.7 Continuous internal assessment mark of 40 for a theory course 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.

5.8 Every student shall have the right to scrutinize his/her answer scripts, assignments etc. and seek clarifications from the teacher regarding his/her evaluation of the scripts immediately after or within 3 days of receiving the evaluated scripts.

5.9 The department shall send all records of evaluation, including internal assessment for safe-keeping, to the college administration, as soon as all the formalities are completed.

5.10 At the end of the semester, each student shall be assigned a grade based on his/ her performance in each subject, in relation to the performance of other students.

5.11 A student securing F grade in a core course must repeat that course in order to obtain the Degree. A student securing F grade in an elective course may be permitted to choose another elective against the failed elective course, as the case may be, in consultation with the Faculty Adviser.

5.12 A student shall not be permitted to repeat any course(s) only for the purpose of improving the grade in a particular course or the cumulative grade point average (CGPA).

5.13 In exceptional cases, with the approval of the Chairperson, PG Programme committee, make-up examination(s) can be conducted to a student who misses end-semester examination(s) due to extreme medical emergency, certified by the college Medical Officer, or due to time-table clash in the end-semester examination between two courses he/she has registered for, in that semester.

5.14 All eligible students shall appear for end-semester examinations.

5.15 No student who has less than 75% attendance in any course will be permitted to attend the end-semester examinations. However, a student who has put in 60-75% attendance in any course and has absented on medical grounds will have to pay a condonation fee of Rs.200/- for each course and produce a medical certificate from a Government Medical Officer not below the rank of R.M.O. or officer of equal grade to become eligible to appear for the examinations. A student with less than 60% attendance shall be given the grade of FA. He/She shall have to repeat that course if it is a core course, when it is offered the next time.

6.0 SUMMER TERM COURSE

6.1 A summer term course (STC) may be offered by the department concerned on the recommendations of M.Tech. Programme Committee. A summer term course is open only to those students who had registered for the course earlier and failed. No student should register for more than two courses during a summer term. Those students who could not appear for examination due to lack of attendance will not be allowed to register for the same course offered in summer, unless, certified by the Vice-Chairperson concerned and the Principal.

6.2 Summer term course will be announced at the end of even semester. A student has to register within the stipulated time by paying the prescribed fees.

6.3 The number of contact hours per week for any summer term course will be twice that of a regular semester course. The assessment procedure in a summer term course will be similar to the procedure for a regular semester course.

6.4 Withdrawal from a summer term course is not permitted.

7.0 M.Tech. PROGRAMME COMMITTEE

7.1 Every M.Tech. Programme shall be monitored by a committee constituted for this purpose by the college. Each committee shall consist of all teachers offering the courses for the programme and two student members or 10% of students enrolled whichever is less. The HOD or a senior faculty in the rank of a Professor shall be the Vice-Chairperson, nominated

by the Head of the Institution. There shall be a common Chairperson in the Rank of Professor nominated by the Head of the Institution for all the P.G. programmes offered by the institute. There can be a common co-ordinator in the rank of Professor nominated by the Head of the Institution.

7.2 It shall be the duty and responsibility of the committee to review periodically the progress of the courses in the programme, discuss the problems concerning the curriculum and syllabi and conduct of classes. The committee may frame relevant rules for the conduct of evaluation.

7.3 The committee shall have the right to make suggestions to individual teachers on the assessment procedure to be followed for his/her course. It shall be open to the committee to bring to the notice of the Head of the Institution any difficulty encountered in the conduct of the classes or any other pertinent matter.

7.4 The committee shall meet at least twice a semester – first at the beginning of the semester, and second at the end of the semester. In the second meeting, the committee excluding student members but with the external experts invited by the Chairperson PG Programme Committee, shall finalize the grades of the students.

8.0 MINIMUM REQUIREMENTS

8.1 To be eligible towards continuing the Programme, a student must have earned a certain number of successful 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. If he/she fails to earn the number of credits by the end of that year (including courses taken in summer), then, he/she shall be asked to discontinue the Programme.

8.2 Students are expected to abide by all the rules of the college and maintain a decorous conduct. Any deviation will be referred to the Head of the Institution for suitable action.

8.3 No student who has any outstanding dues to the college, hostel, library or laboratory or against whom any disciplinary action is contemplated/ pending, will be eligible to receive his/her degree.

9.0 DECLARATION OF RESULTS,RANK AND ISSUE OF GRADE CARD

9.1 The PG Programme(CBCS) office shall display the grades as soon as possible after the finalization of the grades. The student shall have the right, for a look at the evaluated examination scripts and represent to the M.Tech. Programme Committee for review if he/she feels aggrieved by the evaluation within a week from the commencement of succeeding semester classes.

9.2 The College shall issue at the beginning of each semester a grade card to the student, containing the grades obtained by the student in the previous semester (s) and his/her Grade Point Average (GPA) and his/her Cumulative Grade Point Average (CGPA).

9.3 The grade card shall list:
a) title of the course(s) taken by the student.

- b) credits associated with each course.
- c) grade secured by the student.
- d) total credits earned by the student in that semester.
- e) GPA of the student.
- f) total credits earned by the student till that semester and
- g) CGPA of the student.

9.4 The GPA shall be calculated as the weighted average of the Grade Points weighted by the credit of the course as follows:

The product of the credit assigned to each course and the grade point associated with the grade obtained in the course is totaled over all the courses and the total is divided by the sum of credits of all the courses and rounded off to two decimal places.

For example, a student securing grade A in a 4 credit course, grade B in a 2 credit course, grade S in a 3 credit course and grade F in a 3 credit course, will have a GPA as:

$$(9 \times 4 + 8 \times 2 + 10 \times 3 + 0 \times 3) / (4+2+3+3) = 82 / 12 = 6.83 / 10.0$$

The sum will cover all the courses the student has taken in that semester, including those in which he/she has secured grade F. Grades FA are to be excluded for calculating GPA and CGPA.

9.5 For computing CGPA, the procedure described in 9.4 is followed, except, that the sum is taken over all the courses the student has studied in all the semesters till then. If a student has repeated any course, the grade secured by him/her in the successful attempt only will be taken into account for calculating CGPA.

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

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

9.7 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.

9.8 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.

9.9 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**.

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

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

9.12 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 end-semester examinations.

10.0 PROVISION FOR WITHDRAWAL

A candidate may, for valid reasons, and on the recommendation of the vice-chairperson and chairperson be granted permission by the Head of the Institution 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.

11.0 TEMPORARY DISCONTINUATION FROM THE PROGRAMME

If a candidate wishes to temporarily discontinue the programme for valid reasons, he/she shall apply to the Chairperson, PG Programme committee, through the Head of the department in advance and secure a written permission to that effect. 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. 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 8 consecutive semesters including the period of discontinuance.

12.0 POWER TO MODIFY

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

12.2 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.

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	Probability and Stochastic Processes	3	1	0	4	40	60	100
2.	EC 912	Advanced 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	CDMA and OFDM for Wireless Communication	3	1	0	4	40	60	100
4.		Elective – IV	3	0	0	3	40	60	100

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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.	EC 971	Directed Study	-	-	3	3	100	-	100
						12	250	150	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 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 903	Advanced Digital Signal Processing
15	EC 941	WCDMA for UMTS
16	EC 942	Free Space Optical Communication
17	EC 943	Ultra- Wideband Wireless Communication
18	EC 944	Nanotechnology
19	EC 945	Next Generation Wireless Networks

EC 911 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," Mc Graw Hill. New york 1984.
2. Kishor S. Trivedi, "Probability and Statistics with Reliability, Queuing and Computer Science Application," John Wiley, 2002.

EC 912 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", Fifth edition, Mc Graw Hill International edition, 2008.
2. Ian A. Glover and Peter M. Grant, "Digital communications", Second 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" PHI publishers, 2009.
2. Bernard Sklar, "Digital Communications: Fundamentals and Applications", Second edition, Pearson Education Asia, 2002.

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 multipath 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 Infrastructure 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.

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, 1998.
2. Richard Van Nee and Ramjee Prasad, "OFDM for wireless Multimedia Communication", Artech House, 2000.

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 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. Routing and wavelength assignment algorithms for WDM Optical networks.
5. Comparison of Digital modulation schemes over AWGN and flat fading channels.
6. 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.
7. Establishment of a free space optical communication link with the help of available external modulator and performing various measurements to study the links.
8. (i) 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.
(ii) Design and implementation of a firewall or trusted system for a network.
9. Experiments based on FPGA.
10. Experiments on Embedded System Design.
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-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 Willig, "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," Plenum 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 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", 3rd Edition Prentice Hall, 2003.

Reference Books:

1. Michael E.Whitman and Herbert J.Mattord, "Principles of Information security," 1st Edition, 2003.
2. Bruce Schneier,"Applied Cryptography," 2nd Edition, Toha Wiley and Sons, 1996.
3. Douglas 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 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 theorem, Matrix description of linear blocks codes-Equivalent codes-parity check 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 for 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 Education Private Ltd, 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 Ilceev , “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

Introduction, 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, Hybrid 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, Boston, 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 of patterns – Binomial array – Synthesis method – Schelkunoff Polynomial method – Fourier transform method – Dolph-Chebyshev method – Taylor's 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- 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,” Wiley India, 2008.
2. John G. Proakis and Dimitris G.Manolakis, “Digital Signal Processing,” Fourth Edition, Prentice Hall of India, New Delhi, 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,” McGraw Hill, Newyork, 2000.

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 ECWDM and Second Generation Air Interfaces - Core Networks and Services - UMTS Services and Applications - Main Parameters in ECWDM - 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 ULTRA-WIDEBAND WIRELESS COMMUNICATION

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 properties, 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 microscopies, scanning probe microscopies, optical microscopies 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 University 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-Generation Wireless Networks Systems, 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 Systems 3G 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-Repot-343539.html>

INFRASTRUCTURE AND FACULTY REQUIREMENT FOR M.TECH(WIRELESS COMMUNICATION)

1. INFRASTRUCTURE :

(i) Building Infrastructure

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

(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	MSK Trainer kit	1
5	Fiber Optic Trainer	2
6	RF Spectrum Analyzer	1
7	Vector Network Analyzer	1
8	OTDR	1
9	Radio Communication	1
10	Arbitrary Waveform Generator	1
11	Embedded System Trainer Kit	5 User License
12	No. of FPGA kits required with a. I/O Cards b. Add on card for FPGA	5
13	Audio power meter	1
14	Network Simulator Software	5
15	Pspice/Orcad/Multisim – Design Software	5
16	Matlab Software	5 Users
17	Digital Storage oscilloscope (100MHz)	1
18	Yagi uda antenna with booster and other accessories	1
19	Dish Antenna with Set top box	1
20	Optical Source with Drive Unit	1
21	External Optical Modulators	1
22	Photodetector with output display device (like speaker)	1
23	Audio Player with I/O Devices	1
24	PC with LAN connection	20
25	MIC trainer kit	2

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