ELECTRONICS AND COMMUNICATION ENGINEERING

M.TECH(ELECTRONICS AND COMMUNICATION ENGINEERING)

(CBCS)

REGULATIONS, CURRICULUM AND SYLLABUS

(With effect from the Academic Year 2011 – 12)

PONDICHERRY UNIVERSITY
PUDUCHERRY – 605 014.
PONDICHERRY UNIVERSITY
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. (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 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

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Description</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Number of semesters</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>Min. number of credits of the programme</td>
<td>72</td>
</tr>
<tr>
<td>3</td>
<td>Max. number of credits of the programme</td>
<td>75</td>
</tr>
<tr>
<td>4</td>
<td>Min. Cumulative Grade Point Average for pass</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>Min. successful credits needed for registering in the next semester</td>
<td>Sem. I: 10</td>
</tr>
<tr>
<td>6</td>
<td>Min. period of completion of programme (consecutive semesters)</td>
<td>4</td>
</tr>
<tr>
<td>7</td>
<td>Max. period of completion of programme (consecutive semesters)</td>
<td>8</td>
</tr>
<tr>
<td>8</td>
<td>Number of core and Elective courses</td>
<td>12</td>
</tr>
<tr>
<td>9</td>
<td>Laboratory / Seminar</td>
<td>2</td>
</tr>
<tr>
<td>10</td>
<td>Directed study</td>
<td>1</td>
</tr>
<tr>
<td>11</td>
<td>Project work (semesters)</td>
<td>2</td>
</tr>
</tbody>
</table>

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>
<thead>
<tr>
<th>GRADE</th>
<th>POINTS</th>
<th>DESCRIPTION</th>
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</thead>
<tbody>
<tr>
<td>S</td>
<td>10</td>
<td>EXCELLENT</td>
</tr>
<tr>
<td>A</td>
<td>9</td>
<td>VERY GOOD</td>
</tr>
<tr>
<td>B</td>
<td>8</td>
<td>GOOD</td>
</tr>
<tr>
<td>C</td>
<td>7</td>
<td>ABOVE AVERAGE</td>
</tr>
<tr>
<td>D</td>
<td>6</td>
<td>AVERAGE</td>
</tr>
<tr>
<td>E</td>
<td>5</td>
<td>SATISFACTORY</td>
</tr>
<tr>
<td>F</td>
<td>0</td>
<td>FAILURE</td>
</tr>
<tr>
<td>FA</td>
<td>-</td>
<td>FAILURE DUE TO LACK OF ATTENDANCE/FAIlURE BY ABSCNCE</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th></th>
<th>Marks</th>
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</thead>
<tbody>
<tr>
<td>First review</td>
<td>30</td>
</tr>
<tr>
<td>Second review</td>
<td>30</td>
</tr>
<tr>
<td>Report and Viva voce</td>
<td>40</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

Project work – (Phase – I): 300 Marks

<table>
<thead>
<tr>
<th></th>
<th>Marks</th>
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<tr>
<td><strong>Internal valuation</strong></td>
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<tr>
<td>Guide</td>
<td>50</td>
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<tr>
<td>First Evaluation</td>
<td>50</td>
</tr>
<tr>
<td>Second Evaluation</td>
<td>50</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>150</strong></td>
</tr>
<tr>
<td><strong>External valuation</strong></td>
<td></td>
</tr>
<tr>
<td>Evaluation (External Examiner Only)</td>
<td>50</td>
</tr>
<tr>
<td>Viva voce (50 for Ext. + 50 for Int.)</td>
<td>100</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>150</strong></td>
</tr>
</tbody>
</table>

Project work – (Phase – II): 400 Marks

<table>
<thead>
<tr>
<th></th>
<th>Marks</th>
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</thead>
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<tr>
<td><strong>Internal valuation</strong></td>
<td></td>
</tr>
<tr>
<td>Guide</td>
<td>100</td>
</tr>
<tr>
<td>First Evaluation</td>
<td>50</td>
</tr>
<tr>
<td>Second Evaluation</td>
<td>50</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>200</strong></td>
</tr>
<tr>
<td><strong>External valuation</strong></td>
<td></td>
</tr>
<tr>
<td>Evaluation (External Examiner Only)</td>
<td>50</td>
</tr>
<tr>
<td>Viva voce (75 for Ext. + 75 for Int.)</td>
<td>150</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>200</strong></td>
</tr>
</tbody>
</table>

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:

<table>
<thead>
<tr>
<th>Test I</th>
<th>15 Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test II</td>
<td>15 Marks</td>
</tr>
<tr>
<td>Assignment</td>
<td>10 Marks</td>
</tr>
<tr>
<td>Final test covering the whole syllabus</td>
<td>60 Marks</td>
</tr>
<tr>
<td>Total</td>
<td>100 Marks</td>
</tr>
</tbody>
</table>

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:

\[
\frac{9 \times 4 + 8 \times 2 + 10 \times 3 + 0 \times 3}{4+2+3+3} = \frac{82}{12} = 6.83/10.0
\]

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.

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M.TECH (ELECTRONICS AND COMMUNICATION ENGINEERING)  
CURRICULUM AND SCHEME OF EXAMINATION

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

**SEMESTER – I**

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Code</th>
<th>Subject</th>
<th>Hours / Week</th>
<th>Credits</th>
<th>Evaluation (marks)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>L</td>
<td>T</td>
<td>P</td>
</tr>
<tr>
<td>1.</td>
<td>EC 901</td>
<td>Probability and Stochastic Processes</td>
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<td>1</td>
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<tr>
<td>2.</td>
<td>EC 902</td>
<td>Advanced Digital Communication</td>
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<td>3.</td>
<td>EC 903</td>
<td>Advanced Digital Signal Processing</td>
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<td>Elective – III</td>
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<td>Seminar</td>
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<td>-</td>
<td>3</td>
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23  340  360  700

**SEMESTER – II**

<table>
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<tr>
<th>Sl. No.</th>
<th>Code</th>
<th>Subject</th>
<th>Hours / Week</th>
<th>Credits</th>
<th>Evaluation (marks)</th>
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<td></td>
<td></td>
<td></td>
<td>L</td>
<td>T</td>
<td>P</td>
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<td>RF Engineering</td>
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<td>2.</td>
<td>EC 905</td>
<td>High Performance Communication Networks</td>
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<td>1</td>
<td>0</td>
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### SEMESTER – III

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### SEMESTER – IV

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23 290 410 700
# LIST OF ELECTIVE SUBJECTS

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<td>Wireless Sensor Networks</td>
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<td>3</td>
<td>EC 923</td>
<td>Modeling and Simulation of Wireless Communication Systems</td>
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<td>Advanced Techniques for Wireless Reception</td>
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<td>Advanced Information Theory and Coding Techniques</td>
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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

Text Book:

Reference Books:
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

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.

Unit 5: Synchronization

Text Books:
EC 903 ADVANCED DIGITAL SIGNAL PROCESSING
(Common to M.Tech (ECE) and M.Tech (WC))

Unit 1: Discrete Time Random Signal Processing

Unit 2: Spectrum Estimation

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

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:

Reference Books:


EC 904 RF ENGINEERING

Unit 1: RF Passive Components and Transmission Line Analysis

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

Unit 4: RF IC Design

Unit 5: RF System Design
Text Books:

Reference Books:
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:

Reference Books:
EC 906 EMBEDDED CORE DESIGN

Unit 1: Elements of Embedded System

Unit 2: RTL Design with VHDL

Unit 3: Field Programmable Devices

Unit 4: Design with Embedded Processors

Unit 5: Design of an Embedded System

Text Books:

Reference Books:

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.
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
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.

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.
Text Books:


Reference Book:


EC 922 WIRELESS SENSOR NETWORKS
(Common to M.Tech (ECE) and M.Tech (WC))

Unit 1: Introduction

Unit 2: Sensor Networks

Unit 3: Sensor Network Architecture

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

Text Books:

Reference Books:


EC 923 MODELING AND SIMULATION OF WIRELESS COMMUNICATION SYSTEMS
(Common to M.Tech (ECE) and M.Tech (WC))

Unit 1: Modeling and Simulation Approach

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:

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**


**Case Studies:** (1) Performance of 16-QAM equalized Line of Sight Digital Radio Link, (2) performance evaluation of CDMA Cellular Radio System.

**Text Books:**

**Reference Books:**

**EC 924 ADVANCED TECHNIQUES FOR WIRELESS RECEPTION**
(Common to M.Tech (ECE) and M.Tech (WC))

**Unit 1: Blind MUD**
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 via iterative interference cancellation, single user space-time detection and combined single user/multiuser linear detection.
Unit 4: NBI Suppression

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:

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

Unit 3: Message Authentication and Hash Functions

Unit 4: Network Security Practice

Unit 5: System Security

Text book:

Reference Books:

EC 926 MULTIMEDIA COMPRESSION TECHNIQUES
(Common to M.Tech (ECE) and M.Tech (WC))

Unit 1: Introduction

Unit 2: Data Compression

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

Unit 5: Video Compression

Text Books:

Reference Books:
Communication channels, Discrete communication channel—Rate of information transmission over a discrete channel—Capacity of a discrete memoryless channel—Shannon—Hartley theorem and its implications.
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**

**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 of generating cyclic codes—Matrix description of cyclic codes, Syndrome calculation, Error detection and correction—Quasi 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, Ungerboeck’s TCM—Design rules—Decoders, TCM for AWGN channel, TCM for fading channel, Space Time Trellis Codes.

**Text Books:**

**Reference Books:**

**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

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:

Reference Books:
(Common to M.Tech (ECE) and M.Tech (WC))

Unit 1: DIGITAL IMAGE REPRESENTATION AND TRANSFORMS

Unit 2: IMAGE ENHANCEMENT AND RESTORATION
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
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

Text Book:

Reference Books:
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:


Reference Books:

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:
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:


Reference Book:

EC 933 RADIATING SYSTEMS
(Common to M.Tech (ECE) and M.Tech (WC))

Unit 1: Radiation and Antennas

Unit 2: Linear Arrays and Array Synthesis

Unit 3: Aperture Antennas
Slot, Patch and Horn Antennas – Practical Design considerations of large aperture antennas – Terahertz antennas - Baluns

Unit 4: Antenna Measurements

Unit 5: Antennas for Special Applications

Text Books:

Reference Books:

EC 913 WIRELESS COMMUNICATION SYSTEMS
(Common to M.Tech (ECE) and M.Tech (WC))

Unit 1: Cellular Concepts – System Design Fundamentals
Cellular concepts-channel reuse-handoff strategies-dynamic resource allocation-interference and system capacity-improving capacity and coverage of cellular systems.

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.
Unit 4: Diversity

Unit 5: Multiple Access Techniques
Frequency division multiple access-time division multiple access-spectrum division multiple 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:

Reference Books:

EC 914 UBIQUITOUS COMPUTING
(Common to M.Tech (ECE) and M.Tech (WC))

Unit 1: Context-Aware Computing

Unit 2: Emerging Technologies

Unit 3: Wireless LAN

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

Text Books:

Reference Books:

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

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:

Reference Books:
1. Lajas Hanzo, “OFDM and MC-CDMA for Broadband Multiuser Communications,” 2003

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

Text Books:

Reference Books:

EC 935 COMPUTER AIDED DESIGN OF VLSI CIRCUITS

Unit 1: Design Methodologies

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

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

Text Books:

Reference Book:
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:

Reference Book:

EC 937 VLSI SYSTEM DESIGN

Unit 1: Combinational Circuit Design

Unit 2: VLSI System Components

Unit 3: System Level Physical Design

Unit 4: VLSI Clocking and System Design

Unit 5: Reliability and Testing Of VLSI Circuits

Text Book:

Reference Book:
INFRASTRUCTURE AND FACULTY REQUIREMENT FOR M.TECH. (ELECTRONICS AND COMMUNICATION ENGINEERING)

1. INFRASTRUCTURE

(i) Building Infrastructure

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Building Details</th>
<th>Area(sq.m)</th>
<th>No. Required</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Class/ Tutorial Rooms</td>
<td>33</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Laboratory</td>
<td>75</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>Project Lab</td>
<td>50</td>
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(ii) Equipment Infrastructure

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

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Quantity</th>
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</thead>
<tbody>
<tr>
<td>11</td>
<td>MATLAB Software</td>
<td>5 users</td>
</tr>
<tr>
<td>12.</td>
<td>MIC trainer kits</td>
<td>2 nos.</td>
</tr>
</tbody>
</table>

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