1.0 ELIGIBILITY

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

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

2.0 ADMISSION

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

3.0 STRUCTURE OF M.Tech. PROGRAMME

3.1 General

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

3.1.2 The programme of instruction for each stream of specialization will consist of :
(i) Core courses (Compulsory)
(ii) Electives
(iii) Laboratory
(iv) Seminar
(v) Project work

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

3.1.4. Credits will be assigned to the courses based on the following general pattern:
(i) One credit for each lecture period
(ii) One credit for each tutorial period
(iii) Two credits for practical course
(iv) Two credits for seminar
(v) Twenty three credits for Project work divided into 9 credits for Phase-I and 14 credits for Phase – II.
One teaching period shall be of 60 minutes duration including 10 minutes for discussion and movement.

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

Table 1: Minimum credits and other requirements

<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>
</tbody>
</table>
| 5      | Min. successful credits needed for registering in the next semester | Sem. I: 10  
Sem. II: 25  
Sem. III: 40 |
| 6      | Min. period of completion of programme (consecutive semesters) | 4                                                                            |
| 7      | Max. period of completion of programme (consecutive semesters) | 8                                                                            |
| 8      | Number of core and elective courses                  | 13                                                                           |
| 9      | Seminar                                               | 1                                                                            |
| 10     | Laboratory                                            | 1                                                                            |
| 11     | Project work (semesters)                              | 2                                                                            |

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

3.1.7 Elective courses are required to be chosen from the courses offered by the department(s) in that particular semester from among the approved courses. A core course of any M.Tech programme/department may be chosen as an elective by a student from any other M.Tech programme/department.
3.1.8 Each student is required to make a seminar presentation on any chosen topic connected with the field of specialisation. Preparation and presentation of a seminar is intended to investigate an in-depth review of literature, prepare a critical review and develop confidence to present the material by the student. The seminar shall be evaluated by a Department Committee constituted for this purpose, based on a report submitted by the candidate and a viva-voce conducted at the end of the semester.

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

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

4.0 REQUIREMENTS TO APPEAR FOR UNIVERSITY EXAMINATION

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

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

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

5.0 EVALUATION

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

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

<table>
<thead>
<tr>
<th>Seminar (Internal valuation only)</th>
<th>100 Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>First review</td>
<td>30 marks</td>
</tr>
<tr>
<td>Second review</td>
<td>30 marks</td>
</tr>
<tr>
<td>Report and Viva voce</td>
<td>40 marks</td>
</tr>
<tr>
<td>Total</td>
<td>100 marks</td>
</tr>
</tbody>
</table>
**Project work – (Phase – I):** 300 Marks

<table>
<thead>
<tr>
<th>Internal valuation</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Guide</td>
<td>50</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>150</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>External valuation</th>
<th></th>
</tr>
</thead>
<tbody>
<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>Internal valuation</th>
<th></th>
</tr>
</thead>
<tbody>
<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>
</tbody>
</table>

<table>
<thead>
<tr>
<th>External valuation</th>
<th></th>
</tr>
</thead>
<tbody>
<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 Head of the Department and approved by the Head of the Institution.

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

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

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

5.6 All eligible students shall appear for the University examination.
6.0 Grading

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

**TABLE 2: Letter Grade and the Corresponding Grade Point**

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

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

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

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

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

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

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

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

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

7.0 DECLARATION OF RESULTS, RANK AND ISSUE OF GRADE CARD

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

7.2 The grade cards will contain the following details:

   (i) The college in which the candidate is studying/has studied.
   
   (ii) The list of courses enrolled during the semester and the grades scored.
   
   (iii) The Grade Point Average (GPA) for the semester and the Cumulative Grade Point Average (CGPA) of all enrolled subjects from first semester onwards.

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

\[
GPA = \frac{\text{Sum of } (C \times GP)}{\text{Sum of } C}
\]

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

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

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

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

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

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

   (i) Should have passed all the subjects pertaining to semesters 1 to 4 in his/her first appearance in 4 consecutive semesters starting from first semester to which the candidate was admitted.
   
   (ii) Should not have been prevented from writing examinations due to lack of attendance.
   
   (iii) Should have secured a CGPA of 8.50 and above for the semesters 1 to 4.
7.8 A candidate who qualifies for the award of the degree by passing all the subjects relating to semesters 1 to 4 and securing CGPA not less than 6.5 shall be declared to have passed the examination in **FIRST CLASS**.

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

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

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

8.0 PROVISION FOR WITHDRAWAL

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

9.0 TEMPORARY DISCONTINUATION FROM THE PROGRAMME

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

10.0 REVISION OF REGULATIONS AND CURRICULUM

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

11.0 POWER TO MODIFY

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

11.2 Nothing in the foregoing may be construed as limiting the power of the Pondicherry University to amend, modify or repeal any or all of the above.
M.TECH (ELECTRONICS AND COMMUNICATION ENGINEERING) – NON-CBCS
CURRICULUM AND SCHEME OF EXAMINATION

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

SEASONER – 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>
<td>3</td>
<td>1</td>
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<td>Seminar</td>
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SEASONER – II

<table>
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<th>Subject</th>
<th>Hours / Week</th>
<th>Credits</th>
<th>Evaluation (marks)</th>
</tr>
</thead>
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<td>T</td>
<td>P</td>
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<td>High Performance Communication Networks</td>
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<td>3.</td>
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<td>Elective – V</td>
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<tr>
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<td>7.</td>
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<td>Advanced Communication and Embedded Systems Laboratory</td>
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### SEMESTER – III

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<th>Code</th>
<th>Subject</th>
<th>Hours / Week</th>
<th>Credits</th>
<th>Evaluation (marks)</th>
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<tbody>
<tr>
<td></td>
<td></td>
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<td>L</td>
<td>T</td>
<td>P</td>
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<tr>
<td>1.</td>
<td>EC 909</td>
<td>Project Phase-I</td>
<td>-</td>
<td>-</td>
<td>16</td>
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<td>2.</td>
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### SEMESTER – IV

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<th>Sl. No.</th>
<th>Code</th>
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<th>Credits</th>
<th>Evaluation (marks)</th>
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<td></td>
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<td></td>
<td>L</td>
<td>T</td>
<td>P</td>
</tr>
<tr>
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<td>Project Phase II</td>
<td>-</td>
<td>-</td>
<td>24</td>
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## LIST OF ELECTIVE SUBJECTS

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<tr>
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<th>Code</th>
<th>SUBJECT</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>EC 921</td>
<td>Optical Networks</td>
</tr>
<tr>
<td>2</td>
<td>EC 922</td>
<td>Wireless Sensor Networks</td>
</tr>
<tr>
<td>3</td>
<td>EC 923</td>
<td>Modeling and Simulation of Wireless Communication Systems</td>
</tr>
<tr>
<td>4</td>
<td>EC 924</td>
<td>Advanced Techniques for Wireless Reception</td>
</tr>
<tr>
<td>5</td>
<td>EC 925</td>
<td>Cryptography and Wireless Security</td>
</tr>
<tr>
<td>6</td>
<td>EC 926</td>
<td>Multimedia Compression Techniques</td>
</tr>
<tr>
<td>7</td>
<td>EC 927</td>
<td>Advanced Information Theory and Coding Techniques</td>
</tr>
<tr>
<td>8</td>
<td>EC 928</td>
<td>Mobile Satellite Communication</td>
</tr>
<tr>
<td>9</td>
<td>EC 929</td>
<td>Advanced Image Processing</td>
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<td>10</td>
<td>EC 930</td>
<td>Advanced Embedded Systems Design</td>
</tr>
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<td>EC 931</td>
<td>RF MEMS</td>
</tr>
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<td>12</td>
<td>EC 932</td>
<td>Microwave Integrated Circuits</td>
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<tr>
<td>13</td>
<td>EC 933</td>
<td>Radiating Systems</td>
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<td>18</td>
<td>EC 935</td>
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<td>20</td>
<td>EC 937</td>
<td>VLSI System Design</td>
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EC 901 PROBABILITY AND STOCHASTIC PROCESSES  
(Common to M.Tech (ECE) and M.Tech (WC))

Unit 1: Random Variables and their Probability Distributions
Random variables, Probability distribution function, Probability density function, Conditional probability, Statistical Independence, Bayes formula. 
Moments of random variables: Expected value and moments, Mean and variance of random variable, Coefficients of variation, Skewness and kurtosis, Moments, Covariance and Correlation coefficient, Mean and variance of sum and Product of two random variables. Conditional mean and variance, Application of conditional mean and variance.

Unit 2: Discrete Random Variables and their Distributions
Moment Generation Function, Characteristics Function, Cumulants, Probability generating function, Binomial Distribution, Negative Binomial Distribution, Hypergeometric distribution, Multinomial, Poisson Distributions, Relationship between various Discrete-Type distributions

Unit 3: Continuous Random Variables and their Distributions
Normal, Log - Normal, Multivariate Normal, Gamma, Exponential, Chi-square, Weibull, Rayleigh distributions. Relationship between continuous distributions.

Unit 4: Transformation of Random Variables
Transformation of Single, Several Random Variables, Function of Random Variables, Sum, Differences, Product and Ratio of Two Random Variables, Transformation through characteristic Functions.

Unit 5: Stochastic Processes

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:
Reference 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:
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.
**Wavelength rerouting algorithms:** Benefits of wavelength rerouting-issues in wavelength rerouting-lightpath migration-rerouting schemes-rerouting in networks with sparse wavelength conversion-rerouting in multifiber networks.

Unit 3: Virtual Topology Design
Introduction- virtual topology design problems- virtual topology design subproblems-virtual topology design heuristics-need for virtual topology design reconfiguration.
**Optical multicasting:** Introduction to multicast routing-multicasting node architectures-multicast tree generation-source based tree generation-Steiner tree based generation.

Unit 4: Control and Management
Network management functions, management frame work and protocols, configuration management and adaptation management.
**Network survivability:** failures and recovery- protection in SONET- benefits of optical layer protection-restoration schemes in WDM networks-multiplexing schemes-Traffic grooming in WDM.

Unit 5: Optical Burst Switching
OBS node architecture-burst switching protocols-wavelength channel scheduling.
**Optical packet switching and access networks:** Introduction-optical packet switching node architecture- contention resolution protocols. Enhanced HFC-FTTC - PON architectures.

Text Books:
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 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 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:**

**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 fee generating cyclic codes- Matrix description of cyclic codes, syndrome calculation, Error detection and correction quasi cyclic codes and shortened cyclic codes and shortened cyclic codes, Fire codes, Golay codes ,CRC codes, BCH codes, RS codes.

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

Text Books:

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:

EC 929 ADVANCED IMAGE PROCESSING
(Common to M.Tech (ECE) and M.Tech (WC))

Unit 1: DIGITAL IMAGE REPRESENTATION AND TRANSFORMS

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.
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:
2. Allan C. Shaw, “Real time systems & Software,” John Wiley & Sons, India Reprint, 
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:
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:
York, 1975.

Reference Book:
1. Hoffman R.K."HandBook of Microwave integrated circuits", Artech House, Bostan,
1987.
EC 933 RADIATING SYSTEMS  
(Common to M.Tech (ECE) and M.Tech (WC))

Unit 1: Radiation and Antennas  

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 concept-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.
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-

**Unit 4: Diversity**

**Unit 5: Multiple Access Techniques**
Frequency division multiple access-time division multiple access-spread spectrum 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 $E_b/I_0$ 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 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:

EC 936 CONVERGENCE TECHNOLOGIES
Unit 1: Introduction
Evolution and Convergence; The Next Generation Network Concept; A Framework for Examining Next Generation Networks- Characteristics of Evolving Networks; Dealing with Complexity; Framework for Evolving Networks; Examples of Application of Framework; Enabling mobile network technologies; Opportunities and threats to the mobile converging service market

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

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

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

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

Text Books:

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) - Non-CBCS

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>
</tr>
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<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>
<td>1</td>
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</table>

(ii) Equipment Infrastructure

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Facilities/Equipment/Accessories</th>
<th>QTY.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Regulated power supply</td>
<td>10</td>
</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>
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<td>8(a)</td>
<td><strong>VLSI trainer kit:</strong></td>
<td>5 user license</td>
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<tr>
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<td>List of software required</td>
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</tr>
<tr>
<td></td>
<td>Simulator and Synthesizer tool with down loader</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(VHDL/Verilog)</td>
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<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>
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<tr>
<td>9</td>
<td>PC with LAN connection</td>
<td>20</td>
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<td>10</td>
<td>Network Simulator Software/ Glomosim</td>
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VHDL/Verilog
2. LIBRARY

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<td>Titles</td>
<td>As required by the curriculum</td>
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<tr>
<td>Journals</td>
<td>5 related International journals</td>
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3. FACULTY REQUIREMENT : As per AICTE norms

4. TEACHER TO STUDENT RATIO : As per AICTE norms