ELECTRONICS & TELECOMMUNICATION ENGINEERING

M.Tech (Electronics & Telecommunication)
Specialization: Wired &Wireless communication

Effective from A. Y. 2011-12

INDEX

Item	Page No.
PG Rules and Regulations	2
Detailed Syllabus	13
Annexure-I: List of Professional Science/Elective courses offered by ALL departments	33
Annexure-II: List of Liberal Learning courses offered at Institute level	34

List of Abbreviations

Sr. No.	Abbreviation	Stands for:
1	DEC	Departmental Elective Course
2	PCC	Program Core Course
3	LC	Laboratory Course
4	HSSC	Humanities and Social Science Course
5	MLC	Mandatory Learning Course
6	LLC	Liberal Learning Course
7	OEC	Open Elective Course
8	SEC	Science Elective Course
9	PSEC	Program Specific Elective Courses

M. Tech., RULES AND REGULATIONS
(Effective from 2011-12)

COLLEGE OF ENGINEERING, PUNE
Wellesley Road, Shivajinagar, Pune 411005

1. Rules

1.1 The Senate and BOG, College of Engineering, Pune, recommends University of Pune to award the degree of Master of Technology (M. Tech) in Engineering to those who have successfully completed the stipulated Postgraduate Masters Program.

1.2 The Postgraduate Masters Program with the governing Rules and Regulations are formulated & approved by the Senate and BOG of the institute. The Senate can modify or change the course structure, the governing rules and regulations from time to time and shall recommend them to BOG for its approval. These rules and regulations will be applicable to any candidate seeking admission for M. Tech/P.G. programme in the institute.

1.3 A candidate becomes eligible for the recommendation to the Pune University for the award of the M. Tech. degree after fulfilling all the academic requirements prescribed by the Senate of the Institute.

1.4 Director, COEP and Chairman Senate would appoint a Professor from the Institute to work as a Chairman of the PG admission committee on his/behalf. Chairman, PG Admissions would be responsible for the entire admission process including scrutiny of applications and conduct of entrance test, interviews of the candidates etc. He/she would be assisted by the respective departmental heads and departmental admission committee appointed by the Director.

2. CATEGORIES OF M. TECH. STUDENTS

The Institute admits M. Tech students under the following categories:

I) REGULAR (FULL-TIME)

These are students who work **full time** for their M. Tech. degree and receive assistantship from the Institute or any other recognized funding agency.

II) SPONSORED (FULL-TIME) STUDENTS

A candidate in the category is sponsored by a recognized R&D organization, national institute, governmental organization or industry for doing M.Tech in the Institute **on a full time basis**. He/she should have at least two years of working experience in the respective field. He/She will not receive any financial support from the Institute. Sponsorship letter (Form I) should be attached with the application. During the course of programme if a regular student secures a job and wishes to join the same, then he/she will be treated as a sponsored candidate and he/she will have to get the sponsorship letter from him employer. He/she would be charged institutional fees as for sponsored candidates.

III) PROJECT STAFF

This category refers to candidates who are working on sponsored projects in the Institute and admitted to the M. Tech. program. The duration of the project at the time of admission should be at least 2 years. This category of students may be registered on a full-time or a part-time basis.

IV) INSTITUTE FACULTY

This category refers to the candidates who are the staff of College of Engineering , Pune, who can attend classes at the Institute while employed. These candidates should be able to attend regular classes as per the schedule of the Institute. The applicant must be a regular employee of the institute with at least two years of experience with the institute at the time of admission and be engaged in professional work in the discipline in which admission is sought. No financial assistance will be provided by the Institute to such students. A No Objection Certificate from the Head of the Department must be enclosed at the time of applying. This candidate would pay regular fees of the institute under full/part time student category and no concession in institute fees can be allowed.

V) FOREIGN STUDENTS

This category refers to all the Foreign Nationals, who are eligible for Admission to the M.Tech program and who have a certification from the Pune University Foreign Students Cell about their admissions to M.Tech. These students will submit a certificate from the Pune University certifying their Equivalence of Courses at undergraduate levels. These students will have to appear for the institute entrance examination and also a English language test, conducted by the institute. If these students fail in the English language test their applications will be rejected even though they pass in the institute admission test. No financial assistance of any sort will be available for these students. Before admission, these students will have to get a clearance about their background check by the Department of Home, Government of India. A candidate in this category will be admitted **on a full time basis** subject to compliance of various norms laid down by the competent authority from time to time.

3. MINIMUM QUALIFICATIONS

Students for admission to the M. Tech. Program in Engineering Departments must satisfy one of the following criteria:

(i) Bachelor's degree in Engineering/Technology or equivalent in an appropriate area, with a minimum of First Class/60% marks or CGPA of 6.5 on a scale of 10 or equivalent (CGPA of 6.00 or equivalent in case of SC / ST).

(ii) Valid GATE score for Regular (full-time) students.

Departments may specify additional requirements over and above these minimum requirements. All the Non-GATE candidates will have to undergo an entrance test conducted by department in which he/she is applying. Passing in this test will be mandatory for admission.

For the Foreign Students the criteria as in para 2(V) above will be applicable. For these students Institute Admission Test as well as English Test will be mandatory.

4. ADMISSION PROCEDURE

4.1 Admission to the M. Tech. Program of the Institute will normally be in the months of June/July every year. For admission an advertisement will be issued in the month of April/May in National level English news paper, State level Marathi News papers as well as on the Institute website.

4.2 Admission to all the category of students is granted on the basis of GATE scores and / or an interview / admission test held usually during the month of June or July every

year. It will be mandatory for every candidate to appear for the Entrance Test and Interview. No absentia of any sort would be allowed.

4.3 The applicants who have completed or are likely to complete all the examinations including the thesis oral examination, viva etc. of the qualifying degree by the date of admission to the program may be considered for admission; however, if admitted, they
must produce the evidence of their having passed the qualifying degree examination with the specified minimum marks/CPI (as specified in clause 3) within 8 weeks of the beginning of the semester, failing which their admission is liable to be cancelled. In case of any dispute or discrepancy decision of the Director COEP and Ex-officio Chairman of the Senate will be final and shall be binding on the candidate.

4.4 Candidates seeking admission for the M.Tech course other than the area in which candidate has completed his/her bachelor's degree will be eligible to apply provided they have a valid GATE score in the area in which they wish to pursue their M.Tech. These candidate will not be eligible for the scholarships from the external funding agencies. These students will have to under go Institute Entrance Test/Interview conducted by the concerned department.

5. FINANCIAL SUPPORT

Students admitted to the M. Tech. Programs will be considered for assistantships, fellowships etc. subject to the following norms:

5.1 A student must have a valid GATE score at the time of admission.

5.2 Students receiving assistantship from the Institute or from any other funding agencies will be required to perform academic duties assigned to them by the departments as per rules in force from time to time.

5.3 The continuation of the assistantship/fellowship will be subject to satisfactory performance of the duties assigned by the department and satisfactory progress in the postgraduate program. Financial assistance of the candidates failing to secure minimum grades in the semester examination would be stopped without any prior notice.

5.4 Financial assistance will normally be for a maximum period of two years. In no case, it will be extended beyond 2 years.

5.5 No financial assistance from the Institute will be available to foreign students. Project staff will get funding from project as per rules but will not get any additional assistance from the Institute.

5.6 Only those students who are currently registered in the postgraduate program shall be entitled to scholarships. The students on leave longer than that specified under the leave rules, and those who are not registered are not entitled to scholarship.

6. LEAVE RULES

6.1 An M Tech student is eligible for maximum 30 days of leave in a calendar year.

6.1.1 The leave of 30 days includes medical and all other leaves, in an academic year. If any Saturday, Sunday or Holiday falls during the leave, they will be counted towards the leave except for such holidays prefixed or suffixed with the leave. **The accumulated leave can be availed during vacation only.**

6.1.2 Out of the 30 days of leave per annum, an M. Tech. Student will be permitted to avail maximum 15 days of leave on completion of each semester. However, any leave not availed at the end of any semester can be carried over to the next semester and the cumulative can be availed together, subject to a maximum of 30 days at a time.

6.1.3 During the semester period, (i.e. July – November and January – May), a student will be allowed only a maximum of 5 days of leave .

6.2 Absence without obtaining prior sanction of leave will be considered as an act of indiscipline and shall entail reduction of scholarship on a prorata basis, besides any other action that may be decided by the Institute.

6.3 Any absence over and above the prescribed limit of admissible leave shall entail deduction from the scholarship, besides other actions as may be decided by the Institute.

6.4 If a student remains absent or discontinues from the course for a period of more than 3 months his/her admission to the course will be automatically cancelled.

6.5 If a student is unable to complete his/her M.Tech within a period of two years, he/she must apply for permission for the extension of time by six months immediately after completion of two years, with recommendations of the concerned guide and head of the department to Dean Academics. Dean academics will seek the approval of the Director COEP and the Chairman, Senate for granting such extensions on case to case basis. Maximum two extensions of six months duration would be permissible for M.Tech student from any category of students as stipulated in Section(2) above. This extension period will not exceed the total period of three years from the date of admission of the candidate in the institute. Candidate will have to pay institute fees prevailing during this extension period.

6.6 If a student fails to complete his/her M.Tech within a period of four years from the date of admission for the course he/she will automatically cease to be a student of the institute and his/her admission would be automatically cancelled.

7. REGULATIONS

7.1 Rules and regulations

All the rules and regulations pertaining to academics, academic calendar, semesters, discipline etc. will be same as that of B.Tech. regulations.

7.2 Admission

Candidates whose selection is approved by the Chairman, Senate will be admitted to the M. Tech. program of the Institute after payment of the prescribed fees prevailing at the time of admission. BOG reserves the right to modify the Institute fees time to time.

7.3 Academic requirements

7.3.1 Semester load and course units

A semester load would be as per the Syllabus structure in force and as recommended/modified by the Senate from time to time. The minimum credit requirements for the successful completion of M.Tech. would be as specified in the syllabus structure prevailing at the time of admission for the course. The current minimum credits for the completion of M. Tech is 80 credits as specified in the syllabus structure. Any changes subsequently made by the Senate in the minimum credit requirements or syllabus structure will be applicable to only the new/fresh students and not applicable to the old candidates.

7.3.2 The residence requirements for students registered in M Tech. is four semesters. They will be required to complete a minimum credits of load as specified in the course structure in force. Every M Tech student must complete prescribed courses as specified in the syllabi structure. SGPA and CGPA will be calculated on the basis of all the courses taken by the student. No regular student/sponsored student/Research Staff/Institute Faculty/ Foreign student registered for the M Tech program shall continue in the program for more than 3 years after the first registration. The course and research requirements in individual departments/program may be over and above the minimum stated here. The departments/program shall obtain prior approval of the Senate of such requirements and will also inform the students in their postgraduate program at the time of their admission.

7.3.3 Grades and points

(a) The performance of the students in their course work will be evaluated in terms of letter grades: AA, AB, BB, BC, CC, CD, DD & F. These grades are equivalent to the following points/ratings on a 10 point scale representing the quality of performance.
AA = 10, AB = 9, BB = 8, BC = 7, CC = 6, CD = 5, DD = 4, FF = 0.
(b) If a student has done a part of the course work, but has for a genuine reason not been able to do the remaining part, the instructor may send the grade 'I' (incomplete). In this case the student must contact the Instructor soon after the examination and if the Instructor is convinced that the reasons for missing a part of the course/examinations are genuine he may let the student make up for the portion missed. The 'I' Grade can be converted into a regular grade by the Instructor within two weeks of the last date of the End Semester Examination. Otherwise, this will automatically be converted into 'F' Grade.

7.3.4. Academic performance requirements

(a) The SGPA (Semester Grade Point Average) or CGPA (Cumulative Grade Point Average) of a student in any particular semester is calculated as follows:
(i) The points equivalent to the grade awarded in each course for which the student has registered is multiplied by its unit rating.
(ii) These products are added and sum is divided by the total number of units. The ratio is the SGPA or CGPA depending on whether the number of units refer to those in that particular semester or to those in the total period of student's postgraduate program.
(b) **The minimum CGPA requirement for continuing in the M. Tech. program is 5.0**. However, M Tech student securing a CGPA between 4.5 and 5.0 may be allowed to continue in the following semester on the recommendation of the DPPC (Departmental Postgraduate Program Committee) and with approval of the Senate.
Students who secure a CGPA below 5.0 in two consecutive semesters will not be allowed to continue in the postgraduate program. Students must obtain a minimum CGPA of 5.0 in order to graduate. In the first semester in which the student registers the minimum CGPA (SGPA) requirement can be relaxed to 4.5.

7.3.5 Thesis/Project

(a) Project duration shall be one year or two semesters. Thesis supervisor(s) for a student will be appointed from amongst the faculty members of the College of Engineering, Pune. Departments will evolve modalities for appointing of supervisors keeping in view the students' aspirations and faculty interest. The DPPC will co-ordinate this activity and will formally communicate the appointment of thesis supervisor(s) of a student to the COE. No change/addition of Supervisor(s) is allowed after the thesis has been submitted to the academic section. In case there has been a change/addition in the Supervisor(s) the thesis will be submitted not earlier than three months from the date of communication of such change/addition to the academic section.
No student once registered for thesis/project units will be allowed to continue the program without a Thesis Supervisor having been appointed by the DPPC. No student will have more than two supervisors. No change in thesis supervisor(s) will be allowed without the consent of the Chairman, DPPC. In exceptional cases, with prior approval of the Chairman, Senate on the recommendation of the DPPC and COE a student may be allowed to have a co-supervisor from outside the institute.
(b) Project evaluation:
Project evaluation shall be done in two phases in both the semesters. First phase of evaluation shall be in the middle of the semester and second phase of the examination shall be after the end-semester theory examination of the semester.
There will be separate grades awarded for the project course in two semesters. The credits in the first semester shall be relatively less and evaluation shall be based on the literature survey, problem definition, problem formulation, fabrication or software development and preliminary results.

A brief report is required to be submitted at the end of semester. The evaluation and grading will depend on the candidate's performance in the two phases of evaluation in the semester.

The second semester of the project shall carry relatively more weightage and the evaluation shall involve external examiners. The details are provided in the following sub-section.

(c) Thesis/Project Oral Examination Committee :
The thesis/project will be examined by an oral examination committee consisting of the supervisor(s) or in his/her absence the program co-ordinator with prior consent of the supervisor and at least two but not more than four other faculty members of the institute proposed by the thesis supervisor(s)/program co-ordinator in consultation with Head of the Department, recommended by the convener, DPPC and approved by the Dean Academics and COE. The thesis supervisor/program co-ordinator will act as the convener of the committee and one of the members of the committee will be an External Examiner as a part of the panel of examiners.

(d) The Convenor, DPPC will submit to the academic section for approval of the Chairman, DPPC the names of the thesis/project examiners on the prescribed form, at least two weeks before the submission of the thesis. Unbound typed copies of thesis/project one for each examiner prepared according to the prescribed format available in the academic section will be submitted at least one week before the probable date of the oral examination. The oral examination will be held

within two months from the date of submission of the thesis/project. If however the student does not make available for the examination, his/her program will be deemed to have been terminated. Request for revival of the program by such a student should be addressed to the Chairman, Senate.
The Department will record the date of submission of the thesis/project and arrange to send the thesis to the examiners. The supervisor/program co-ordinator will inform the examiners of the date of the oral examination and send a copy to the academic section. The thesis/project will be evaluated and the Oral Examination conducted by the Committee on the scheduled date. The report will be communicated by the Convener, DPPC to the academic section for record and necessary action.
The grade to be awarded to a student shall be evolved by the committee by consensus. The report of the oral examination committee including the grade shall be submitted to the Convenor, DPPC by the committee.

(e) Acceptance/Rejection of the Thesis/Project

A thesis/project will be considered to have been accepted if all members of the committee recommend its acceptance. Otherwise thesis/project will be considered to have been rejected. If a thesis/project is rejected along with a recommendation by the Committee for resubmission after incorporating and modification/correction suggested by the Committee, oral examination for the re-submitted thesis/project will be conducted by the same Committee unless otherwise approved by the Chairman Senate. If the resubmitted thesis/project is rejected, the matter will be reported to the Senate for appropriate action. Acceptance of thesis/project will be reported by the COE to the Senate for approval.

7.3.6. Provision for the Change of Guide

Project Guide may submit his request for change of guide to the HoD of the concerned department stating the reasons for the change request. HOD of the concerned department will forward the Application with his/her recommendations and name of the new proposed guide to the Dean Academics for the permission. Dean Academics in consultation with the Director, COEP and Chairman of the Senate may approve such applications.

Procedure for submission of M. Tech. Project Thesis and Oral Examination

1. The supervisor(s) shall be satisfied that the work has been completed. The supervisor(s) shall forward a list of examiners (comprising of at least two but not more than four faculty members from the department, in addition to the supervisor(s) and one member from outside the department or an external expert) through the Departmental PG Coordinator, to HOD.
2. The HOD will then forward the list of examiners to the Dean of Academics for the approval at least 15 days before submission of the thesis.
3. Following the approval, unbound copies of the thesis (one each for every examiner) shall be submitted to the Department (PG Coordinator) at least one week before probable date of the examination.

4. The PG Coordinator, will fix the date of oral examination, make an announcement (through notices and e-mail) and forward unbound copies of thesis to the examiners. The date of oral examination shall be communicated to the COE.

5. The oral examination of a M. Tech. Project shall be held as per announced schedule and it shall be an open one.

6. The Supervisor / PG Coordinator (if Supervisor is not available at the time of oral examination) shall be the convener of the oral examination committee. The committee shall evaluate the project of the candidate on the basis of presentation of the report, originality of the contents therein, demonstration of equipment model/ hardware/ software developed, the oral presentation and oral examination. In case the committee recommends a major revision and recommends a re-examination of the project, Grade "I" shall be awarded and the student shall be required to continue the project and resubmit the thesis within a period of two months. In case the committee rejects the thesis, Grade "F" shall be awarded and the student shall be required to re-register for the project in the next semester.

7. On successful completion of Oral Examination, each student shall submit bound copies of the thesis making corrections, if any, suggested by the examiners (one each to the supervisor(s), Academic Section and the department). The academic section will forward the copy of the thesis/report to the Central library after verification.

8. The candidate should also submit a soft copy of the thesis in pdf format to the PG Coordinator who shall compile all the M. Tech project reports of the academic year of the department on a CD and same shall be placed in the dept library and institute website server.

FORM-I

Format of Certificate by the Employer/Management for Sponsored Candidates

This is to certify that ,

Shri./Smt._____

is working in this Institute as _____

since _____and he/she is permitted to study for **M.Tech program** at College of Engineering, Pune. If he/she is admitted to the said program, he/she will be permitted to attend the College as a full time student during the working hours of the College till completion of his/her program. We understand that he/she will fulfill institute norms for the attendance.

This is further to certify that he/she has been appointed on regular basis and his/her appointment is not temporary.

FORM II – APPLICATION FOR THE EXTENSION OF TIME

Reference No.
Date:
To
The Dean Academics,
College of Engineering , Pune

Sub : Grant of six months extension in order to complete M. Tech. Program

Dear Sir,

I of Mr./ Ms .....who is M.Tech student in ……..Department and pursuing my M. Tech in ……..specialization. I have joined the M.Tech. course in the academic year …… . I am unable to complete my M.Tech. in the prescribed period of two years. I am aware that maximum duration of my M.Tech. course is four years and my admission for the M.Tech will get cancelled after a period of four years from the date of admission and no extension of time is permissible after three years.

I may be permitted Six months extension for completing M. Tech. Program at your Institute as a full -time student.

Date: Signature of the Student

Recommendation of the Project Guide

FORM III – Undertaking By the Full Time M.Tech (Non-Sponsored Student)

Reference No.
Date:
To
The Dean Academics,
College of Engineering , Pune

Sub : Undertaking by the M.Tech Students who is a Non-Sponsored Full Time Student

Dear Sir,

I of Mr./ Ms ..... is M.Tech student in ……..Department and pursuing my M. Tech in ……..specialization. I have joined the M.Tech course in the academic year …… .

I here by solemnly affirm that I am not in any sort of full time/Part Time or Visiting employment of any sort in any organization while joining my M.Tech as fulltime student. I do here by undertake that I will not engage myself in any sort of employment either fulltime/part time or visiting during my studentship as fulltime M.Tech student of College of Engineering, Pune, unless otherwise I am offered such privilege by COEP under a sponsored project.

I do understand that if I am found to indulge in such employment any time during my tenure as a Full Time M.Tech student of College of Engineering, Pune , my admission to M.Tech course will be immediately cancelled by the institute in addition to financial penalty and other disciplinary action initiated by Dean Academics, on behalf of the institute.

Date: Signature of the Student

Recommendation of the HOD

M Tech-Electronics and Telecommunication
Specialization: Wired & Wireless
Structure

Semester I

Sr. No.	Course Code	Course Name	Teaching Scheme			Credits
			L	T	P	
1.	OEC I IS-501	Mobile Communication	3	0	0	3
2.	Core-I WW 501	Statistical Information Processing	3	0	0	3
3.	Core-II WW 503	Advances in Digital Communication	3	0	0	3
4.	Core-IIIWW 505	Optical Communication and Networks	3	0	0	3
5.	DE-II WW-517, WW-515	Voice and Data Networks Measurement and Standards for Communication Systems	3	--	--	3
6.	CS	Seminar	0	0	2	1
7.	LLC LL-503	LLC	0	0	0	1
8.	LC WW-511	PG Laboratory -I	0	0	6	3
		Total	**15**	**0**	**8**	**20**

Semester II

Sr. No.	Course Code	Course Name	Teaching Scheme			Credits
			L	T	P	
9.	OECII IS 502-9	Adaptive Filter Theory	3	0	0	3
10.	DEC-II WW 510 WW 512	High Performance Network Pattern Recognition	3	0	0	3
11.	CoreIVWW 502	Antennas and Radiating Systems	3	0	0	3
12.	PSC-I WW 514 WW 516	RF and Microwave Circuit Design Satellite Communication	3	0	0	3
13	PSC-II WW 518 WW 520	A. Wireless Sensor Network B. MIMO System	3	0	0	3
14.	MLC ML 504	Intellectual Property Rights	1	0	0	1
15.	LC WW 508	PG Laboratory II	0	0	8	4
		Total	**16**	**0**	**6**	**20**

Semester-III

Sr. No.	Course Code	Course Name	Teaching Scheme			Credits
			L	T	P	
1	MLC ML 603	Environmental Studies	2	0	0	2
2	MLC ML 601	Constitution of India	2	0	0	2
3	WW 601	Project Stage I	0	0	0	16
		Total	4	0	0	20

Semester-IV

Sr. No.	Course Code	Course Name	Teaching Scheme			Credits
			L	T	P	
1	WW 602	Project Stage II	0	0	0	20
		Total	0	0	0	20

OEC-I IS 501: Mobile Communication

Teaching Scheme
Lectures : 3 hrs/week

Examination Scheme
T1 - 20 Marks T2 20 Marks
End-Sem Exam-60 Marks

Course Outcomes:

At the end of this course students will demonstrate the ability to

- Design principles and technique appropriate to mobile communication systems
- Understand the frequency-reuse concept in mobile communications, and to analyze its effects on interference, system capacity.
- Understand characteristics like path loss and interference for wireless telephony, and to analyze their influences on a mobile-communication system's performance.
- Understand various multiple-access techniques for mobile communications e.g. FDMA, TDMA, CDMA, and their advantages and disadvantages.
- In depth awareness of GSM system with system architecture, network structure, cell layout, frequency reuse.
  Knowledge of CDMA system functioning in depth with knowledge of forward and reverse channel details

Syllabus Contents:

Introduction to Mobile Communication :- Cellular mobile architecture overview and cellular system design , Frequency management and channel assignment, Frequency reuse channels, concepts of cell splitting, handover in cellular system, handoff techniques and dropped calls.
Multiple access schemes: FDMA, TDMA, CDMA, comparison of T/F/CDMA based on signal separation and their advantages, disadvantages
Propagation path loss and mobile point to point models, Co-channel & Non-cochannel interference, Exploring co-channel interference areas in system, reduction of cochannel interference, Different types of non-co-channel interferences, different ways to reduce interference and in turn improve cell coverage, Mob ile Telephony: Introduction to GSM systems, GSM architecture, GSM network structure, Cell layout and frequency planning, Mobile station, Base station systems, Switching subsystems, Home location registers, VLR (Visiting location registers), Equipment identity register, Echo canceller, CDMA : Introduction to code division multiple access technology, IS 95 system Architecture, Spread spectrum systems, System architecture for wireless communication , Diversity, Combining and antennas, Physical and Logical channels of IS 95 CDMA, Voice application in CDMA systems

References :

- V.K.Garg, J.E.Wilkes, "Principle and Application of GSM", Pearson Education.
- V.K.Garg, "IS-95 CDMA & CDMA 2000", Pearson Education
- William C.Y.Lee, "Mobile Cellular Telecommunications Analog and Digital Systems", II Ed. TMH.
- T.S.Rappaport, "Wireless Communications Principles and Practice", II Ed. PHI
- Bellamy, "Digital Telephony".
- Asha Mrhrotra, Artech House Publishers Bosten London, "A GSM system Engineering

Core-I WW 501: Statistical Information Processing

Teaching Scheme
Lectures : 3 hrs/week

Examination Scheme
T1- 20 Marks T2-20 Marks
End-Sem Exam-60 Marks

Course Contents:

Stochastic Processes and Decision theory:
Bayes law, Conditional and joints, mg functions, limit theorems, Chernov bound, convergence of random sequences, random process - stationarity - PSD, Detection & Estimation: MLE, MAP, correlation detection, minmax detection, hypothesis testing and UMP tests, point and interval estimation, CRLB and parametric estimation (MVUE), K-NN estimation, Time series - Linear regression, BLUE, ARMA model, PCA and Fisher information models, Weiner Process, Yule-Walker and Riccati equations, Markov Processes and Hidden Markov model, Cepstrum analysis.Signal design for sources: Asymptotic equipartition property, information measures, law of large numbers, information spectrum method, information theory & estimation theory, source coding theorem, entropy rate, existence theorem for min. length coding, coding for DMS sources - fixed to fixed, fixed to variable and Kraft-McMillan inequality proof based on partitions and proof given by Karush, variable to variable length encoding, Ziv-Lempel universal coding and proof for asymptotic optimality, Differential entropy and entropy of DMS, Joint source - channel coding theorem, Wolf–Slepian theorem, Error exponents and reliability function due to Gallager. Nyquist's sampling, Scalar quantization, vector quantization, entropy based quantization, uniform and non-uniform quantization, rate-distortion theory and Shannon's third coding theorem, multi terminal source coding, Error exponents of noisy sources – the Weismann-Shamai-Ziv exponents, Compression via error correction, Introduction to pattern recognition & search, database structuring and search: inverse to statistical classification, Bhatnagar bounds on rate-distortion and error rates, Random sort-search methods and complexity analysis, Multiple Description problem and Multi-terminal source coding, Universal lossless trellis coding, Sensor compression. Source coding for – palmprint, iris, text etc., Representation for storage/retrieval, RDF - Resource description format and the Semantic

References :

- Statistical signal processing – Estimation theory – Kay, P. Sica
- Statistical signal processing – Manolikis, Ingle
- Estimation and Detection Theory (I) & (II) – Harry Van Tress
- Information theory and reliable communication – R G. Gallager
- Elements of Information Theory – T.Cover, J. Thomas
- Selected Research papers (as per topics and based on the instructor's discretion from IEEE Transac. of Information Theory, Signal Processing, Pattern Recognition (Elsevier press)
- "50 years of Information theory" – IEEE Press, 1999, Sergio Verdu, Steven Mclaughlin (Editors)

Core-II WW 503: Advances in Digital Communication

Teaching Scheme
Lectures : 3 hrs/week

Examination Scheme
T1-20 Marks T2-20 Marks
End-Sem Exam- 60 Marks

Course Contents:

Overview of digital communication principles, base-band and band-pass digital modulation-demodulation schemes and coding techniques in digital communication.
Communication through band limited linear filter channels, Optimum receiver for channels with ISI and AWGN, Linear equalization, Decision feedback equalization, Iterative equalization and decoding, Adaptive equalization, Spread Spectrum signals for digital communication, DS-SS and FHSS systems, CDMA, Digital communication through fading multi-path channels, Characterization of fading multi-path channels, Effect of signal characteristics on the choice of a channel model, Diversity techniques for fading multi-path channels.

References :

- John G. Proakis, Digital Communications, 4th edition, McGraw Hill.
- John R. Barry, Edward A. Lee and David G. Messerschmitt, Digital Communication, Springer 2003 edition.
- Bernard Sklar, Digital Communication – Fundamentals and Applications, Pearson Education Asia Edition.
- Andrew J. Viterbi, CDMA: Principles of Spread Spectrum Communications, Prentice Hall, USA

Core-III WW 505: Optical Communication and Networks

Teaching Scheme
Lectures : 3 hrs/week

Examination Scheme
T1- 20 Marks T2 -20 Marks
End-Sem Exam- 60 Marks

Course Outcomes:

At the end of this course students will demonstrate the ability to

- Understand and visualize the different modes of light wave propagation in optical fiber.
- Compare merits and demerits of various optical sources, fibers and detectors.
- Contribute in the areas of optical communication link design and optical equipment /device design.
- Implement simple optical network and quickly understand further technology developments for future enhanced network.

Course Contents:

Overview of Optical fiber Communication, Optical fibers Structures and Wave guiding, Signal degradation in optical fibers, Optical Sources, Photo detectors, Optical receiver operations, Digital Links. Wavelength Division Multiplexing: concepts and components.
Optical Networks: Network concepts, Topologies, SONET/SDH, High speed light wave links, Optical Add /Drop Multiplexing, Design issues in WDM Optical Network, Optical switching, WDM network examples, Wavelength Routing Algorithms, Next generation Optical Internet Networks, IP over ATM, IP over SONET, Overlay and Integrated models for IP/WDM networks.

References :

- Optical Fiber Communication by Gerd Keiser, TMH, 4/e.
- WDM Optical Networks: Concepts Design, and Algorithms by C. Siva Ram Murthy and Mohan Gurusamy, PHI, EEE.

DE-I WW 517: Voice and Data Networks

Teaching Scheme
Lectures : 3 hrs/week

Examination Scheme
T1-20 Marks T2-20 Marks
End-Sem Exam- 60 Marks

Course Outcomes:

At the end of this course students will demonstrate the ability to

- Deal with protocol rules and algorithms, tradeoffs, rationale
- Deal with routing, transport, DNS resolution,

Deal with network extensions and next generation architecture Wireless, mobile, sensor

Course Contents:

Network Design Issues, Network Performance Issues, Network Terminology, centralized and distributed approaches for networks design, Issues in design of voice and data networks. Layered and Layer less Communication, Cross layer design of Networks, Voice Networks (wired and wireless) and Switching, Circuit Switching and Packet Switching, Statistical Multiplexing. Data Networks and their Design, Link layer design:- Link adaptation, Link Layer Protocols, Retransmission. Mechanisms (ARQ) , Hybrid ARQ (HARQ), Go Back N, Selective Repeat protocols and their analysis. Queuing Models of Networks , Traffic Models , Little's Theorem, Markov chains, M/M/1 and other Markov systems, Multiple Access Protocols , Aloha System , Carrier Sensing , Examples of Local area networks , Internetworking , Bridging, Global Internet , IP protocol and addressing , Subnetting , Classless Interdomain Routing (CIDR) , IP address lookup , Routing in Internet. End to End Protocols, TCP and UDP. Congestion Control , Additive Increase/Multiplicative Decrease , Slow Start, Fast Retransmit/ Fast Recovery , Congestion avoidance , RED TCP Throughput Analysis, Quality of Service in Packet Networks. Network Calculus, Packet Scheduling Algorithms.

References :

- D Bertsekas and R Gallager, 'Data Networks', Prentice Hall, 1992.
- L Peterson and B S Davie, 'Computer Networks: A Systems Approach',
- Morgan Kaufman.
- Kumar, D. Manjunath and J. Kuri, 'Communication Networking: An analytical approach' Morgan Kaufman.
- J Walrand, 'Communications Network:: A First Course', McGraw Hill 1998.
- Leonard Kleinrock, `Queueing Systems Volume I' :-Theory, John Wiley and Sons.
- Research Papers
- Aaron Kershenbaum- Telecommunication Network Design Algorithms,
- McGraw Hill, international Editions 1993.
- Vijay Ahuja - Communications Network Design and Analysis of Computer Communication Networks, McGraw Hill, International Editions.

DE-I WW 515: Measurement and Standards for Communication Systems

Teaching Scheme	Examination Scheme
Lectures : 3 hrs/week	T1-20 Marks T-2 20 End-Sem Exam- 60 Marks

Course Outcomes:

At the end of this course, students will demonstrate the ability to

- State the key features of RF measuring and signal analysis instruments related to communication systems and elaborate the advancements in modern day measuring instruments.
- Compare and analyze various measurement techniques used in communication signal analysis.
- Elaborate key features of various standards related to WLAN, Wi-Fi, Wi-MAX systems. Elaborate key features and evolution process of various mobile communication standards from 2nd generation 4th generation systems.

Course Contents:

Measurements and instruments for communication signal analysis: Spectrum analyzer, Network analyzer and related measurements, harmonic distortion analyzer, RF measurement issues, receiver related measurements.

Standards for communication systems: Study of IEEE 802.11 a, b and g (Wi-Fi) standards, 802.16 d and e Wi-MAX standards, Mobile communication standards 2G, 2.5G, 3G standards, current scenario of 3G and 4G standards, GSM, EDGE, HSCSD, CDMA, WCDMA standards, concept of convergence of the standards towards broadband communication.

References :

- Theodore S. Rappaport, Wireless communications: principles and practice, Pearson education
- H. S. Kalsi, Electronic Instrumentation, Tata McGraw-Hill, 2/e.

- Vijay K. Garg, Joseph E. Wilkes, “Principle & Applications of GSM”, Person Education.
- Vijay K. Garg, “IS-95 CDMA and CDMA 2000”, Pearson Education.

Seminar

Course Outcomes:

- Ability to understand of contemporary / emerging technology for various processes and systems.
- An ability to share knowledge effectively in oral and written form and formulate documents

Course Contents:

The students are required to search / gather the material / information on a specific a topic comprehend it and present / discuss in the class.

Liberal Learning Course

Course Outcomes:

- Ability to exhibit self learning capabilities and its use in effective communication.
- An ability to inculcate impact of various areas to relate with society at large.
- Demonstrate the familiarity with one or more multi-disciplinary areas of their choice.

Course Contents:

Identification of topic and resources, scope, and synthesize viewpoints for the areas such as performing arts, basic Sciences, business, philosophy, sports and athletics, defense studies and education.

PG Laboratory – I

Teaching Scheme
Practical: 6 hrs/week

Examination Scheme
Marks - 100

Statistical Information Processing

List of Experiments:

1 Basic Probability theorem and Baye’s theorem
2 Statistical probability, Probability Density functions & Joint density Distribution, marginal density functions
3 Advanced distribution alpha, gamma, beta Central limit theorem, Gaussian etc
4 Random variables &random processes, correlation cross correlation etc
5 Markov chain and processes

6 Maximum likelihood theorems
7 Estimation Theorems
8 Hidden markov model and its use in speech recognition
[Note: All Experiments are based on Matlab coding and problems on above topics]

Optical Fiber Lab

List of Experiments:

1. Fiber optics connectors & adaptors.
2. To study amplitude modulation using optical signals as carrier.
3. To study optical point to point link.
4. To simulate patterns of TEOm modes of an optical fiber.
5. Study of I vs P characters of laser diode.
6. Study of Optical time domain reflectometer OTDR & its applications.
7. OCN –seminar

SEM II

OEC-II IS 502-9: Adaptive Filter Theory

Teaching Scheme
Lectures : 3 hrs/week

Examination Scheme
T1 - 20 Marks T2- 20 Marks
End-Sem Exam- 60

Course Outcomes:

At the end of this course students will demonstrate the ability to

- Characterize and apply probabilistic techniques in modern decision systems, such as information systems, receivers, filtering and statistical operations.
- Demonstrate mathematical modelling and problem solving using such models.
- Comparatively evolve key results developed in this course for applications to signal processing, communications systems.
- Develop frameworks built into applications of mathematics and statistical approaches for modelling and analysis of various information sources involving functionalities in decision making, representation and coding.

Course Contents:

Signal design for channels: Background and theme: Finite fields, groups, primitives, residue classes – rings – ideals, review of information measures, rate – distortion framework, log optimal portfolio, quantization and Lloyd –Max, Huffman and competitive optimality, bound given by information capacity, jointly typical sets the AEP for noisy coding, zero error achievability and Shannon - Fano's inequality, types of channels, motivation for signal design for channels, capacity of various DMC,Capacity with feedback, min. distance and code rate, Code design and complexity issues: Plotkin, Gilber-Varshamov, McEliece-Rodemich-Welch bounds. Standard array and LBC, Error detection vs. ARQ, error correction, distance distribution and Mc

William's identities, Error models and Probability of error for SAD.

Codes on finite geometries: Reed-Muller codes, Transform codes – cyclic codes, BCH, non-binary cyclic (Reed-Solomon), Lattice codes, Forney's Concatenated codes, Fountain codes, Berlekamp-Massey algorithm, TCM, Sequential decoding and Threshold decoding

(codes with memory), Generalised Distributive Law and Graph based decoding, near Shannon's limit codes – Gallager's LDPC codes (structure, probabilistic majority voting, intrinsic information, EXIT charts).

References :

- Information theory and reliable communication – R G. Gallager, John Wiley pub.
- Principles of Digital communication – R G. Gallager, MIT Press pub.
- Error correcting codes – W. Peterson, E. Weldon Jr., MIT Press pub.
- Error correcting codes: Fundamentals and applications-– S. Lin, D. Costello, Pearson pub.
- Elements of Information theory – T. Cover, J. Thomas
- Information Transmission – Wozencraft, Abramson, MIT press
- "50 years of Information theory" – IEEE Press, 1999, Sergio Verdu, S McLaughlin Editors

DE-II WW 510: High Performance Networks

Teaching Scheme
Lectures : 3 hrs/week

Examination Scheme
T1 - 20 Marks T-2 20 Marks
End-Sem Exam- 60 Marks

Course Outcomes:

At the end of this course students will demonstrate the ability to

- Apply knowledge of mathematics, probability, and statistics to model and analyze some networking protocols.
- Design, implement, and analyze simple computer networks.
- Identify, formulate, and solve network engineering problems.
- Show knowledge of contemporary issues in computer networks.
- Use techniques, skills, and modern networking tools necessary for engineering practice..

Course Contents:

Types of Networks, Network design issues, Data in support of network design. Network design tools, protocols and architecture. VoIP system architecture, protocol hierarchy, Structure of a voice endpoint, Protocols for the transport of voice media over IP networks. Providing IP quality of service for voice, signaling protocols for VoIP, PSTN gateways, VoIP applications. Introduction, challenges, SCSI protocols and architecture: RAID, Backup and mirroring, Fiber channel attached storage. Network attached storage including NFS, CIFS and DAFS, Management of network storage architectures. New storage protocols, architectures and

enabling technologies. Introduction to CDMA and spread spectrum system, CDMA standards, system architectures of wireless communication systems, physical, network and data link layer of CDMA, wireless LAN standards: IEEE 802.11b, ARPA. Overview of Information Theory. Lossless Compression: Run-Length Encoding, Facsimile compression, String-matching Algorithms. Lossy Compression: DCT, Wavelet compression.

A model for internet security, security attacks, services, internet standards & RFCs, Cryptography, Conventional encryption, principles and algorithms, cipher-block, modes of operation, location of encryption devices , key distribution ,Public key cryptography principles and algorithms, RSA algorithm.

References :

- Kershenbaum A., "Telecommunications Network Design Algorithms", Tata McGraw Hill.
- Ramaswami R., Shivrajan K, "Optical Networks", Morgan Kaufmann.
- Douskalis B., "IP Telephony: The Integration of Robust VoIP Services", Pearson Ed. Asia.
- Warland J., Varaiya P., "High-Performance Communication Networks", Morgan Kaufmann, 1996.
- Stallings W., "High-Speed Networks: TCP/IP and ATM Design Principles", Prentice Hall, 1998.
- Garg V., Smolk K., Vilkes J.,"Applications of CDMA in wire less communication".
- William Stalling : Network security, essentials- Pearson education Asia publication.

DE-II WW 512: Pattern Recognition

Teaching Scheme
Lectures : 3 hrs/week

Examination Scheme
T1- 20 Marks T2-20 Marks
End-Sem Exam- 60 Marks

Course Outcomes:

At the end of this course students will demonstrate the ability to

- Understand object description and recognition techniques
- Understand, Design and implement classification techniques
- Understand the mathematical concepts of pattern recognition
- Apply pattern recognition techniques to object detection and classification.

Course Contents:

Introduction-purpose, state of the art Image Formation - image sensors , projection, color Geometric Calibration- interior and exterior calibration, rectification, Stereo imaging and motion- epipolar geometry, correspondence, triangulation , detection and tracking of point features, optical flow Object Tracking Kalman filter, condensation, tracking humans Object Tracking Kalman filter, condensation, tracking humans, Non-visible-light Imagery- processing of non visible light images and depth images, Applications of computer vision - Fingerprint or iris recognition system , tomography , automatic reading of license plates , Industrial robot vision etc.

References :

- Ballard and Brown. "Computer Vision." Prentice Hall.
- Forsyth and Ponce, Computer Vision: A Modern Approach, Prentice Hall

Core-IV WW 502: Antennas and Radiating Systems

Teaching Scheme
Lectures : 3 hrs/week

Examination Scheme
T1 - 20 Marks T2 - 20 Marks
End-Sem Exam- 60 Marks

Course Outcomes:

At the end of this course students will demonstrate the ability to

- Compute the far field distance, radiation pattern and gain of an antenna for given current distribution.
- Estimate the input impedance, efficiency and ease of match for antennas.
- Compute the array factor for an array of identical antennas.
- Design antennas and antenna arrays for various desired radiation pattern characteristics.

Syllabus Contents:

Types of Antennas: Wire antennas, Aperture antennas, Micro strip antennas, Array antennas Reflector antennas, Lens antennas, Radiation Mechanism, Current distribution on thin wire antenna, Fundamental Parameters of Antennas: Radiation Pattern, Radiation Power Density, Radiation Intensity, Directivity, Gain, Antenna efficiency, Beam efficiency, Bandwidth, Polarization, Input Impedance, radiation efficiency, Antenna Vector effective length, Friis Transmission equation, Antenna Temperature, Linear Wire Antennas: Infinitesimal dipole, Small dipole, Region separation, Finite length dipole, half wave dipole, Ground effects. Loop Antennas: Small Circular loop, Circular Loop of constant current, Circular loop with non uniform current, Linear Arrays: Two element array, N Element array: Uniform Amplitude and spacing, Broadside and End fire array, Super directivity, Planar array, Design consideration, Aperture Antennas: Huygen's Field Equivalence principle, radiation equations, Rectangular Aperture, Circular Aperture. Horn Antennas: E-Plane, H-plane Sectoral horns, Pyramidal and Conical horns, Micro strip Antennas: Basic Characteristics, Feeding mechanisms, Method of analysis, Rectangular Patch, Circular Patch. Reflector Antennas: Plane reflector, parabolic reflector, Cassegrain reflectors.

References :

- Constantine Ballanis, "Antennas Theory Analysis and Design", 2/e, Wiley.
- John D Krauss, "Antennas", TMH.

PSC-I WW 514: RF and Microwave Circuit Design

Teaching Scheme
Lectures : 3 hrs/week

Examination Scheme
T1 -20 Marks T2 -20 Marks
End-Sem Exam- 60 Marks

Course Outcomes:

At the end of this course, students will demonstrate the ability to

- Understand the behavior of RF passive components and model active components.
- Perform transmission line analysis.
- Demonstrate use of Smith Chart for high frequency circuit design.
- Justify the choice/selection of components from the design aspects.
- Contribute in the areas of RF circuit design.

Course Contents:

RF behavior of passive components , Transmission line analysis, Micro strip lines, Smith chart, Single and Multiport networks, RF filter design, RF diodes , BJT's, FET's, active component modeling, High electron mobility transistors, Impedance matching networks ,RF amplifier design, high frequency Oscillator and Mixers design

References :

- Reinhold Ludwig: RF circuit Design Theory and Applications
- Radmanesh: RF and Microwave Electronics Illustrated , Pearson Education

PSC-I WW 516*:* Satellite Communication

Teaching Scheme
Lectures : 3 hrs/week

Examination Scheme
T1-20 Marks T2 -20 Marks
End-Sem Exam- 60 Marks

Course Outcomes:

At the end of this course, students will demonstrate the ability to

- State the key features of Satellite Communication System and elaborate the role of satellites in modern day communication.
- Visualize the architecture of satellite systems as a means of broadband communication and also the Indian scenario in the satellite area.
- Compare and analyze various multiple access techniques used in satellite communication.
- Solve numerical problems related to orbital mechanics for the evaluation of orbital period and velocity of the satellite in the orbit.
- Design link power budget for uplink and downlink for various types of satellites and estimate the transmit power required to achieve the given C/N ratio for both the links.

Course Contents:

Necessity of satellites for communication, space & earth segments, basic resources, system modeling. Tele traffic types of traffic, their sources & interfaces with terrestrial & satellite systems, telecommunications network, equipment performance. Multiple access techniques: overview FDMA, TDMA, SDMA, CDMA, random multiple access-RMA operation, ALOHA forms. Satellite orbits-Circular & elliptical orbits, station keeping in geo stationary orbits and launching in orbits & tracking of satellite. Earth station –Azimuth, elevation & range design of an earth station. Space craft technology-zero gravity space configurations & subsystems, telemetry, tracking electric power considerations solar array.Antenna link receiver design considerations power budget calculations.

References :

- Pratt : Satellite Communication : PHI
- Mingle : Telecommunication Technology handbook

PSC-II WW 518: Wireless Sensor Networks

Teaching Scheme
Lectures : 3 hrs/week

Examination Scheme
T1 -20 Marks T2 -20 Marks
End-Sem Exam- 60 Marks

Course Outcomes:
At the end of this course, students will demonstrate the ability to

- Design principles and technique appropriate to wireless sensor network systems
- Understand the hardware details of different types of sensors in order to select right type of sensor for various applications.
- Understand radio standards and communication protocols used by wireless sensor network based systems.
- Use operating systems and programming languages for wireless sensor nodes, performance of wireless sensor networks systems and platforms.
- Handle special issues related to sensors like energy conservation and security challenges.

Course Contents:
Introduction and overview: Overview of the course; overview of sensor network protocols, architecture, and applications; simulation and experimental platforms; main features of WSNs; research issues and trends, Enabling technologies, Fundamentals of 802.15.4, Bluetooth, and UWB; Physical and MAC layers, Sensor node hardware and software, Hardware: mica2, micaZ, telosB, cricket, Imote2, tmote, btnode, and Sun SPOT, Software (OS): tinyOS, MANTIS, Contiki, and RetOS, Programming tools: C, nesC, Mate, Localization, connectivity, and topology Sensor deployment mechanisms; coverage issues; node discovery protocols, Network layer protocols, Data dissemination and processing; multi-hop and cluster based protocols; routing. Middleware and application layers, Data dissemination; data storage; query processing; sensorWeb; sensorGrid, Open issues for future research, Energy preservation and efficiency; security challenges; fault-tolerance.

References :

- Protocols and Architectures for Wireless Sensor Networks. H. Karl and A. Willig. John Wiley & Sons, June 2005.
- Wireless Sensor Networks: Technology, Protocols, and Applications. K. Sohraby, D.
- Minoli, and T. Znati. John Wiley & Sons, March 2007.
- Wireless Sensor Networks. C. S. Raghavendra, K. M. Sivalingam, and T. Znati, Editors. Springer Verlag, Sep. 2006.
- Wireless Sensor Networks: Architectures and Protocols. E. H. Callaway, Jr. AUERBACH, Aug. 2003.
- Networking Wireless Sensors. B. Krishnamachari. Cambridge University Press, Dec. 2005.
- Wireless Sensor Networks: An Information Processing Approach. F. Zhao and L. Guibas. Morgan Kaufmann, Jul. 2004.
- Sensor Networks and Configuration: Fundamentals, Standards, Platforms, and Applications. N. P. Mahalik. Springer Verlag, Nov. 2006.
- Wireless Sensor Networks: A Systems Perspective, N. Bulusu and S. Jha, Editors, Artech House, August 2005

PSC-II WW 520: MIMO Systems

Teaching Scheme
Lectures : 3 hrs/week

Examination Scheme
T1- 20 Marks T2 -20 Marks
End-Sem Exam- 60 Marks

Course Contents:

Introduction to Multi-antenna Systems, Motivation, Types of multi-antenna systems, MIMO vs. multi-antenna systems, Diversity, Exploiting multipath diversity
Transmit diversity, Space-time codes, The Alamouti scheme, Delay diversity, Cyclic delay diversity, Space-frequency codes, Receive diversity, The rake receiver, Combining techniques, Spatial Multiplexing, Spectral efficiency and capacity, Transmitting independent streams in parallel, Mathematical notation, The generic MIMO problem, Singular Value Decomposition, Eigenvalues and eigenvectors, Equalising MIMO systems, Disadvantages of equalising MIMO systems, Predistortion in MIMO systems, Disadvantages of predistortion in MIMO systems, Precoding and combining in MIMO systems, Advantages of precoding and combining, Disadvantages of precoding and combining, Channel state information
Codebooks for MIMO, Beamforming, Beamforming principles, Increased spectrum efficiency, Interference cancellation, Switched beam beamformer, Adaptive beamformer, Narrowband beamformer, Wideband beamformer, Case study: MIMO in LTE, Codewords to layers mapping, Precoding for spatial multiplexing, Precoding for transmit diversity, Beamforming in LTE, Cyclic delay diversity based precoding, Precoding codebooks, Propagation Channels, Time & frequency channel dispersion, AWGN and multipath propagation channels, Delay spread values and time variations, Fast and slow fading environments, Complex baseband multipath channels, Narrowband and wideband channels, MIMO channel models, Channel Estimation, Channel estimation techniques, Estimation and tracking, Training based channel estimation, Blind channel estimation, Channel estimation architectures, Iterative channel estimation, MMSE channel estimation, Correlative channel sounding, Channel estimation in single carrier systems, Channel estimation for CDMA, Channel estimation for OFDM.

References :

- Claude Oestges, Bruno Clerckx, "MIMO Wireless Communications : From Real-world Propagation to Space-time Code Design," Academic, 2007.
- Mohinder Janakiraman, " Space Time Codes and MIMO Systems, Artech House Publishers

MLC ML 504: Intellectual Property Rights

Teaching Scheme
Lectures : 3 hrs/week

Examination Scheme
T1- 20 Marks T2 -20 Marks
End-Sem Exam- 60 Marks

Course Outcomes:

- Understood the importance of IPR.
- Understood how IPR are regarded as a source of national wealth and mark of an economic leadership in the context of global market scenario.
- Got familiarized with the origins and the development of the international framework of IP.
- Created internal vigilance and enlightenment among students to generate new ideas.

Course Contents:

Importance of IPR in the field of R & D and innovation. IP is an important element of the institutional fabric of an efficiently organized society. Intellectual property right (IPR) is an attempt to safeguard the rights of original contributor of ideas, concept, and creativity of individuals. IPR are regarded as a source of national wealth and mark of an economic leadership in the context of global market scenario. Created internal vigilance and enlightenment among students to generate new ideas. IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

PG Laboratory – II

Wireless Sensor Network Lab

Teaching Scheme
Practical: 2 Hrs / Week

Examination Scheme
Term Work: 50 Marks
Oral: 50 Marks

List of Experiments

1. Emerging application areas of sensor networks, describe any one in detail
2. NS-2 simulator study for wireless applications
3. Realization of wireless environment for data transfer among nodes using NS-2 simulator
4. Comparison of sensor nodes: mica 2, MicaZ, telos B, cricket, imote, Sun spot, tmote

5. Comparison of sensor networks operating systems: tiny OS, MANTIS, Contiki, RetOS
6. Details of wireless standard IEEE 802.15.4, features and applications
7. Difference in UWB and Bluetooth
8. Detail study of any 2 MAC layer protocols for sensor networks and their comparison
9. Mac layer protocol testing using Qual Net Simulator
   (802.11, 802.11e, ALOHA, CSMA, MACA, TDMA)
10. Detail description of any 2 Network layer protocols and their comparison
11. Observe the effect of parameter variation (like number of nodes, packet sent rate, energy model) on protocol behavior for various performance parameters (throughput, energy consumption, network lifetime, delay etc.)
12. Issues related to security and energy efficiency for sensor networks
13. Virtual lab experimentation

.

Study following case studies for better understanding of WSN applications

National Instruments (NI) Wireless Sensor Network (WSN) Application Areas

Environmental Monitoring
Structural Health Monitoring
Energy Monitoring
Machine Condition Monitoring
Transportation
Industrial Monitoring
Distributed Temperature Monitoring
Researchers Use NI Lab VIEW and NI Compact RIO to Perform Environmental Monitoring in the Costa Rican Rain Forest

High Performance Networks Lab

Teaching Scheme
Practical: 2 Hrs / Week

Examination Scheme
Term Work: 50 Marks
Oral: 50 Marks

List of Experiments:

1. Installation and study the features of ns-2.
2. Installation and study the features of ns-3.
3. Simulate and evaluate the performance of Flow control and Error control protocols for High performance Network.
4. Implementation of congestion control protocols for High Performance Networks.
5. Implementation of protocols for Quality of Service (QoS) support.
6. Performance improvement in Wireless Networks.
7. Case study of High Performance Networks.

MLC ML 603: Environmental Studies

Teaching Scheme
Lectures : 3 hrs/week

Examination Scheme
T1- 20 Marks T2 -20 Marks
End-Sem Exam- 60 Marks

Course Outcomes:

- Understanding of the importance of environment, its purpose, design and perspectives.
- Environmental issues related to the exploration of natural resources and development of the mankind.
- Understanding the role of professional in protecting the environment from degradation.
- Awareness of the solutions for environmental problems created by local, national and global developmental activities .

Course Contents:

Environment in which they are living and to make them aware about its benefits , the importance of the sustainable use of natural resources, impact human actions on environment and measures to minimize and mitigate them, current issues and problems pertaining to the environment

Text Books:

- R Rajgopalan, “Environmental studies from crisis to cue”, III edn. OUP ISBN no 0-19-537393-X
- S C Santra,” Environmental Science”, New Central Book Agency Pvt.Ltd. London ISBN no. 81-7382-404-X
- De A.K, “Environmental Chemistry”, Wiley Eastern Ltd.

Reference Books:

- Bharucha Erach , “ The Biodiversity of India” Mapin Publishing Pvt. Ltd., Ahmadabad – 380 013, India, Email:mapin@icenet.net
- Trivedi R.K, “Handbook of Environmental Laws , Rules, Guidelines , Compliances and Standards, Vol I and II, Enviro Media

MLC ML 601: Constitution of India

Teaching Scheme
Lectures : 3 hrs/week

Examination Scheme
T1- 20 Marks T2 -20 Marks
End-Sem Exam- 60 Marks

Course Outcomes:

- Understood the Constitution which is the combination of the positive aspects of other Constitutions.
- Interpretation of the Preambles.

- Gained confidence on our Constitution by knowing it better.

Course Contents:

Basic foundation of our nation as well as to understand the basic law for the governance of our nation, the history and the different types of Constitutions. Different aspects considered by the framers while framing the Constitution. Different rights enshrined in the Constitution and understand the rights and duties of the government. the basis and procedure of amendments and the different important amendments, knowledge how our country was founded, who founded it, what our rights are, what life was like, how life has changed, how the rights still apply today.

WW 601, WW 602 Project Work I and II

Guidelines for Dissertation Phase – I and II at M. Tech. (Electronics):

- As per the AICTE directives, the dissertation is an year long activity, to be carried out and evaluated in two phases i.e. Phase – I: July to December and Phase – II: January to June.
- The dissertation may be carried out preferably in-house i.e. department's laboratories and centers OR in industry allotted through department's T & P coordinator.
- After multiple interactions with guide and based on comprehensive literature survey, the student shall identify the domain and define dissertation objectives. The referred literature should preferably include IEEE/IET/IETE/Springer/Science Direct/ACM journals in the areas of Computing and Processing (Hardware and Software), Circuits-Devices and Systems, Communication-Networking and Security, Robotics and Control Systems, Signal Processing and Analysis and any other related domain. In case of Industry sponsored projects, the relevant application notes, while papers, product catalogues should be referred and reported.
- Student is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and phase wise work distribution, and submit the proposal within a month from the date of registration.
- **Phase – I deliverables:** A document report comprising of summary of literature survey, detailed objectives, project specifications, paper and/or computer aided design, proof of concept/functionality, part results, A record of continuous progress.
- **Phase – I evaluation:** A committee comprising of guides of respective specialization shall assess the progress/performance of the student based on report, presentation and Q & A. In case of unsatisfactory performance, committee may recommend to repeat the phase-I work.
- During phase – II, student is expected to exert on design, development and testing of the proposed work as per the schedule. Accomplished results/contributions/innovations should be published in terms of research papers in reputed journals and reviewed focused conferences OR IP/Patents.
- **Phase – II deliverables:** A dissertation report as per the specified format, developed system in the form of hardware and/or software, A record of continuous progress.
- **Phase – II evaluation:** Guide along with appointed external examiner shall assess the progress/performance of the student based on report, presentation and Q & A. In case of unsatisfactory performance, committee may recommend for extension or repeating the work.

Course Outcomes:

- Ability to synthesize knowledge and skills previously gained and applied to an in-depth study and execution of new technical problem.
- Capable to select from different methodologies, methods and forms of analysis to produce a suitable research design, and justify their design.
- Ability to present the findings of their technical solution in a written report.
- Presenting the work in International/ National conference or reputed journals.

Course Contents:

The dissertation / project topic should be selected / chosen to ensure the satisfaction of the urgent need to establish a direct link between education, national development and productivity and thus reduce the gap between the world of work and the world of study.
The dissertation should have the following

- Relevance to social needs of society
- Relevance to value addition to existing facilities in the institute
- Relevance to industry need
- Problems of national importance
- Research and development in various domain

The student should complete the following:

- Literature survey
- Problem Definition
- Motivation for study and Objectives
- Preliminary design / feasibility / modular approaches
- Implementation and Verification
- Report and presentation

The dissertation stage II is based on a report prepared by the students on dissertation allotted to them.
It may be based on:

- Experimental verification / Proof of concept
- Design, fabrication, testing of Communication System.
- The viva-voce examination will be based on the above report and work

Annexure I

Sample list of Professional Science/Elective courses offered by various departments

Branch Name	Subject Name
Civil Engineering (Construction and Management)	Environmental Impact Assessment
Civil Engineering (Environmental and Water)	Numerical Method
Civil Engineering (Geotechnical Engineering)	Advanced Mathematical Methods
Civil Engineering	Introduction to Coastal Engineering
Civil Engineering	Fortran Programming for Engineering Application
Civil Engineering	Housing and Social aspects of planning
Computer/ Information Technology	Financial Computing
Electrical Engineering (Control System)	Matrix and linear Algebra
Electrical Engineering (Power System)	Wind and Solar Energy
Electrical Engineering (Power System)	Engineering Optimization
Electrical Engineering (Power System)	Linear Systems Theory and Design
Electrical Engineering	Industrial Motion Control
Electronics and Telecommunications (Signal Processing)	Mobile Communication
Electronics and Telecommunications	Applied Statistical Physics
Electronics and Telecommunications(VLSI and Embedded)	Image processing and analysis
Electronics and Telecommunications	Artificial Intelligence
Mechanical Engineering	Finite Element and Boundary Element Methods
Mechanical Engineering	Energy Conservation and Management
Mechanical Engineering	Operation Research
Mechanical Engineering	Introduction to Nuclear Energy
Metallurgical Engineering (Physical/Process)	Electronics and Magnetic Materials
Metallurgical Engineering (Physical/Process)	Thermo mechanical Processing of Metals
Metallurgical Engineering	Nanotechnology
Town and Country Planning	Quantitative Techniques
Production Engineering (Manufacturing Engineering and Automation)	Microcontroller and Applications
Production Engineering (Manufacturing Engineering and Automation)	Reliability Engineering
Production	Robot Dynamics and Analysis
Production	Commercial Law
Project Management	Project Planning and Control
Applied Physics	Laser Technology
Mathematics	Complex Analysis
Mathematics	Advanced Mathematical Methods (for all except Mech. and Instru.)
Mathematics	Advanced Mathematics
Mathematics	Engineering Mathematics for Problem Solving
Mathematics	Linear Algebra

Annexure-II:

Sample list of Liberal Learning courses offered at Institute level

Course Outcome:
Student will be able to choose and enhance practical learning and application in the subject of his/her choice.

One credit course spread over the semester to enhance practical learning and application

1. **Agriculture (**Landscaping, Farming, etc.**)**
2. **Business (**Management, Entrepreneurship, etc.**)**
3. **Defence (**Study about functioning of Armed Forces**)**
4. **Education (**Education system, Policies, Importance, etc.**)**
5. **Fine Arts (**Painting, Sculpting, Sketching, etc.**)**
6. **Linguistics**
7. **Medicine and Health (**Diseases, Remedies, Nutrition, Dietetics, etc.**)**
8. **Performing Arts (**Music, Dance, Instruments, Drama, etc.**)**
9. **Philosophy**
10. **Social Sciences (**History, Political Sc., Archaeology, Geography, Civics, Economics, etc.**)**