ACADEMIC REGULATIONS
COURSE STRUCTURE
AND
DETAILED SYLLABUS

M.TECH
MICROWAVE AND
RADAR ENGINEERING

(Applicable for the batches admitted from 2013-14)

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
KUKATPALLY, HYDERABAD – 500 085.

ACADEMIC REGULATIONS R13 FOR M. TECH. (REGULAR) DEGREE COURSE

Applicable for the students of M. Tech. (Regular) Course from the Academic Year 2013-14 and onwards

The M. Tech. Degree of Jawaharlal Nehru Technological University Hyderabad shall be conferred on candidates who are admitted to the program and who fulfil all the requirements for the award of the Degree.

1.0 ELIGIBILITY FOR ADMISSIONS

Admission to the above program shall be made subject to eligibility, qualification and specialization as prescribed by the University from time to time.

Admissions shall be made on the basis of merit/rank obtained by the candidates at the qualifying Entrance Test conducted by the University or on the basis of any other order of merit as approved by the University, subject to reservations as laid down by the Govt. from time to time.

2.0 AWARD OF M. TECH. DEGREE

2.1 A student shall be declared eligible for the award of the M. Tech. Degree, if he pursues a course of study in not less than two and not more than four academic years. However, he is permitted to write the examinations for two more years after four academic years of course work.

2.2 A student, who fails to fulfill all the academic requirements for the award of the degree within four academic years from the year of his admission, shall forfeit his seat in M. Tech. course.

2.3 The student shall register for all 88 credits and secure all the 88 credits.

2.4 The minimum instruction days in each semester are 90.

3.0 A. COURSES OF STUDY

The following specializations are offered at present for the M. Tech. course of study.

1. Advanced Manufacturing Systems
2. Aerospace Engineering/ Aeronautical Engineering
3. Automation
4. Biomedical Signal Processing and Instrumentation
5. Bio-Technology
6. CAD/CAM
7. Chemical Engineering
8. Communication Systems
9. Computer Networks
10. Computer Networks and Information Security
11. Computer Science
12. Computer Science and Engineering
13. Computers and Communication Engineering.
14. Construction Management
15. Control Engineering
16. Control Systems
17. Cyber Forensic / Cyber Security & Information Technology
18. Design for Manufacturing/ Design and Manufacturing
19. Digital Electronics and Communication Engineering.
20. Digital Electronics and Communication Systems
21. Digital Systems and Computer Electronics
22. Electrical Power Engineering
23. Electrical Power Systems
24. Electronics & Instrumentation

25. Electronics and Communication Engineering
26. Embedded Systems
27. Embedded Systems and VLSI Design
28. Energy Systems
29. Engineering Design
30. Environmental Engineering
31. Geoinformatics and Surveying Technology
32. Geotechnical Engineering.
33. Heating Ventilation & Air Conditioning.
34. Highway Engineering
35. Image Processing
36. Industrial Engineering and Management
37. Information Technology
38. Infrastructure Engineering
39. Machine Design
40. Mechatronics.
41. Microwave & Radar Engineering
42. Nano Technology
43. Neural Networks
44. Parallel Computing
45. Power and Industrial Drives
46. Power Electronics
47. Power Electronics and Electrical Drives
48. Power Engineering and Energy Systems
49. Power Plant Engineering & Energy Management
50. Power System Control and Automation
51. Power System with Emphasis H.V. Engineering / H.V. Engineering
52. Production Engineering.
53. Real Time Systems
54. Software Engineering
55. Structural Engineering
56. Systems & Signal Processing
57. Thermal Engineering.
58. Transportation Engineering
59. VLSI
60. VLSI and Embedded System/ Electronics Design Technology
61. VLSI Design
62. VLSI System Design
63. Web Technologies
64. Wireless and Mobile Communication

and any other course as approved by the University from time to time.

3.0 B. Departments offering M. Tech. Programmes with specializations are noted below:

Civil Engg.	Construction Management Environmental Engineering Geoinformatics and Surveying Technology Geotechnical Engineering Highway Engineering Infrastructure Engineering Structural Engineering Transportation Engineering
EEE	Control Engineering Control Systems Electrical Power Engineering Electrical Power Systems Power and Industrial Drives Power Electronics Power Electronics and Electrical Drives Power Engineering and Energy Systems Power Plant Engineering & Energy Management Power System Control and Automation Power System with Emphasis H.V. Engineering / H.V. Engineering
ME	Advanced Manufacturing Systems Automation CAD/CAM Design for Manufacturing/ Design and Manufacturing Energy Systems Engineering Design Heating Ventilation & Air Conditioning Industrial Engineering and Management Machine Design Mechatronics. Power Plant Engineering & Energy Management Production Engineering Thermal Engineering.
ECE	Biomedical Signal Processing and Instrumentation Communication Systems Computers and Communication Engineering. Digital Electronics and Communication Engineering. Digital Electronics and Communication Systems Digital Systems and Computer Electronics Electronics & Instrumentation Electronics and Communication Engineering Embedded Systems Embedded Systems and VLSI Design

	Microwave & Radar Engineering Systems & Signal Processing VLSI VLSI and Embedded System/ Electronics Design Technology VLSI Design VLSI System Design Wireless and Mobile Communication
CSE	Computer Networks Computer Networks and Information Security Computer Science Computer Science and Engineering Cyber Forensic / Cyber Security & Information Technology Image Processing Information Technology Neural Networks Parallel Computing Real Time Systems Software Engineering Web Technologies
Aeronautical Engg.	Aerospace Engineering / Aeronautical Engineering
Bio-technology	Bio-Technology
Chemical Engg.	Chemical Engineering
Nano Technology	Nano Technology

4.0 ATTENDANCE

The programs are offered on a unit basis with each subject being considered a unit.

4.1 A student shall be eligible to write University examinations if he acquires a minimum of 75% of attendance in aggregate of all the subjects.

4.2 Condonation of shortage of attendance in aggregate up to 10% (65% and above and below 75%) in each semester shall be granted by the College Academic Committee.

4.3 Shortage of Attendance below 65% in aggregate shall not be condoned.

4.4 Students whose shortage of attendance is not condoned in any semester are not eligible to write their end semester examination of that class and their registration shall stand cancelled.

4.5 A prescribed fee shall be payable towards condonation of shortage of attendance.

4.6 A student shall not be promoted to the next semester unless he satisfies the attendance requirement of the present semester, as applicable. They may seek readmission into that semester when offered next. If any candidate fulfills the attendance requirement in the present semester, he shall not be eligible for readmission into the same class.

4.7 A candidate shall put in a minimum required attendance at least in three (3) theory subjects in the present semester to get promoted to the next semester. In order to qualify for the award of the M. Tech. Degree, the candidate shall complete all the academic requirements of the subjects, as per the course structure.

4.8 A student shall not be promoted to the next semester unless he satisfies the attendance requirements of the previous semester including the days of attendance in sports, games, NCC and NSS activities.

5.0 EVALUATION

The performance of the candidate in each semester shall be evaluated subject-wise, with a maximum of 100 marks for theory and 100 marks for practicals, on the basis of Internal Evaluation and End Semester Examination.

5.1 For the theory subjects 60 marks shall be awarded based on the performance in the End Semester Examination and 40 marks shall be awarded based on the Internal Evaluation. The internal evaluation shall be made based on the average of the marks secured in the two Mid Term-Examinations conducted-one in the middle of the Semester and the other immediately after the completion of instruction. Each mid term examination shall be conducted for a total duration of 120 minutes with Part A as compulsory question (16 marks) which consists of four sub-questions and carries 4 marks each and Part B with 3 questions to be answered out of 5 questions each question for 8 marks. If any candidate is absent from any subject of a mid-term examination, an on-line test will be conducted for him by the University. The details of the Question Paper pattern for End Examination (Theory) is given below:

- The End semesters Examination will be conducted for 60 marks which consists of two parts viz. i).Part-A for 20 marks, ii). Part –B for 40 marks.
- Part-A is compulsory question where it consists of five questions one from each unit and carries four marks each. This will be treated as Question 1.
- Part-B consists of five Questions (numbered from 2 to 6) carries 8 marks each. Each of these questions is from one unit and may contain sub-questions. For each question there will be an "either" "or" choice (that means there will be two questions from each unit and the student should answer only one question)

5.2 For practical subjects, 60 marks shall be awarded based on the performance in the End Semester Examinations and 40 marks shall be awarded based on the day-to-day performance as Internal Marks.

5.3 There shall be two seminar presentations during I year I semester and II semester. For seminar, a student under the supervision of a faculty member, shall collect the literature on a topic and critically review the literature and submit it to the department in a report form and shall make an oral presentation before the Departmental Academic Committee consisting of Head of the Department, Supervisor and two other senior faculty members of the department. For each Seminar there will be only internal evaluation of 50 marks. A candidate has to secure a minimum of 50% of marks to be declared successful.

5.4 There shall be a Comprehensive Viva-Voce in II year I Semester. The Comprehensive Viva-Voce will be conducted by a Committee consisting of Head of the Department and two Senior Faculty members of the Department. The Comprehensive Viva-Voce is intended to assess the students' understanding of various subjects he has studied during the M. Tech. course of study. The Comprehensive Viva-Voce is evaluated for 100 marks by the Committee. There are no internal marks for the Comprehensive Viva-Voce.

5.5 A candidate shall be deemed to have secured the minimum academic requirement in a subject if he secures a minimum of 40% of marks in the End semester Examination and a minimum aggregate of 50% of the total marks in the End Semester Examination and Internal Evaluation taken together.

5.6 In case the candidate does not secure the minimum academic requirement in any subject (as specified in 5.5) he has to reappear for the End semester Examination in that subject. A candidate shall be given one chance to re-register for each subject provided the internal marks secured by a candidate are less than 50% and so has failed in the end examination. In such a case, the candidate must re-register for the subject(s) and secure the required minimum attendance. The candidate's attendance in the re-registered subject(s) shall be calculated separately to decide upon his eligibility for writing the end examination in those subject(s). In the event of the student taking another chance, his internal marks and end examination marks obtained in the previous attempt stand cancelled.

5.7 In case the candidate secures less than the required attendance in any subject, he shall not be permitted to write the End Examination in that subject. He shall re-register the subject when next

offered.

5.8 Laboratory examination for M. Tech. courses must be conducted with two Examiners, one of them being the Laboratory Class Teacher and the second examiner shall be another Laboratory Teacher.

6.0 EVALUATION OF PROJECT/DISSERTATION WORK

Every candidate shall be required to submit a thesis or dissertation on a topic approved by the Project Review Committee.

6.1 A Project Review Committee (PRC) shall be constituted with Principal as Chairperson, Heads of all the Departments offering the M. Tech. programs and two other senior faculty members.

6.2 Registration of Project Work: A candidate is permitted to register for the project work after satisfying the attendance requirement of all the subjects, both theory and practical.

6.3 After satisfying 6.2, a candidate has to submit, in consultation with his project supervisor, the title, objective and plan of action of his project work to the Departmental Academic Committee for approval. Only after obtaining the approval of the Departmental Academic Committee can the student initiate the Project work.

6.4 If a candidate wishes to change his supervisor or topic of the project, he can do so with the approval of the Departmental Academic Committee. However, the Departmental Academic Committee shall examine whether or not the change of topic/supervisor leads to a major change of his initial plans of project proposal. If yes, his date of registration for the project work starts from the date of change of Supervisor or topic as the case may be.

6.5 A candidate shall submit his status report in a bound-form in two stages at least with a gap of 3 months between them.

6.6 The work on the project shall be initiated at the beginning of the II year and the duration of the project is two semesters. A candidate is permitted to submit Project Thesis only after successful completion of theory and practical course with the approval of PRC not earlier than 40 weeks from the date of registration of the project work. For the approval of PRC the candidate shall submit the draft copy of thesis to the Principal through Head of the Department and make an oral presentation before the PRC.

6.7 Three copies of the Project Thesis certified by the supervisor shall be submitted to the College/ School/Institute.

6.8 The thesis shall be adjudicated by one examiner selected by the University. For this, the Principal of the College shall submit a panel of 5 examiners, eminent in that field, with the help of the guide concerned and head of the department.

6.9 If the report of the examiner is not favourable, the candidate shall revise and resubmit the Thesis, in the time frame as decided by the PRC. If the report of the examiner is unfavourable again, the thesis shall be summarily rejected.

6.10 If the report of the examiner is favourable, Viva-Voce examination shall be conducted by a board consisting of the Supervisor, Head of the Department and the examiner who adjudicated the Thesis. The Board shall jointly report the candidate's work as one of the following:

A. Excellent

B. Good

C. Satisfactory

D. Unsatisfactory

The Head of the Department shall coordinate and make arrangements for the conduct of Viva- Voce examination.

If the report of the Viva-Voce is unsatisfactory, the candidate shall retake the Viva-Voce examination only after three months. If he fails to get a satisfactory report at the second Viva- Voce examination, he will not be eligible for the award of the degree.

7.0 AWARD OF DEGREE AND CLASS

After a student has satisfied the requirements prescribed for the completion of the program and is eligible for the award of M. Tech. Degree he shall be placed in one of the following four classes:

Class Awarded	% of marks to be secured
First Class with Distinction	70% and above
First Class	Below 70% but not less than 60%
Second Class	Below 60% but not less than 50%
Pass Class	Below 50% but not less than 40%

The marks in internal evaluation and end examination shall be shown separately in the memorandum of marks.

8.0 WITHHOLDING OF RESULTS

If the student has not paid the dues, if any, to the university or if any case of indiscipline is pending against him, the result of the student will be withheld and he will not be allowed into the next semester. His degree will be withheld in such cases.

9.0 TRANSITORY REGULATIONS

9.1 Discontinued, detained, or failed candidates are eligible for admission to two earlier or equivalent subjects at a time as and when offered.

9.2 The candidate who fails in any subject will be given two chances to pass the same subject; otherwise, he has to identify an equivalent subject as per R13 academic regulations.

10. GENERAL

10.1 Wherever the words “he”, “him”, “his”, occur in the regulations, they include “she”, “her”, “hers”.

10.2 The academic regulation should be read as a whole for the purpose of any interpretation.

10.3 In the case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Vice-Chancellor is final.

10.4 The University may change or amend the academic regulations or syllabi at any time and the changes or amendments made shall be applicable to all the students with effect from the dates notified by the University.

MALPRACTICES RULES

DISCIPLINARY ACTION FOR / IMPROPER CONDUCT IN EXAMINATIONS

	Nature of Malpractices/Improper conduct	Punishment
	If the candidate:	
1. (a)	Possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, Cell phones, pager, palm computers or any other form of material concerned with or related to the subject of the examination (theory or practical) in which he is appearing but has not made use of (material shall include any marks on the body of the candidate which can be used as an aid in the subject of the examination)	Expulsion from the examination hall and cancellation of the performance in that subject only.
(b)	Gives assistance or guidance or receives it from any other candidate orally or by any other body language methods or communicates through cell phones with any candidate or persons in or outside the exam hall in respect of any matter.	Expulsion from the examination hall and cancellation of the performance in that subject only of all the candidates involved. In case of an outsider, he will be handed over to the police and a case is registered against him.
2.	Has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the subject of the examination (theory or practical) in which the candidate is appearing.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that Semester/ year. The Hall Ticket of the candidate is to be cancelled and sent to the University.
3.	Impersonates any other candidate in connection with the examination.	The candidate who has impersonated shall be expelled from examination hall. The candidate is also debarred and forfeits the seat. The performance of the original candidate who has been impersonated, shall be cancelled in all the subjects of the examination (including practicals and project work) already appeared and shall not be allowed to appear for examinations of the remaining subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. If the imposter is an outsider, he will be handed over to the police and a case is registered against him.

4.	Smuggles in the Answer book or additional sheet or takes out or arranges to send out the question paper during the examination or answer book or additional sheet, during or after the examination.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
5.	Uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks.	Cancellation of the performance in that subject.
6.	Refuses to obey the orders of the Chief Superintendent/Assistant – Superintendent / any officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a walk out or instigates others to walk out, or threatens the officer-in charge or any person on duty in or outside the examination hall of any injury to his person or to any of his relations whether by words, either spoken or written or by signs or by visible representation, assaults the officer-in-charge, or any person on duty in or outside the examination hall or any of his relations, or indulges in any other act of misconduct or mischief which result in damage to or destruction of property in the examination hall or any part of the College campus or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination.	In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that subject and all other subjects the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. The candidates also are debarred and forfeit their seats. In case of outsiders, they will be handed over to the police and a police case is registered against them.
7.	Leaves the exam hall taking away answer script or intentionally tears of the script or any part thereof inside or outside the examination hall.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.

8.	Possess any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat.
9.	If student of the college, who is not a candidate for the particular examination or any person not connected with the college indulges in any malpractice or improper conduct mentioned in clause 6 to 8.	Student of the colleges expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat. Person(s) who do not belong to the College will be handed over to police and, a police case will be registered against them.
10.	Comes in a drunken condition to the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year.
11.	Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny.	Cancellation of the performance in that subject and all other subjects the candidate has appeared including practical examinations and project work of that semester/year examinations.
12.	If any malpractice is detected which is not covered in the above clauses 1 to 11 shall be reported to the University for further action to award suitable punishment.	

Malpractices identified by squad or special invigilators

1. Punishments to the candidates as per the above guidelines.
2. Punishment for institutions : (if the squad reports that the college is also involved in encouraging malpractices)
   - (i) A show cause notice shall be issued to the college.
   - (ii) Impose a suitable fine on the college.
   - (iii) Shifting the examination centre from the college to another college for a specific period of not less than one year.

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M.TECH - MICROWAVE AND RADAR ENGINEERING

COURSE STRUCTURE AND SYLLABUS

I Year I Semester

Code	Group	Subject	L	P	Credits
		Advanced Electromagnetic Theory	3	-	3
		Microwave Antenna Theory and Design	3	-	3
		Radar System Engineering	3	-	3
		Microwave Components and Measurements	3	-	3
	Elective -I	Advanced Digital Signal Processing. Satellite Communications Radio Navigational Aids	3	-	3
	Elective -II	Random Processes and Time Series Analysis Microwave Integrated Circuits EMI/EMC	3	-	3
	Lab	Microwave Measurements Lab	-	3	2
		Seminar	-	-	2
		Total Credits	18	3	22

I Year II Semester

Code	Group	Subject	L	P	Credits
		Microwave Networks	3	-	3
		Radar Signal Processing	3	-	3
		Microwave Solid State Devices	3	-	3
		Phased Array Systems	3	-	3
	Elective - III	RF Circuit Design Software Radio Optical Communication Technology	3	-	3
	Elective – IV	Smart Antennas Detection and Estimation Theory Wireless Communications and Networks	3	-	3
	Lab	Antennas and Simulation Lab	-	3	2
		Seminar	-	-	2
		Total Credits	18	3	22

II Year - I Semester

Code	Group	Subject	L	P	Credits
		Comprehensive Viva	-	-	2
		Project Seminar	-	3	2
		Project work	-	-	18
		Total Credits	-	3	22

II Year - II Semester

Code	Group	Subject	L	P	Credits
		Project work and Seminar	-	-	22
		Total Credits	-	-	22

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – I Sem. (MRE)

ADVANCED ELECTROMAGNETIC THEORY

UNIT -I:

Fundamental Concepts:

Introduction, Basic Equations, constitutive relation ships, generalized current concepts, energy and power, circuit concepts, complex quantities, complex equations, complex constitutive parameters, complex power, A-C Characteristics of matter, A discussion of current, A-C behavior circuit elements, Singularities of field.

UNIT -II:

Introduction of Waves:

Wave Equation, Waves in perfect dielectrics, Intrinsic wave constants, waves in lossy matter, reflection of waves, transmission line concepts, waveguide concepts, resonator concepts, radiation, and antenna concepts.

UNIT -III:

Some Theorems & Concepts:

Source concepts, duality, uniqueness, Image theory, Equivalence principle, fields in off space, Induction theorem, reciprocity, Green's functions, Integral equations, construction of solutions, the radiation field.

UNIT -IV:

Plane Wave Functions:

Wave functions, Plane waves, rectangular waveguides, alternative mode sets, Rectangular cavity, partially filled wave guide, dielectric- slab guide, surface guided waves, modal Expansions of fields, currents in waveguides, Apertures in ground planes.

UNIT -V:

Perturbational and Variational Techniques:

Intriduction, perturbation of cavity walls, cavity material perturbations, waveguide perturbations, stationary formulas for cavity, Ritz procedure, reaction concepts, starionary formulas for waveguides,stationary formulas for impedance, stationary formulas for scattering,scattering by dielectric obstacles, transmission through Apertures.

TEXT BOOKS:

1. 'Time Harmonic Electromagnetis' by R. F Harrington., McGrawhill, 1961.
2. Electromagnetic wave and Radiating systems, 2nd Edition, By E.C Jordan &K.G. Balmain, Prentice hall India, Pvt. Ltd., New Delhi.

REFERENCE BOOKS:

1. 'Elements of Elentromagnetics, 4th edition by M.N.O.Sadiku, Oxford UIniversity Press, 2001.
2. 'Advanced Engineering Electromagnetics ' by C.A. Balmain, Wiley India, Pvt. Ltd., 2005.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – I Sem. (MRE)

MICROWAVE ANTENNA THEORY AND DESIGN

UNIT -I:

Antenna Theory:

Antennas, Radiation concept, Types of Antennas, Antenna parameters, Friis Transmission equation.

UNIT -II:

Aperture Antenna:

Introduction, Pyramidal Horns- Design Procedure, Conical and Corrugated Horns, Aperture Corrugated Horns, Reflected Antennas- Parameters, Analysis of front-fed parabolic reflector, Feed methods and feed types, Cassegrain Reflector Horns.

UNIT -III:

Microstrip Radiators:

Introduction, Rectangular Microstrip Antenna analysis and Design, Circular Microstrip Antenna Analysis and Design.

UNIT -IV:

Microstrip Slot Antennas:

Wave guide fed slots, Radiational mechanism, Micro strip slot antennas, Introduction rectangular slot antennas, narrow, wide, tapered and circularly polarized slot antennas, Annular slot antennas, Comparison of microstrip slot antennas with patch antennas.

UNIT -V:

Micro Strip Antenna Arrays:

Introduction, Micro strip array antennas, Characteristics of fixed beam linear antenna arrays, Linear micro strip arrays, Characteristics of planar arrays, Microstrip planar arrays, Microstrip scanned array antennas, Phase scanned microstrip arrays, Time delay scanning, Electronic feed switching, Frequency scanned microstrip arrays, Advantage and disadvantages of phased array antennas.

TEXT BOOKS:

1. Constantine Balanis. A - 'Antenna Theory-Analysis and Design', 3rd Edition, John Wiley, 2005.
2. Bahl IJ, and Bhartia -NMicrostrip Antennas, Artech House, 1982.

REFERENCE BOOKS:

1. Microstrip Antenna Design Hand Book -Ramesh Garg, Prakash Bhatia, Architect House Inc. 2001.
2. Samuel Silve - Microwave Antenna - Theory and design, IEE Press, 1984.
3. James.J R. Hall, P S. Wood.C. - Micro strip Antenna-Theory and Design, PeterPeregrinu,1981.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – I Sem. (MRE)

RADAR SYSTEMS ENGINEERING

UNIT -I:

Radar Range Equation:

Radar fundamentals, Derivation of range equation, the search radar equation, Jamming and radar range with jamming, Radar clutter and radar range with clutter, Radar range with combined interferences sources.

UNIT -II:

Theory of Target Detection:

Noise and false alarms, Detection of one sample of signal with noise, Integration of pulse trains, Detection of fluctuating targets, CFAR, Optimum and matched filter Theory, Loss factors in detection.

UNIT -III:

Targets and Interference:

Definition of radar cross section, Radar cross section of simple and complex objects, Spatial distribution of cross section, Bistatic cross section, CW and FM Radar: Doppler Effect, CW and FMCW Radar, Airborne Doppler Navigation, Multi frequency CW Radar.

UNIT -IV:

MTI Radar:

Delay lines and line cancellors, Subclutter Visibility. MTI using range gates and filters, Pulse Doppler radar, Non-coherent MTI radar, Application of Digital signal processing to radar system.

Tracking Radar: Different types of tracking techniques, Tracking in range, Tracking in Doppler, Search Acquisition radar, Comparison of Trackers.

UNIT -V:

Introduction to Pulse Compression Radar: Height finding radars, Air traffic control Radars and data handling, Atmospheric effects of radar, Electromagnetic compatibility aspects, Airborne Radars, Synthetic Aperture Radar, Secondary surveillance Radars.

TEXT BOOKS:

1. David Barton .K - Modern Radar System Analysis, Artech House, 1988.
2. Fred Nathanson E, Radar Design Principles Signal Processing and The Environment, Mcgraw Hill,1969.

REFERENCE BOOKS:

1. Cook CE. Bernfield. M - Radar Signals. Academic Press, 1967.
2. Skolnik - Introduction to radar systems, Mcgraw hill, 2nd Edition 2003.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – I Sem. (MRE)

MICROWAVE COMPONENTS AND MEASUREMENTS

UNIT -I:

Microwave Circuits & Theorems: Equation of Voltage and Currents, Impedance description of waveguide circuits, Fosters reactance theorem, N-Port circuits, Two-port junctions, S-matrix formulation and properties, Illustrative problems.

UNIT -II:

Impedance Matching: Impedance matching Concepts, Quarter wave Transformers, Theory of small reflections, single and multi sections, Binomial and Chebysheve Transformers.

UNIT -III:

Passive Microwave Components: Introduction to Power dividers and couplers-T Junctions and Willkinson power dividers, Analysis and Design of Directional Couplers- Bethehole, Multi hole Couplers, Quadrature Hybrids, Faraday rotation, S-matrix of Directional Couplers and T-Junctions, Gyrator, Isolator, Circulator-Applications.

UNIT -IV:

Microwave Measurements-I: Measurement of Wavelength, Frequency and Impedance-Introduction, Equivalent circuit of Cavity wave meters, Typical wave meters, resonant cavities, Methods of frequency measurements-direct method - Interpolation method, Standard wave reflectors, Measurement of reflection coefficient, Low, Medium, High VSWR measurements, Standing wave pattern, Slotted Line section and its limitation, Impedance measurement techniques, Reflectometer.

UNIT -V:

Microwave Measurements-II: Vector Network analyzer, Concept and description, Reflection and Transmission measurements, magnitude and Phase, measurement of S- Parameters, SWR and Impedances measurements, errors and corrections.

TEXT BOOKS:

1. 'Foundations for microwave Engineering' - R.E. Collin, McGrawhill Kogakusha,Ltd, International Student edition, 2nd Edition.
2. Microwave Engineering - David. M. Pozar 3rd Edition, John wiley & sons Inc, 1998.

REFERENCE BOOKS:

1. Microwave Circuits and Passive Devices - M.L.Sisodia, G.S.Raghuvamsi, New Age International Pub. Ltd, WEL-1995.
2. Microwave Measurements - E.I.Ginzton, Mcgraw Hill Book Comp, INC, 1957.
3. Microwave and Circuit design - Ganesh Prasad Srivastava, Vijaya Lakshmi guptha, Eastern Economy Edition, Printice Hall of India Pvt. Ltd., New Delhi-2006.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – I Sem. (MRE)

ADVANCED DIGITAL SIGNAL PROCESSING

(ELECTIVE -I)

UNIT –I:

Review of DFT, FFT, IIR Filters and FIR Filters:

Multi Rate Signal Processing: Introduction, Decimation by a factor D, Interpolation by a factor I, Sampling rate conversion by a rational factor I/D, Multistage Implementation of Sampling Rate Conversion, Filter design & Implementation for sampling rate conversion.

UNIT –II:

Applications of Multi Rate Signal Processing: Design of Phase Shifters, Interfacing of Digital Systems with Different Sampling Rates, Implementation of Narrow Band Low Pass Filters, Implementation of Digital Filter Banks, Subband Coding of Speech Signals, Quadrature Mirror Filters, Transmultiplexers, Over Sampling A/D and D/A Conversion.

UNIT -III:

Non-Parametric Methods of Power Spectral Estimation: Estimation of spectra from finite duration observation of signals, Non-parametric Methods: Bartlett, Welch & Blackman-Tukey methods, Comparison of all Non-Parametric methods.

UNIT –IV:

Implementation of Digital Filters: Introduction to filter structures (IIR & FIR), Frequency sampling structures of FIR, Lattice structures, Forward prediction error, Backward prediction error, Reflection coefficients for lattice realization, Implementation of lattice structures for IIR filters, Advantages of lattice structures.

UNIT –V:

Parametric Methods of Power Spectrum Estimation: Autocorrelation & Its Properties, Relation between auto correlation & model parameters, AR Models - Yule-Walker & Burg Methods, MA & ARMA models for power spectrum estimation, Finite word length effect in IIR digital Filters – Finite word-length effects in FFT algorithms.

TEXT BOOKS:

1. Digital Signal Processing: Principles, Algorithms & Applications - J.G.Proakis & D. G. Manolakis, 4th Ed., PHI.
2. Discrete Time signal processing - Alan V Oppenheim & Ronald W Schaffer, PHI.
3. DSP – A Practical Approach – Emmanuel C. Ifeacher, Barrie. W. Jervis, 2 ed., PE.

REFERENCE BOOKS:

1. Modern spectral Estimation: Theory & Application – S. M .Kay, 1988, PHI.
2. Multi Rate Systems and Filter Banks – P.P.Vaidyanathan – Pearson Education.
3. Digital Signal Processing – S.Salivahanan, A.Vallavaraj, C.Gnanapriya, 2000,TMH.
4. Digital Spectral Analysis – Jr. Marple.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – I Sem. (MRE)

SATELLITE COMMUNICATIONS

(ELECTIVE - I)

UNIT -I:

Communication Satellite: Orbit and Description: A Brief history of satellite Communication, Satellite Frequency Bands, Satellite Systems.

Applications, Orbital Period and Velocity, effects of Orbital Inclination, Azimuth and Elevation, Coverage angle and slant Range, Eclipse, Orbital Perturbations, Placement of a Satellite in a Geo-Stationary orbit.

UNIT -II:

Satellite Sub-Systems: Attitude and Orbit Control system, TT&C subsystem, Attitude Control subsystem, Power systems, Communication subsystems, Satellite Antenna Equipment.

Satellite Link: Basic Transmission Theory, System Noise Temperature and G/T ratio, Basic Link Analysis, Interference Analysis, Design of satellite Links for a specified C/N, (With and without frequency Re-use), Link Budget.

UNIT -III:

Propagation Effects: Introduction, Atmospheric Absorption, Cloud Attenuation, Tropospheric and Ionospeheric Scintillation and Low angle fading, Rain induced attenuation, rain induced cross polarization interference.

Multiple Access: Frequency Division Multiple Access (FDMA) - Intermodulation, Calculation of C/N, Time Division Multiple Access (TDMA) - Frame Structure, Burst Structure, Satellite Switched TDMA, On-board Processing, Demand Assignment Multiple Access (DAMA) – Types of Demand Assignment, Characteristics, CDMA Spread Spectrum Transmission and Reception.

UNIT -IV:

Earth Station Technology: Transmitters, Receivers, Antennas, Tracking Systems, Terrestrial Interface, Power Test Methods, Lower Orbit Considerations.

Satellite Navigation and Global Positioning Systems: Radio and Satellite Navigation, GPS Position Location Principles, GPS Receivers, GPS C/A Code Accuracy, Differential GPS.

UNIT -V:

Satellite Packet Communications: Message Transmission by FDMA: M/G/1 Queue, Message Transmission by TDMA, PURE ALOHA-Satellite Packet Switching, Slotted Aloha, Packet Reservation,Tree Algorithm.

TEXT BOOKS:

1. Satellite Communications –Timothy Pratt, Charles Bostian, Jeremy Allnutt, 2nd Edition, 2003, John Wiley & Sons.
2. Satellite Communications Engineering – Wilbur, L. Pritchand, Robert A. Nelson and Heuri G. Suyderhoud, 2nd Ed., Pearson Publications.
3. Digital Satellite Communications-Tri.T.Ha, 2nd Edition, 1990, Mc.Graw Hill.

REFERENCE BOOKS:

1. Satellite Communications-Dennis Roddy, 2nd Edition, 1996, McGraw Hill.
2. Satellite Communications: Design Principles – M. Richcharia, 2nd Ed., BSP, 2003.
3. Digital Satellite Communications – Tri. T. Ha, 2nd Ed., MGH, 1990.
4. Fundamentals of Satellite Communications – K. N. Raja Rao, PHI, 2004.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – I Sem. (MRE)

RADIO NAVIGATIONAL AIDS

(ELECTIVE-I)

UNIT –I:

Navigational Systems: Review of Navigational Systems: Aircraft navigational system. Geometry of the earth. Navigation equation. Navigation errors. Radio navigation system types and Performance parameters. ILS System, Hyperbolic navigation systems, Loran, Omega, Decca Radio direction finding, DME. TACAN and VORTAC.

UNIT –II:

Inertial Navigation: Inertial navigation system. Sensing instruments: Accelerometer. Gyro- copes, Analytic and Gimbaled platforms. Mechanization. Error analysis, Alignment.

UNIT –III:

Global Positioning System (GPS) for Navigation: Overview of GPS, Reference systems. Satellite orbits, Signal structure, Geometric dilution of precision (GDOP), or Precision dilution of recision (PDOP), Satellite ephemeris, Satellite clock, Ionospheric group delay. Tropospheric group delay, Multipath errors and Receiver measurement errors.

UNIT –IV:

Differential GPS and WAAS: Standard and precise positioning service local area DGPS and Wide area DGPS errors. Wide Area Augmentation System (WAAS) architecture. Link budget and Data Capacity, Ranging function, Precision approach and error estimates.

UNIT –V:

GPS Navigational Application: General applications of GPS, DGPS, Marine. Air and Land Navigation, Surveying, Mapping and Geographical information systems, Military and Space.

TEXT BOOKS:

1. Myron Kavton and Walter Friend, R. - “Avionics Navigation Systems”, Wiley,1997.
2. Parkinson. BW. Spilker - “Global Positioning System Theory and Applications”,Progress in Astronautics, Vol. I and II, 1996.

REFERENCE BOOKS:

1. Hoffman. B., Wellenhof. H. Lichtenegger and J. Collins - “GPS Theory andPractice”, Springer Verlang Wien New York, 1992.
2. Elliot D. Kaplan - “Understanding GPS Principles and Applications”, Artech House. Inc., 1996.
3. Lieck Alfred. - “GPS Satellite Surveying”, John Wiley, 1990.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – I Sem. (MRE)

RANDOM PROCESSES AND TIME SERIES ANALYSIS

(ELECTIVE –II)

UNIT -I:

Stationary Random Processes from a Probability Point of View: Probability Density and Probability Distribution Functions of a Random Variable, Expected Value of Random Variable, Markov and Chebyshev Inequalities, Computer Methods for Generating Random Variables, Multidimensional Random variables, Chi-square tests of hypotheses concerning distribution.

UNIT -II:

Random Processes Analyzed in the Time Domain: Continuous and Discrete Time, Stationarity, Auto Covariance and Auto Correlation functions, Continuity, differentiation, Integrals of Random Processes.

Some special cases: The Poisson process, the Normal (Gaussian) Process.

UNIT -III:

Random Processes Analyzed in the Frequency Domain: The Fourier Transform, Spectral Density, The Cross Power Spectral Density, Linear Systems with random input: Impulse response, Transfer function, the relation between the spectral density for the input and for the output.

UNIT- IV:

Markov Chains: Markov Processes: Discrete time Markov chains, state transition probability matrix, n-step state transition probability, transition diagrams, classification of states, limiting state probabilities, Continuous-time Markov chains, Gambler's ruin as a Markov chains.

UNIT -V:

Basic Queuing Theory: Elements of a Queueing System, Little's Formula, M/M/1, Queue- Delay Distribution in M/M/1 System, M/M/1 System with Finite Capacity, M/G/1 Queueing system- Residual Service Time, Mean Delay in M/G/1 Systems.

TEXT BOOKS:

1. Probability, Random Variables, and Random Signal Principles – Peebles, P. Z (1993)- Third edition or later – New York – McGraw-Hill.
2. Fundamentals of Applied Probability and Random Processes – Oliver C. Ibe, Elsevier, 2009.
3. Probability and Random Processes for Electrical Engineering - Alberto Leon-Garcia, 2nd Ed, Pearson.

REFERENCE BOOKS:

1. Probability, Random Variables and Stochastic Processes – Athanasios Papoulis, S. Unnikrishna Pillai – TMH, 2008.
2. Probability and Random Processes with Applications to Signal Processing – Henry Stark, John W. Woods, 3rd Edition, Pearson.
3. Probability and Stochastic Processes – A Friendly Introduction for Electrical and Computer Engineers – Roy D. Yates, David J. Goodman.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – I Sem. (MRE)

MICROWAVE INTEGRATED CIRCUITS

(ELECTIVE-II)

UNIT I

MIC Technology – Thick film and Thin film technology, Hybrid MIC's, Monolithic MIC technology.

UNIT II

Analysis of stripline and microstripline, Method of conformal Transformation, Characteristic parameters of strip, Microstrip lines, Microstrip Circuit Design, Impedance transformers, Filters, Lumped constant Microstrip circuits.

UNIT III

Coupled Microstrips and Directional couplers, Even and odd mode analysis, Theory of couled microstrip Directional couplers, Calculations for a coupled pair of Microstrips, Branch line couplers.

UNIT IV

Lumped Elements for MIC's Design and fabrication of lumped elements, circuits using lumped elements.

UNIT V

Nonreciprocal components for MIC's Microstrip on Ferrimagnetic substrates, Microstrip circulators. Isolators and phase shifters, Design of microstrip circuits – high power and low power circuits.

TEXT BOOKS:

1. Gupta KC and Amarjit Singh - Microwave Integrated circuits, Wiley Eastern, 1974.
2. Leo Young - Advances in Microwaves, Academic Press.

REFERENCE BOOK:

1. Bharathi Bhat, and S.K. Koul -"Stripline-like Transmission Lines for Microwave Integrated Circuits, New Age International, 2007.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – I Sem. (MRE)

ELECTROMAGNETIC INTERFERENCE AND ELECTROMAGNETIC COMPATIBILITY (EMI / EMC)

(ELECTIVE-II)

UNIT -I:

Introduction, Natural and Nuclear Sources of EMI / EMC: Electromagnetic environment, History, Concepts, Practical experiences and concerns, frequency spectrum conservations, An overview of EMI / EMC, Natural and Nuclear sources of EMI.

UNIT -II:

EMI from Apparatus, Circuits and Open Area Test Sites: Electromagnetic emissions, Noise from relays and switches, Non-linearities in circuits, passive intermodulation, Cross talk in transmission lines, Transients in power supply lines, Electromagnetic interference (EMI), Open area test sites and measurements.

UNIT -III:

Radiated and Conducted Interference Measurements and ESD: Anechoic chamber, TEM cell, GH TEM Cell, Characterization of conduction currents / voltages, Conducted EM noise on power lines, Conducted EMI from equipment, Immunity to conducted EMI detectors and measurements, ESD, Electrical fast transients / bursts, Electrical surges.

UNIT -IV:

Grounding, Shielding, Bonding and EMI filters: Principles and types of grounding, Shielding and bonding, Characterization of filters, Power lines filter design.

UNIT -V:

Cables, Connectors, Components and EMC Standards: EMI suppression cables, EMC connectors, EMC gaskets, Isolation transformers, optoisolators, National / International EMC standards.

TEXT BOOKS:

1. Engineering Electromagnetic Compatibility - Dr. V.P. Kodali, IEEEPublication, Printed in India by S. Chand & Co. Ltd., New Delhi, 2000.
2. Electromagnetic Interference and Compatibility IMPACT series, IIT – Delhi, Modules 1 – 9.

REFERENCE BOOK:

1. Introduction to Electromagnetic Compatibility - Ny, John Wiley, 1992, by C.R. Pal.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – I Sem. (MRE)

MICROWAVE MEASUREMENTS LABORATORY

Section -A

1. Microwave source characteristics-Reflex Klystron and Gunn oscillator.
2. Waveguide Discontinuities-Inductive and capacitive Diaphragms.
3. Slide Screw Tuner-Equivalent circuit.
4. S-matrix of Directional Coupler, Circulator, Magic Tee.
5. Gain measurement of 1) Pyramidal Horn, 2) Conical Horn antennas.
6. Pattern Measurement of 1. Pyramidal Horn, 2. Conical Horn antennas.
6. Characterization of Waveguide Slotted Array.
7. Frequency Scanned Array Characteristics.
8. Measurement of Input Impedance of an Antenna.
9. Measurements with Network Analyzer.

Section –B

The above Experiments are to be conducted preferably using X-band setup.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – II Sem. (MRE)

MICROWAVE NETWORKS

UNIT –I:

Introduction to Microwave Circuit Concept:

One port junction, Terminal voltage and currents in multipart junctions, Poynting's energy theorem, Normalized waves and scattering matrix. Properties of [s]matrix.

UNIT –II:

Relationship between [s], [z] and [y] Parameters:

Wave amplitude transmission matrix[A], Relation between [A] and [s], [s] matrix of magic T, E and H plane tees, Directionl coupler, Applications of hybrid junction and magic tee.

UNIT –III:

Passive Microwave Devices:

Even and odd mode analysis of symmetrical 4 port networks, Analysis and design of branch line couplers, Hybrid ring coupler, Frequency response, Branching synthesis of hybrids, Applications of hybrids.

UNIT –IV:

Microwave Propagation in Ferrites:

Principles of Faraday rotation, Isolator, Gyrator, Circulator, Phase shifters, S-matrix of non reciprocal devices, Broad band matching multisection quarter wave transformers, Binomial and chebshev transformers design, Tapered transmission line exponential and triangular tapers, Synthesis of transmission line tapers.

UNIT –V:

Wave Analysis of Periodic Structures:

Image parameters method of micro wave filter design, Power loss ratio, Filter design by insertion loss method, Frequency transformation maximally flat and chebyshev filter design and characteristics.

TEXT BOOKS:

1. Altmen JL -Microwave circuit, D van Nostrand Co.,Inc.,1964.
2. Collins. RE - Foundations for microwave engineering, John Wiley & Sons, inc 2nd Edn, 2009.

REFERENCE BOOKS:

1. Ghosh.RN - Microwave Circuit Theory and Analysis, McGrew Hill.
2. Pozer.D M - Microwave Engineering, 2nd Edn., John Wiley and Sons, Inc.,1999.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – II Sem. (MRE)

RADAR SIGNAL PROCESSING

(ELECTIVE - II)

UNIT-I:

Introduction:

Radar Block Diagram, Radar Equation, Information Available from Radar Echo, Review of Radar Range Performance– General Radar Range Equation, Radar Detection with Noise Jamming, Beacon and Repeater Equations, Bistatic Radar.

Matched Filter Receiver – Impulse Response, Frequency Response Characteristic and its Derivation, Matched Filter and Correlation Function, Correlation Detection and Cross-Correlation Receiver, Efficiency of Non-Matched Filters, Matched Filter for Non-White Noise.

UNIT –II:

Detection of Radar Signals in Noise:

Detection Criteria – Neyman-Pearson Observer, Likelihood-Ratio Receiver, Inverse Probability Receiver, Sequential Observer, Detectors – Envelope Detector, Logarithmic Detector, I/Q Detector. Automatic Detection - CFAR Receiver, Cell Averaging CFAR Receiver, CFAR Loss, CFAR Uses in Radar, Radar Signal Management – Schematics, Component Parts, Resources and Constraints.

UNIT –III:

Waveform Selection [3, 2]:

Radar Ambiguity Function and Ambiguity Diagram – Principles and Properties; Specific Cases – Ideal Case, Single Pulse of Sine Wave, Periodic Pulse Train, Single Linear FM Pulse, Noiselike Waveforms, Waveform Design Requirements, Optimum Waveforms for Detection in Clutter, Family of Radar Waveforms.

UNIT –IV:

Pulse Compression in Radar Signals:

Introduction, Significance, Types. Linear FM Pulse Compression – Block Diagram, Characteristics, Reduction of Time Sidelobes, Stretch Techniques, Generation and Decoding of FM Waveforms – Block Schematic and Characteristics of Passive System, Digital Compression, SAW Pulse Compression.

UNIT –V:

Phase Coding Techniques:

Principles, Binary Phase Coding, Barker Codes, Maximal Length Sequences (MLS/LRS/PN), Block Diagram of a Phase Coded CW Radar.

Poly Phase Codes: Frank Codes, Costas Codes, Non-Linear FM Pulse Compression, Doppler Tolerant PC Waveforms – Short Pulse, Linear Period Modulation (LPM/HFM). Sidelobe Reduction for Phase Coded PC Signals.

TEXT BOOKS:

1. Radar Handbook - M.I. Skolnik, 2nd Ed., 1991, McGraw Hill.
2. Radar Design Principles: Signal Processing and The Environment - Fred E. Nathanson, 2nd Ed., 1999, PHI.
3. Introduction to Radar Systems - M.I. Skolnik, 3rd Ed., 2001, TMH.

REFERENCE BOOKS:

1. Radar Principles - Peyton Z. Peebles, Jr., 2004, John Wiley.
2. Radar Signal Processing and Adaptive Systems - R. Nitzberg, 1999, Artech House.
3. Radar Design Principles - F.E. Nathanson, 1st Ed., 1969, McGraw Hill.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – II Sem. (MRE)

MICROWAVE SOLID STATE DEVICES

UNIT –I:

Varactor Diode: Equivalent circuit, static and dynamic figures of merit Manley Rowe power relation, Parametric amplifiers, Up converter, Degeneration amplifiers, Varactor multipliers, Charge storage capacitance.

UNIT –II:

Tunnel Diode: Equivalent circuit, Tunnel diode stability, Tunnel diode amplifiers, Gunn devices: Volt amp. Characteristics, Small signal, Nonlinear, large signal theory, Modes of operation of Gunn diode, Gunn amplifiers-Gunn oscillators, Avalanche transit time MW diodes. Small signal theory, Large signal operation, Noise.

UNIT –III:

PIN Diodes: Description, the I-layer, Equivalent circuit behavior under reverse bias and forward bias, Diode impedance, Materials, Applications.

UNIT –IV;

Schottky Barrier Diode: Physics of Schottky barriers, Design of and performance of Schottky barrier diode applications, IMPATT & TRAPATT diodes: Principles and applications as amplifiers and oscillators.

UNIT –V:

Microwave Transistor: Wafer design. Equivalent circuit, Design compromises, Package design.

TEXT BOOKS:

1. Watson - “Microwave Semiconductor Devices and their applications”, McGraw Hill, 1969.
2. Sze. S.M, and Kwok K. Ng - “Physics of Semiconductor Devices”, John Weiley-3rd Edition 2007.

REFERENCE BOOK:

1. Shurmer,H.V - “Microwave Semiconductors”, Wien Oldenbourg,1971.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – II Sem. (MRE)

PHASED ARRAY SYSTEMS

UNIT –I:

Conventional Scanning Techniques: Mechanical versus electronic scanning, Techniques of Electronic scanning, Frequency, Phase and time delay scanning principle, Hybrid scanning techniques.

UNIT –II:

Array Theory:

Linear and Planner arrays, various grid configuration, Concept of cell and grid, Calculation of minimum number of elements, Radiation pattern, Grating lobe formation, Rectangular and triangular grid design of arrays.

UNIT –III:

Feed Networks for phased Arrays: Corporate Feed, Lens and Reflect feed.

Techniques, Optimum f/d ratio basic building block for corporate feed network, Series, Parallel feed networks, Comparison of various feeding techniques, Antenna Array Architecture, Brick/ Tile Type construction.

UNIT –IV:

Frequency Scanned Array Design: Snake feed, Frequency-phase scanning, Phase scanning, Digital phase shifter PIN diode and Ferrite phase shifters for phased arrays, Beam pointing errors due to digitalization, Beam pointing accuracy.

UNIT –V:

Search Patterns: Calculation of search frame time, airborne phased array design, Electronic scanning radar parameter calculation, Application of phased arrays, Phased Array Radar Systems, Active Phased Array, TR/ATR Modules.

TEXT BOOKS:

1. Olliner, A.A, and G.H. Knittel - Phased Array Antennas, Artech House, 1972.
2. Kahrilas. PJ - Electronic Scanning Radar Systems Design Handbook, Artech House, 1976.

REFERENCE BOOKS:

1. Skolnik. MI- Radar Handbook, Mcgraw Hillso, NY,McGrow Hills-2007.
2. Galati,G-(editor) - Advanced Radar Technique and Systems, Peter Peregrims Ltd, London, 1993.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – II Sem. (MRE)

RF CIRCUIT DESIGN

(ELECTIVE-III)

UNIT -I:

Introduction to RF Electronics: The Electromagnetic Spectrum, units and Physical Constants, Microwave bands – RF behavior of Passive components: Tuned resonant circuits, Vectors, Inductors and Capacitors - Voltage and Current in capacitor circuits – Tuned RF / IF Transformers.

UNIT -II:

Transmission Line Analysis: Examples of transmission lines- Transmission line equations and Biasing- Micro Strip Transmission Lines- Special Termination Conditions- sourced and Loaded Transmission Lines.

Single And Multiport Networks: The Smith Chart, Interconnectivity networks, Network properties and Applications, Scattering Parameters.

UNIT- III:

Matching and Biasing Networks: Impedance matching using discrete components – Micro strip line matching networks, Amplifier classes of Operation and Biasing networks.

RF Passive & Active Components: Filter Basics – Lumped filter design – Distributed Filter Design – Diplexer Filters- Crystal and Saw filters- Active Filters - Tunable filters – Power Combiners / Dividers – Directional Couplers – Hybrid Couplers – Isolators. RF Diodes, BJTs, FETs, HEMTs and Models.

UNIT -IV:

RF Transistor Amplifier Design: Characteristics of Amplifiers - Amplifier Circuit Configurations, Amplifier Matching Basics, Distortion and noise products, Stability Considerations, Small Signal amplifier design, Power amplifier design, MMIC amplifiers, Broadband High Power multistage amplifiers, Low noise amplifiers, VGA Amplifiers.

UNIT -V:

Oscillators: Oscillator basics, Low phase noise oscillator design, High frequency Oscillator configuration, LC Oscillators, VCOs, Crystal Oscillators, PLL Synthesizer, and Direct Digital Synthesizer.

RF Mixers: Basic characteristics of a mixer, Active mixers, Image Reject and Harmonic mixers, Frequency domain considerations.

TEXT BOOKS:

1. RF Circuit design: Theory and applications - Reinhold Ludwing, Pavel Bretchko, Pearson Education Asia Publication, New Delhi 2001.
2. Radio Frequency and Microwave Communication Circuits – Analysis and Design – Devendra K. Misra, Wiley Student Edition, John Wiley & Sons.

REFERENCE BOOKS:

1. Radio Frequency And Microwave Electronics Illustrated Mathew M.Radmangh, 2001, PE Asia Publication.
2. RF Circuit Design – Christopher Bowick, Cheryl Aljuni and John Biyler, Elsevier Science, 2008.
3. Secrets of RF Design - Joseph Carr., 3rd Edition, Tab Electronics.
4. Complete Wireless Design - Cotter W. Sawyer, 2nd Edition, Mc-Graw Hill.
5. Practical RF Circuit Design for Modem Wireless Systems Vol.2 - Less Besser and Rowan Gilmore.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – II Sem. (MRE)

SOFTWARE RADIO

(ELECTIVE-III)

UNIT -I:

Introduction:

The Need for Software Radios, What is Software Radio, Characteristics and benefits of software radio- Design Principles of Software Radio, RF Implementation issues- The Purpose of RF Front – End, Dynamic Range- The Principal Challenge of Receiver Design – RF Receiver Front- End Topologies- Enhanced Flexibility of the RF Chain with Software Radios- Importance of the Components to Overall Performance- Transmitter Architectures and Their Issues- Noise and Distortion in the RF Chain, ADC and DAC Distortion.

UNIT -II:

Multi Rate Signal Processing:

Introduction- Sample Rate Conversion Principles- Polyphase Filters- Digital Filter Banks- Timing Recovery in Digital Receivers Using Multirate Digital Filters.

Digital Generation of Signals:

Introduction- Comparison of Direct Digital Synthesis with Analog Signal Synthesis- Approaches to Direct Digital Synthesis- Analysis of Spurious Signals- Spurious Components due to Periodic jitter- Band Pass Signal Generation- Performance of Direct Digital Synthesis Systems- Hybrid DDS-PLL Systems- Applications of direct Digital Synthesis- Generation of Random Sequences- ROM Compression Techniques.

UNIT -III:

Analog to Digital and Digital to Analog Conversion:

Parameters of ideal data converters- Parameters of Practical data converters- Analog to Digital and Digital to Analog Conversion- Techniques to improve data converter performance- Common ADC and DAC architectures.

UNIT -IV:

Digital Hardware Choices:

Introduction- Key Hardware Elements- DSP Processors- Field Programmable Gate Arrays- Trade-Offs in Using DSPs, FPGAs, and ASICs- Power Management Issues- Using a Combination of DSPs, FPGAs, and ASICs.

UNIT -V:

Object – Oriented Representation of Radios and Network Resources:

Networks- Object Oriented Programming- Object Brokers- Mobile Application Environments- Joint Tactical Radio System.

Case Studies in Software Radio Design: Introduction and Historical Perspective, SPEAK easy- JTRS, Wireless Information Transfer System, SDR-3000 Digital Transceiver Subsystem, Spectrum Ware, CHARIOT.

TEXT BOOKS:

1. Software Radio: A Modern Approach to Radio Engineering - Jeffrey H. Reed, 2002, PEA Publication.
2. Software Defined Radio: Enabling Technologies- Walter Tuttle Bee, 2002, Wiley Publications.

REFERENCE BOOKS:

1. Software Defined Radio for 3G - Paul Burns, 2002, Artech House.

2. Software Defined Radio: Architectures, Systems and Functions - Markus Dillinger, Kambiz Madani, Nancy Alonistioti, 2003, Wiley.
3. Software Radio Architecture: Object Oriented Approaches to wireless System Enginering – Joseph Mitola, III, 2000, John Wiley & Sons.
4. R.F Microelectronics – B. Razavi, 1998, PHI.
5. DSP – A Computer Based Approach – S. K. Mithra, 1998, McGraw-Hill.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – II Sem. (MRE)

OPTICAL COMMUNICATIONS TECHNOLOGY

(ELECTIVE-III)

UNIT –I:

Signal propagation in Optical Fibers: Geometrical Optics approach and Wave Theory approach, Loss and Bandwidth, Chromatic Dispersion, Non Linear effects- Stimulated Brillouin and Stimulated Raman Scattering, Propagation in a Non-Linear Medium, Self Phase Modulation and Cross Phase Modulation, Four Wave Mixing, Principle of Solitons.

UNIT –II:

Fiber Optic Components for Communication & Networking: Couplers, Isolators and Circulators, Multiplexers, Bragg Gratings, Fabry-Perot Filters, Mach Zender Interferometers, Arrayed Waveguide Grating, Tunable Filters, High Channel Count Multiplexer Architectures, Optical Amplifiers, Direct and External Modulation Transmitters, Pump Sources for Amplifiers, Optical Switches and Wavelength Converters.

UNIT –III:

Modulation and Demodulation: Signal formats for Modulation, Subcarrier Modulation and Multiplexing, Optical Modulations – Duobinary, Single Side Band and Multilevel Schemes, Ideal and Practical receivers for Demodulation, Bit Error Rates, Timing Recovery and Equalization, Reed-Solomon Codes for Error Detection and Correction.

UNIT -IV:

Transmission System Engineering : System Model, Power Penalty in Transmitter and Receiver, Optical Amplifiers, Crosstalk and Reduction of Crosstalk, Cascaded Filters, Dispersion Limitations and Compensation Techniques.

UNIT –V:

Fiber Non-Linearities and System Design Considerations : Limitation in High Speed and WDM Systems due to Non-linearities in Fibers, Wavelength Stabilization against Temperature Variations, Overall System Design considerations – Fiber Dispersion, Modulation, Non-Linear Effects, Wavelengths, All Optical Networks.

TEXT BOOKS:

1. Optical Networks: A Practical Perspective - Rajiv Ramaswami and Kumar N. Sivarajan, 2nd Ed., 2004, Elsevier Morgan Kaufmann Publishers (An Imprint of Elsevier).
2. Optical Fiber Communications – Gerd Keiser, 3rd Ed., 2000, McGraw Hill.

REFERENCE BOOKS:

1. Optical Fiber Communications: Principles and Practice – John.M.Senior, 2nd Ed., 2000, PE.
2. Fiber Optics Communication – Harold Kolimbris, 2nd Ed., 2004, PEI.
3. Optical Networks: Third Generation Transport Systems – Uyless Black, 2nd Ed., 2009, PEI.
4. Optical Fiber Communications – Govind Agarwal, 2nd Ed., 2004, TMH.
5. Optical Fiber Communications and Its Applications – S.C.Gupta, 2004, PHI.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – II Sem. (MRE)

SMART ANTENNAS

(ELECTIVE-IV)

UNIT -I:

Smart Antennas: Introduction, Need for Smart Antennas, Overview, Smart Antenna Configurations, Switched-Beam Antennas, Adaptive Antenna Approach, Space Division Multiple Access (SDMA), Architecture of a Smart Antenna System, Receiver, Transmitter, Benefits and Drawbacks, Basic Principles, Mutual Coupling Effects.

UNIT -II:

DOA Estimation Fundamentals: Introduction, Array Response Vector, Received Signal Model, Subspace-Based Data Model, Signal Autocovariance, Conventional DOA Estimation Methods, Conventional Beamforming Method, Capon's Minimum Variance Method, Subspace Approach to DOA Estimation, MUSIC Algorithm, ESPRIT Algorithm, Uniqueness of DOA Estimates.

UNIT -III:

Beam Forming Fundamentals: Classical Beam former, Statistically Optimum Beamforming Weight Vectors, Maximum SNR Beam former, Multiple Sidelobe Canceller and Maximum, SINR Beam former, Minimum Mean Square Error (MMSE), Direct Matrix Inversion (DMI), Linearly Constrained Minimum Variance (LCMV), Adaptive Algorithms for Beamforming.

UNIT -IV:

Integration and Simulation of Smart Antennas: Overview, Antenna Design, Mutual Coupling, Adaptive Signal Processing Algorithms, DOA, Adaptive Beam forming, Beam forming and Diversity Combining for Rayleigh-Fading, Channel, Trellis-Coded Modulation (TCM) for Adaptive Arrays, Smart Antenna Systems for Mobile Ad Hoc Networks (MANETs), Protocol, Simulations, Discussion.

UNIT -V:

Space–Time Processing: Introduction, Discrete Space–Time Channel and Signal Models, Space–Time Beamforming, Intersymbol and Co-Channel Suppression, Space–Time Processing for DS-CDMA, Capacity and Data Rates in MIMO Systems, Discussion.

TEXT BOOKS:

1. 'Introduction to Smart Antennas' - Constantine A. Balanis & Panayiotis I. Ioannides, Morgan & Claypool Publishers' series-2007.
2. Joseph C. Liberti Jr., Theodore S Rappaport - "Smart Antennas for Wireless Communications IS-95 and Third Generation CDMA Applications", PTR – PH publishers, 1st Edition, 1989.

REFERENCE BOOKS:

1. T.S Rappaport - "Smart Antennas Adaptive Arrays Algorithms and Wireless Position Location", IEEE press 1998, PTR – PH publishers 1999.
2. Smart Antennas - Lal Chand Godara, CRC Press, LLC-2004.

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DETECTION AND ESTIMATION THEORY

(ELECTIVE - IV)

UNIT –I:

Random Processes: Discrete Linear Models, Markov Sequences and Processes, Point Processes, and Gaussian Processes.

UNIT –II:

Detection Theory: Basic Detection Problem, Maximum A posteriori Decision Rule, Minimum Probability of Error Classifier, Bayes Decision Rule, Multiple-Class Problem (Bayes)- minimum probability error with and without equal a priori probabilities, Neyman-Pearson Classifier, General Calculation of Probability of Error, General Gaussian Problem, Composite Hypotheses.

UNIT –III:

Linear Minimum Mean-Square Error Filtering: Linear Minimum Mean Squared Error Estimators, Nonlinear Minimum Mean Squared Error Estimators. Innovations, Digital Wiener Filters with Stored Data, Real-time Digital Wiener Filters, Kalman Filters.

UNIT –IV:

Statistics: Measurements, Nonparametric Estimators of Probability Distribution and Density Functions, Point Estimators of Parameters, Measures of the Quality of Estimators, Introduction to Interval Estimates, Distribution of Estimators, Tests of Hypotheses, Simple Linear Regression, Multiple Linear Regression.

UNIT –V:

Estimating the Parameters of Random Processes from Data: Tests for Stationarity and Ergodicity, Model-free Estimation, Model-based Estimation of Autocorrelation Functions, Power Special Density Functions.

TEXT BOOKS:

1. Random Signals: Detection, Estimation and Data Analysis - K. Sam Shanmugan & A.M. Breipohl, Wiley India Pvt. Ltd, 2011.
2. Random Processes: Filtering, Estimation and Detection - Lonnie C. Ludeman, Wiley India Pvt. Ltd., 2010.

REFERENCE BOOKS:

1. Fundamentals of Statistical Signal Processing: Volume I Estimation Theory– Steven.M.Kay, Prentice Hall, USA, 1998.
2. Fundamentals of Statistical Signal Processing: Volume I Detection Theory– Steven.M.Kay, Prentice Hall, USA, 1998.
3. Introduction to Statistical Signal Processing with Applications - Srinath, Rajasekaran, Viswanathan, 2003, PHI.
4. Statistical Signal Processing: Detection, Estimation and Time Series Analysis – Louis L.Scharf, 1991, Addison Wesley.
5. Detection, Estimation and Modulation Theory: Part – I – Harry L. Van Trees, 2001, John Wiley & Sons, USA.
6. Signal Processing: Discrete Spectral Analysis – Detection & Estimation – Mischa Schwartz, Leonard Shaw, 1975, Mc Graw Hill.

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WIRELESS COMMUNICATIONS AND NETWORKS

(ELECTIVE-IV)

UNIT -I:

The Cellular Concept-System Design Fundamentals: Introduction, Frequency Reuse, Channel Assignment Strategies, Handoff Strategies- Prioritizing Handoffs, Practical Handoff Considerations, Interference and system capacity – Co channel Interference and system capacity, Channel planning for Wireless Systems, Adjacent Channel interference , Power Control for Reducing interference, Trunking and Grade of Service, Improving Coverage & Capacity in Cellular Systems- Cell Splitting, Sectoring .

UNIT –II:

Mobile Radio Propagation: Large-Scale Path Loss: Introduction to Radio Wave Propagation, Free Space Propagation Model, Relating Power to Electric Field, The Three Basic Propagation Mechanisms, Reflection-Reflection from Dielectrics, Brewster Angle, Reflection from prefect conductors, Ground Reflection (Two-Ray) Model, Diffraction-Fresnel Zone Geometry, Knife-edge Diffraction Model, Multiple knife-edge Diffraction, Scattering, Outdoor Propagation Models- Longley-Ryce Model, Okumura Model, Hata Model, PCS Extension to Hata Model, Walfisch and Bertoni Model, Wideband PCS Microcell Model, Indoor Propagation Models-Partition losses (Same Floor), Partition losses between Floors, Log-distance path loss model, Ericsson Multiple Breakpoint Model, Attenuation Factor Model, Signal penetration into buildings, Ray Tracing and Site Specific Modeling.

UNIT –III:

Mobile Radio Propagation: Small –Scale Fading and Multipath: Small Scale Multipath propagation-Factors influencing small scale fading, Doppler shift, Impulse Response Model of a multipath channel-Relationship between Bandwidth and Received power, Small-Scale Multipath Measurements-Direct RF Pulse System, Spread Spectrum Sliding Correlator Channel Sounding, Frequency Domain Channels Sounding, Parameters of Mobile Multipath Channels-Time Dispersion Parameters, Coherence Bandwidth, Doppler Spread and Coherence Time, Types of Small-Scale Fading-Fading effects Due to Multipath Time Delay Spread, Flat fading, Frequency selective fading, Fading effects Due to Doppler Spread-Fast fading, slow fading, Statistical Models for multipath Fading Channels-Clarke's model for flat fading, spectral shape due to Doppler spread in Clarke's model, Simulation of Clarke and Gans Fading Model, Level crossing and fading statistics, Two-ray Rayleigh Fading Model.

UNIT -IV:

Equalization and Diversity: Introduction, Fundamentals of Equalization, Training A Generic Adaptive Equalizer, Equalizers in a communication Receiver, Linear Equalizers, Non linear Equalization-Decision Feedback Equalization (DFE), Maximum Likelihood Sequence Estimation (MLSE) Equalizer, Algorithms for adaptive equalization-Zero Forcing Algorithm, Least Mean Square Algorithm, Recursive least squares algorithm. Diversity Techniques-Derivation of selection Diversity improvement, Derivation of Maximal Ratio Combining improvement, Practical Space Diversity Consideration-Selection Diversity, Feedback or Scanning Diversity, Maximal Ratio Combining, Equal Gain Combining, Polarization Diversity, Frequency Diversity, Time Diversity, RAKE Receiver.

UNIT -V:

Wireless Networks: Introduction to wireless Networks, Advantages and disadvantages of Wireless Local Area Networks, WLAN Topologies, WLAN Standard IEEE 802.11,IEEE 802.11 Medium Access Control,

Comparison of IEEE 802.11 a, b, g and n standards, IEEE 802.16 and its enhancements, Wireless PANs, Hiper Lan, WLL.

TEXT BOOKS:

1. Wireless Communications, Principles, Practice – Theodore, S. Rappaport, 2nd Ed., 2002, PHI.
2. Wireless Communications-Andrea Goldsmith, 2005 Cambridge University Press.
3. Mobile Cellular Communication – Gottapu Sasibhushana Rao, Pearson Education, 2012.

REFERENCE BOOKS:

1. Principles of Wireless Networks – Kaveh Pah Laven and P. Krishna Murthy, 2002, PE.
2. Wireless Digital Communications – Kamilo Feher, 1999, PHI.
3. Wireless Communication and Networking – William Stallings, 2003, PHI.
4. Wireless Communication – Upen Dalal, Oxford Univ. Press.
5. Wireless Communications and Networking – Vijay K. Gary, Elsevier.

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ANTENNAS AND SIMULATION LABORATORY

SECTION –A

Design and testing of microwave Antennas operations:

1. Pyramidal Horn- Antenna
2. Conical Horn –Antenna
3. Rectangular Microstrip patch Antenna
4. Circular Microstrip patch Antenna
5. Microstrip Monopole Antenna.

SECTION –B

Software Simulation (using HFSS/IE3D/FEKO or Equivalent) and Testing of:

1. Rectangular Microstrip Antenna, Circular Microstrip antenna.
2. Micro strip Monopole
3. Microstrip Tee
4. Cylindrical Horn antenna, Pyramidal Horn antenna
5. Microstrip Filters
6. Microstrip power Dividers, Passive Components
7. Radar Signals