PRASAD V POTLURI SIDDHARTHA INSTITUTE OF TECHNOLOGY

AICTE Approved, Autonomous, NBA& NAAC A^{+} Accredited, an ISO 9001:2015 certified Institute

Permanently Affiliated to JNTUK, Kakinada

Kanuru, Vijayawada- 520 007

Andhra Pradesh

Department of Electronics & Communication Engineering

Academic Regulations
&
Syllabus (PVP 22)
M.Tech.Two Year Degree Programme
Microwave and Communication Engineering

Sponsored by

Siddhartha Academy of General& Technical Education

Vijayawada-520010

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(Autonomous)

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Academic Regulations for Two Year M. Tech. Programme (PVP 22)

(w.e.f. the Academic Year 2022-23)

(Common to all Programmes)

CONTENTS

1. Introduction

Academic Programmes of the Institute are governed by rules and regulations approved by the Academic Council, which is the highest Academic body of the Institute. These academic rules and regulations are effective from the academic year 2022-23 for students admitted into two year postgraduate programme offered by the Institute leading to Master of Technology (M.Tech.) in various specializations offered by respective departments as given in Table 1.

2. Programmes Offered

Currently, the Institute is offering M.Tech. Programmes in the following disciplines:

Table 1: List of Specializations

Sl. No.	Specialization	Offering Department
1	Microwave & Communication Engineering	Electronics and Communication Engineering
2	Machine Design	Mechanical Engineering

3. Duration of the Programme

The duration of the programme is two academic years consisting of four semesters. A student is permitted to complete the M.Tech. programme in a stipulated time frame of 4 years from the date of admission. Otherwise they shall forfeit their seat in M.Tech. programme and their admission shall stand cancelled.

4. Minimum Instruction Days

Each semester normally consists of a minimum of 90 instruction days.

5. Eligibility Criteria for Admission

The eligibility criteria for admission into M.Tech. programme shall be as per the guidelines of Andhra Pradesh State Council of Higher Education (APSCHE) & AICTE from time to time.

6. Registration

A student shall register for courses in each semester at the beginning of every semester according to the choice provided and courses offered by the concerned department.

7. Medium of Instruction

The medium of instruction and examination is English.

8. Programme Structure

Every specialization of M.Tech. programme shall have theory courses and practical courses along with Term Paper/ Mini project/ Seminar in the first and second semesters.

Pedagogy training / Industrial training shall be for a period of 4 weeks at the beginning of third semester followed by a Dissertation in third and fourth semesters.

8.1 Course Code and Course Numbering Scheme

Course Code consists of 9/10 characters which is specified by Regulation, department, programme, semester number, type of course, course number & elective code. The details are described in Tables 2, 3, 4 & Figure-1.

Table 2: Third and Fourth Characters description

Characters	Name of the Department
EC	Electronics & Communication Engineering
ME	Mechanical Engineering

Table 3: Fifth and Sixth Characters description

Characters	Name of the Programme
MC	Microwave & Communication Engineering
MD	Machine Design

Table 4: Course Type description

Course Type Character	Description
T	Theory course
L	Laboratory /Practice course
TR	Pedagogy training/ Industrial training
DS-A	Dissertation Part-A
DS-B	Dissertation Part-B

For example, the annotation of the course **22ECMC1T5A is** as given in Figure-1below.

2	**2**	**E**	**C**	**M**	**C**	**1**	**T**	**5**	**A**
Year of Framing the Regulations		Department Code		Specialization code		Semester number	Course type	Course number	Code for Elective courses

Figure – 1: Course code description

8.2 Contact Hours and Credits

The Course Credits are broadly fixed based on the following norms.

- Theory – One Lecture period is assigned 1 credit
- Laboratory – Three periods are assigned 2 credits and two periods are assigned 1 credit
- Mini project /Term Paper/Seminar is assigned 2 credits
- Pedagogy training/Industrial training is conducted for four weeks and is assigned 2 credits
- Dissertation is assigned 16 credits

- However, some courses are prescribed with fixed number of credits depending on the complexity of the subject and relative importance.

8.3 Theory classes

Each course is prescribed with fixed number of lecture periods per week. During lecture periods, the course instructor shall deal with the concepts of the course.

8.4 Laboratory Courses

A minimum prescribed number of experiments/ programs have to be performed by the students, who shall complete these in all respects and get each experiment evaluated by course instructor concerned and certified by the Head of the Department concerned at the end of the semester.

8.5 Programme Credits

Each discipline of the M.Tech. programme is designed to have a total of 74 credits and the student shall have to register for all the courses prescribed in the curriculum and secure all 74 credits for award of the degree.

9. Syllabus

As approved by the BOS of concerned department and ratified by Academic Council.

10. Eligibility Requirement for Appearing at Semester End Examination and Condonation

10.1 A candidate shall be deemed to have eligibility to write his end semester examinations if he has put in at least 75% of attendance in all the courses in that semester, which is computed by totalling the number of periods of lectures, practical courses and Dissertation (as the case may be), held in that semester with the total number of periods attended by the student in all the courses put together.

10.2 Condonation of shortage in attendance may be recommended by respective Heads of Departments on genuine medical grounds, provided the student puts in at least 65% attendance as calculated above and provided the Principal is satisfied with the genuineness of the reasons and the conduct of the student.

10.3 Students, having shortage of attendance percentage less than 75 and greater than or equal to 65, shall have to pay requisite fee towards condonation.

10.4 A student who gets less than 65% attendance in that semester shall not be permitted to take the end semester examinations. His registration for those courses in that semester will be cancelled. The student shall re register for that semester and repeat those courses of that semester as and when they are offered next.

10.5 The candidate should secure a minimum of 50% aggregate marks in internal examinations conducted for theory and laboratory courses in that semester, to be eligible to write semester end examinations.

10.6 A student, who does not satisfy the attendance and/or internal marks requirement, shall have to repeat that semester.

11. Examinations and Scheme of Evaluation

11.1 Internal Examinations:

11.1.1 Theory Courses

Each course is evaluated for 4**0** marks (a+b)

a) Two mid- term examinations each for 30 marks will be conducted for 90 minutes duration in every theory course in a semester. The First mid examination will be conducted in Units 1 & 2 of the syllabus, and the second mid examination will be conducted in Units 3 & 4 of the syllabus. The mid examination marks shall be awarded by calculating the average of the marks secured in the two mid- term examinations.

There shall be two questions from each unit of syllabus prescribed. Any one question from each unit has to be answered. Each question carries 15 marks.

b) Two home assignments each for 10 marks are to be conducted for each course after completion of First & Third units of Syllabus. The assignment marks shall be awarded by calculating the average of the marks secured in the two Assignments.

Students shall be informed regarding the home assignment and they have to submit the completed assignment within the prescribed period.

NOTE: A student who is absent for any Mid Term Exam or non-submission of assignment, for any reason whatsoever, shall be deemed to have scored zero marks in that Exam/ Assignment.

11.1.2 Laboratory Courses:

For Laboratory courses there shall be continuous evaluation during the semester for 25 internal marks. The distribution of internal marks is given below:

Criteria	Marks
Day to Day work	10
Record	05
Internal Examination	10

11.1.3 Term Paper/ Mini Project/ Seminar:

Two internal reviews are to be conducted for Term Paper/ Mini Project/ Seminar. The distribution of internal marks is given below:

Criteria	Marks
Review -1	10
Review -2 & Viva – Voce	15

11.2 Semester End Examinations

11.2.1 Theory Courses: 60 marks

- The Semester end examinations shall be conducted for 3 hours duration at the end of the semester. The question paper shall be given in the following pattern:
  Each course shall consist of four units of syllabus. There shall be two questions from each unit of syllabus prescribed. Any one question from each unit has to be answered. Each question carries 15 marks.

11.2.2 Laboratory Courses **50 marks**

- 40marks are allotted for experiments &10marks are allotted for viva-voce examination.
- Each Semester-end Laboratory Examination shall be evaluated by an External Examiner along with an Internal Examiner.

11.2.3 Term Paper/ Mini Project/ Seminar

The distribution of Semester end examination marks are given below.

Criteria	Marks
Report	30
Seminar & Viva – Voce	20

11.2.4 Pedagogy training/ Industrial training

- Pedagogy training shall be for a period of at least 4 weeks and evaluation shall be totally internal for 75 marks based on the performance during the training.
- Industrial training shall be for a period of at least 4 weeks and a report has to be submitted by the end of the third semester. The assessment shall be carried out for 75 marks during fourth semester by an internal evaluation committee comprising Head of the Department and two faculty of the department including the project supervisor.

11.2.5 MOOCS

- MOOCS Course can be chosen either from the listed electives III or IV as the case may be, or can be chosen by the student from other sources without having a conflict with the already offered courses of the programme.

- The course will be finalized by a committee constituted at the Department level.
- A mentor has to be identified in the department who would monitor the MOOCS course work from time to time and submit interim reports to the HOD duly signed by the mentor and the student.
- The duration of the course must be within 40-60 contact hours.
- Apart from the online certification the student would be evaluated for 40 marks for internals and 60 marks for external examination.
- The MOOCS course has to be completed as per the academic calendar for the concerned semester.

11.2.6 Dissertation

Dissertation shall be for a period of at least 40 weeks. There shall be two parts for evaluation:

Part-A: A Status report has to be submitted by the end of third semester which shall be evaluated for 50 marks by the Project Review Committee (PRC)based on the presentation made by student on the topic selected, literature survey and the progress of the work.

Part-B: The Project assessment shall be further carried out for 150 marks during fourth semester by an internal & external evaluation committee comprising Head of the Department, Project Supervisor and an External Examiner appointed by the Principal.

Evaluation of Dissertation Work

Every candidate shall be required to submit the dissertation after taking up a topic approved by the PRC.

a) The PRC shall be constituted with the Head of the Department as the Chairman and two senior faculty as Members along with the supervisor to oversee the proceedings of the dissertation work from allotment of topic to submission.

b) Registration of Dissertation Work: A candidate shall register for the Dissertation work in the beginning of the second year. The duration of the Dissertation work is for two semesters.

c) After satisfying point b, a candidate has to submit, in consultation with his supervisor, the title, objective and plan of action of his Dissertation to the PRC for its approval. Only after obtaining the approval of PRC the student can initiate the Dissertation work.

d) If a candidate wishes to change his supervisor or topic of the Dissertation work he can do so with the approval of the PRC. If so, his date of registration for the Dissertation work shall start from the date of change of supervisor or topic as the case may be whichever is earlier.

e) Evaluation of the Dissertation shall be done twice, one at the end of the third Semester and the other during the fourth Semester.

f) The evaluation at the end of third semester shall be carried out by PRC for 50 marks based on the presentation made by student on the topic selected, literature survey and the progress of the work. The student shall be permitted to proceed for the remaining work in fourth semester if he gets at least 25 marks. Otherwise, the student shall reappear before the PRC with improved work within four weeks.

g) The evaluation during fourth semester shall be carried out twice each for 25 marks.

h) Dissertation is said to be completed only if the work done by the student leads to publication in Peer Reviewed international journal, national journal, international conference and national conference (Preferably in IEEE, ASME, Elsevier, Springer etc. proceedings) while evaluating the Dissertation.

i) The candidate shall make an oral presentation before the PRC for the approval to submit a draft copy of the Dissertation. A candidate shall be permitted to submit his Dissertation not earlier than 40 weeks from the date of registration of the Dissertation.

j) Three copies of the Dissertation certified by the supervisor shall be submitted to the Institute after approval by the PRC.

k) For the purpose of adjudication of the Dissertation, an external examiner shall be selected by the Principal from a panel of 5 examiners who are experienced in that field and proposed by the Head of the Department in consultation with the supervisor.

l) The final evaluation, i.e., viva-voce examination, for 100 marks, shall be conducted by a board consisting of the supervisor, Head of the Department and the external examiner.

m) A student is deemed to be failed, if he secures less than 50 marks in the external viva-voce examination and/or less than 100 marks from both internal and external viva-voce examination put together and shall be awarded Fail grade (F).

n) If any candidate fails or does not submit his thesis due to ill health or any other reason permitted by the head of the institution, he will be given another chance to attend for the viva-voce examination conducted separately at a later date. The expenditure for conducting the viva-voce is completely borne by the candidate. If the candidate still fails to complete the project he should reregister into the second year and has to repeat the Dissertation.

12. Conditions for Pass and Award of Credits for a Course

12.1 Conditions for Pass and award of Grades & Credits:

a) A candidate shall be declared to have passed in individual theory course if he secures a minimum of 50% aggregate marks (Internal & semester end

examination marks put together), subject to a minimum of 40% marks in semester end examination.

b) A candidate shall be declared to have passed in individual laboratory/project course if he/she secures a minimum of 50% aggregate marks (Internal & semester end examination marks put together), subject to a minimum of 50% marks in semester end examination.

c) The student has to pass the failed course by appearing at the supplementary examination as per the requirement for the award of degree.

d) On passing a course of a programme, the student shall earn assigned credits in that Course.

12.2 Method of Awarding Letter Grades and Grade Points for a Course:

A letter grade and grade points will be awarded to a student in each course based on his/her performance as per the grading system shown in Table - 5.

Table - 5: Grading System for M.Tech Programme

Marks Range Theory/ Laboratory (Max-100)	Marks Range Mini Project/Project Work or Dissertation (Max-100)	Letter Grade	Level	Grade Points
≥ 90	≥ 90	O	Excellent	10
≥80 to <90	≥80 to <90	S	Very Good	9
≥70 to <80	≥70 to <80	A	Good	8
≥60 to < 70	≥60 to < 70	B	Fair	7
≥50 to < 60	≥50 to < 60	C	Satisfactory	6
< 50	< 50	F	Fail	0
		AB	Absent	0

12.3 Calculation of Semester Grade Points Average (SGPA)

The performance of each student at the end of the each semester is indicated in terms of SGPA. The SGPA is calculated as below:

$$\textbf{SGPA} = \frac{\sum(CR\ X\ GP)}{\sum \text{CR}}$$

Where CR= Credits of a course
GP = Grade points awarded for a course

12.4 Calculation of Cumulative Grade Point Average (CGPA) and Award of Division for Entire Programme:

The CGPA is calculated as below:

$$\textbf{CGPA} = \frac{\sum(CR\ X\ GP)}{\sum \text{CR}}$$ (for entire programme)

Where CR= Credits of a course
GP = Grade points awarded for a course

12.5 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.

Table 6: Award of Divisions

Class Awarded	CGPA to be secured	
First Class with Distinction	≥ 7.75 (Without any supplementary appearance)	**From the CGPA secured from 74 Credits**
First Class	≥ 7.75 (With any supplementary appearance) ≥ 6.75 and < 7.75 (Without any supplementary appearance)	
Second Class	≥ 6.75 and < 7.75 (With any supplementary appearance) ≥ 6.0 and < 6.75 (Without any supplementary appearance)	
Pass Class	≥ 6.0 and < 6.75 (With any supplementary appearance)	

The Grades secured, Grade points and Credits obtained will be shown separately in the memorandum of marks.

13. Supplementary Examinations

Supplementary examinations will be conducted along with regular semester end examinations.

14. Re-admission Criteria

A candidate, who is detained in a semester due to lack of attendance/marks/credits, has to obtain written permission from the Principal for readmission into the same semester after duly fulfilling all the required norms stipulated by the Institute in addition to paying an administrative fee of Rs. 1,000/-

15. Re-Registration

A candidate, who is unable to secure 50% marks in any course due to lack of internal marks, can re-register for that course(s) of that semester along with subsequent batches of admitted students for one attempt. However he should attend the class work and appear for the internal & external examinations of that course(s) of the semester. Attendance in the re-registered courses(s) has to be calculated separately to become eligible to write the end examination in the re-registered course(s). In the event of taking another chance, the internal marks and end examination marks obtained in the

previous attempt are nullified. The re-registration courses for a student at a time should not exceed one course during course work semester and two courses during Dissertation period. An administrative fee of Rs. 2000/- per each semester has to be paid.

16. Break in Study

Student, who discontinues the studies for reasons what so ever, can get readmitted into appropriate semester of M.Tech. programme only with the prior permission of the Principal of the Institute. However the academic regulations under which he was first admitted shall continue to be applicable to him. An administrative fee of Rs. 2000/- per each year of break in study in addition to the prescribed tuition and special fee has to be paid by the candidate to condone his break in study.

17. Transitory Regulations

A Candidate, who is detained or discontinued in the semester, on readmission will have to continue his studies in the same academic regulations under which he was first admitted.

18. Eligibility for Award of M.Tech. Degree

The M.Tech Degree shall be conferred on a candidate who has satisfied the following requirement.

- A Regular student (two year programme) should register himself for 74 Credits and has to secure all 74 academic credits.

19. Conduct and Discipline

- Students shall conduct themselves within and outside the premises of the Institute in a manner befitting the ethical code of the Institute.
- As per the order of Honorable Supreme Court of India and AICTE guidelines, ragging in any form is considered a criminal offence and is banned. Ragging within or outside any educational institution is prohibited. Ragging means doing an act, that causes or is likely to cause insult or annoyance or fear of apprehension or threat or intimidation or outrage of modesty or injury to a student. Any form of ragging will be severely dealt with as per AP Prohibition of Ragging Act-1997 section-4.

Table 7: Punishments for Ragging

Nature of ragging	Punishment

Teasing, embarrassing and humiliating	Imprisonment upto 6 months or fine upto Rs.1,000/- or both
Assaulting or using criminal force or criminal intimidation	Imprisonment upto 1 year or fine upto Rs.2,000/- or both
Wrongfully restraining or confining or causing hurt	Imprisonment upto 2 years or fine upto Rs.5,000/- or both
Causing grievous hurt kidnapping or raping or committing unnatural offence	Imprisonment upto 5 years and fine upto Rs.10,000/-
Causing death or abetting suicide	Imprisonment upto 10 years and fine upto Rs.50,000/-

- A student convicted of an offence under this act and punished with imprisonment for a term of more than six months shall not be admitted in any other educational institution.
- Whenever any student complains of ragging to the head or manager of an educational institution, such head or manager should inquire into the complaint and if the complaint in prima-facie found true, should suspend the student or students complained against.
- If the head or manager of an educational institution fails or neglects to take action in the manner specified in the Act, the person shall be deemed to have abetted the offence and shall be punished for the offence.
- If a student commits suicide due to or in consequence of ragging, the person who commits such ragging shall be deemed to have abetted such suicide.

The following acts of omission and/or commission shall constitute gross violation of the code of conduct and are liable to invoke disciplinary measures.

1. Lack of courtesy and decorum; indecent behaviour anywhere within or outside the campus.
2. Possession, consumption or distribution of alcoholic drinks or any kind of narcotics or hallucinogenic drugs.

The following activities are not allowed within the campus:

- Mutilation or unauthorized possession of library books.
- Noisy and unruly behaviour, disturbing studies of fellow students.
- Hacking computer systems (such as entering into other person's areas without prior permission, manipulation and/or damage of computer hardware and software or any other cybercrime etc.)
- Use of mobile phones in the campus.

- Plagiarism of any nature.
- Any other act of gross indiscipline as decided by the Institute from time to time.
- Commensurate with the gravity of offense, the punishment may be reprimand, fine, expulsion from the institute / hostel, debarment from an examination, disallowing the use of certain facilities of the Institute, rustication for a specified period or even outright expulsion from the Institute, or even handing over the case to appropriate law enforcement authorities or the judiciary, as required by the circumstances.
- For an offence committed in (i) a hostel, (ii) a department or in a class room and (iii) elsewhere, the Chief Warden, the Head of the Department and the Principal, respectively, shall have the authority to reprimand or impose fine.
- Cases of adoption of unfair means and/or any malpractice in an examination shall be reported to the Principal for taking appropriate action.
- Unauthorized collection of money in any form is strictly prohibited.
- Detained and break-in-study candidates are allowed into the campus for academic purposes only with permission from authorities.
- Misconduct committed by a student outside the Institute campus but having the effect of damaging, undermining & tarnishing the image & reputation of the institution will make the student concerned liable for disciplinary action commensurate with the nature and gravity of such misconduct.
- The disciplinary action committee constituted by the Principal, shall be the authority to investigate the details of the offence, and recommend disciplinary action based on the nature and extent of the offence committed.
- Grievance redressal committee, constituted by the Principal, shall deal with all grievances pertaining to the academic / administrative and disciplinary matters.
- All the students must abide by the code and conduct rules of the Institute.

20. Malpractices

The Principal shall refer the cases of malpractice by students in internal assessment tests and end semester examinations, to a malpractice enquiry committee constituted for the purpose. The committee shall follow the approved scales of punishment.

The committee consists of:

1. Heads of Department (Three)
2. Controller of Examinations
3. Deputy Controller of Examinations

Table 8: Disciplinary action for malpractices/improper conduct in examinations

	Nature of Malpractices/Improper conduct	**Punishment**
1 (a)	If the candidate possesses or keeps accessible, any paper, note book, programmable calculators, mobile phones, pager, palm computers or any other form of material concerned with or related to the subject of the examination (theory or practical) in the examination hall but has not made use of (material shall include any marks on the student's body that 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)	If the candidate gives assistance or guidance or receives it from any other candidate orally or by any other body language methods or communicates through mobile 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	If the candidate 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 Dissertation. He 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.
3	If the candidate 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 practical's and Dissertation) 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	If the candidate smuggles in an 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 Dissertation 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 other examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
5	If the candidate 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	If the candidate 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 results in damage to or destruction of property in the examination hall or any part of the Institute 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 Institute, 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 will be registered against them.

7	If the candidate 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 Dissertation 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 other examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
8	If the candidate possesses 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 Dissertation 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 Institute, who is not a candidate for the particular examination or any person not connected with the Institute indulges in any malpractice or improper conduct mentioned in clause 6 to 8.	Student of the Institute: 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 Dissertation. He 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 Institute: Will be handed over to police and a police case will be registered against them.
10	If the candidate 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 Dissertation. He 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 Dissertation of that semester/year examinations.

12	If any malpractice is detected which is not covered in the above clauses 1 to 11, shall be awarded suitable punishment.	

Note: Special squads may be formed to oversee the proper conduct of examinations.

21. Withholding of Results

- If the candidate has not paid any dues to the Institute or if any case of indiscipline is pending against him, the result of the candidate shall be withheld and he will not be allowed into the next higher semester. The recommendation for the issue of the degree shall be liable to be withheld in all such cases.

22. Other Matters

22.1 The physically challenged students who have availed additional examination time and a scribe during their Intermediate/ EAMCET (AP) examinations will be given similar concessions on production of relevant proof/documents.

22.2 Students who are suffering from contagious diseases are not allowed to appear for internal or end semester examinations.

22.3 The students who have participated in coaching/tournaments held at State/ National/ International levels through University/ Indian Olympic Association during end semester external examination period will be promoted to subsequent semesters till the entire course is completed as per the guidelines of University Grants Commission Letter No. F.1-5/ 88(SPE/PES), dated 18-08-1994.

22.4 The Principal shall deal with any academic problem, which is not covered under these rules and regulations, in consultation with the Heads of the Departments in an appropriate manner and subsequently such actions shall be placed before the Academic Council for ratification. Any emergency modification of regulation, approved in the meetings of the Heads of the Departments, shall be reported to the Academic Council of the Institute for ratification.

23. General

- The Academic Council may, from time to time, revise, amend or change the regulations, schemes of examination and/or syllabus and the changes or amendments made shall be applicable to all the students with effect from the dates notified by the Institute.

- Wherever the words “he”, “him”, “his”, occur in the regulations, they may include “she”, “her”, “hers” also.
- The academic regulations should be read as a whole for the purpose of any interpretation.
- In case of any doubt or ambiguity in the interpretation of above rules, the decision of the principal is final.

24. Institute Rules and Regulations

- Use of Mobile phones is strictly prohibited inside the Institute academic area.
- Students should come to Institute in proper dress.
- All students should wear identity cards in the Institute campus.
- Students should be present in their respective classrooms by start time of class sharply.
- Students should not leave the Institute campus without prior permission of their respective Heads during Institute hours.
- Students should maintain silence in the class rooms during working periods.
- Sitting / wandering of the students at the stair cases, corridors, cycle stands or the areas within the Institute premises is strictly prohibited.
- Vehicle horn inside the campus is prohibited.

PROGRAM STRUCTURE
&
SYLLABUS

Prasad V. Potluri Siddhartha Institute of Technology (Autonomous)-Vijayawada-7
Department of Electronics and communication Engineering
M.Tech. Microwave & Communication Engineering
PVP- 22 - Program structure

First Semester

Code	Course	Contact Hours		Marks			Credits
		L	P	Int.	Ext.	Total	
22ECMC1T1	Advanced Digital Signal Processing	4		40	60	100	4
22ECMC1T2	Modern Wireless Communications	4		40	60	100	4
22ECMC1T3	Adaptive and Smart Antennas	4		40	60	100	4
22ECMC1T4	Microwave Solid State Devices	4		40	60	100	4
22ECMC1T5	Elective - I	4		40	60	100	4
22ECMC1T6	Elective - II	4		40	60	100	4
22ECMC1L1	Wireless Communications and Signal Processing Lab		3	25	50	75	2
22ECMC1L2	Term Paper		3	25	50	75	2
Total		**24**	**6**	**290**	**460**	**750**	**28**

Second Semester

Code	Course	Contact Hours		Marks			Credits
		L	P	Int.	Ext.	Total	
22ECMC2T1	Advanced Electromagnetic Fields	4		40	60	100	4
22ECMC2T2	Detection and Estimation Theory	4		40	60	100	4
22ECMC2T3	Microwave Networks	4		40	60	100	4
22ECMC2T4	Optical Networks	4		40	60	100	4
22ECMC2T5	Elective - III	4		40	60	100	4
22ECMC2T6	Elective – IV/MOOCS	4		40	60	100	4
22ECMC2L1	Wireless Sensor Networks and Antenna Lab		3	25	50	75	2
22ECMC2L2	Mini Project		3	25	50	75	2
Total		**24**	**6**	**290**	**460**	**750**	**28**

Third Semester

Code	Course	Contact Hours		Marks			Credit
			P	Int.	Ext.	Total	
22ECMC3TR	Pedagogy Training/Industrial Training			75		75	2
22ECMC3DS-A	Dissertation Part - A			50		50	6
	Total			**125**		**125**	**8**

Fourth Semester

Code	Subject		Int	Ext	Total	Credits
22ECMC4DS-B	Dissertation Part – B		50	100	150	10
	Total		**50**	**100**	**150**	**10**

Elective – I

22ECMC1T5A	Cognitive Radio
22ECMC1T5B	Conformal Antennas
22ECMC1T5C	Artificial Neural Networks
22ECMC1T5D	Video Processing

Elective – II

22ECMC1T6A	EMI/EMC
22ECMC1T6B	Soft Computing Techniques
22ECMC1T6C	Microwave Integrated Circuits
22ECMC1T6D	Machine Learning

Elective – III

22ECMC2T5A	Wireless MIMO Communications
22ECMC2T5B	Under Water Communications
22ECMC2T5C	DSP Processors
22ECMC2T5D	Wireless Sensor Networks

Elective – IV

22ECMC2T6A	Electromagnetic Metamaterials
22ECMC2T6B	RF IC Design
22ECMC2T6C	Phased Arrays
22ECMC2T6D	Research Methodology

Advanced Digital Signal Processing

22ECMC1T1 **Credits: 4**

Lecture: 4 periods/week **Internal assessment: 40 marks**

Semester end examination: 60 marks

Prerequisites: Digital signal processing

Course outcomes:

At the end of the course Student will be able to

- Design a sample rate converter that reduces/increase by a given factor
- Analyze and synthesize FIR filter for given multi structure filterbank
- Evaluate the optimum reflection coefficients for the lattice forward and backward predictors
- Analyze the concepts of power spectral estimation for different signals

Unit – I

Multirate Digital Signal Processing

Introduction, Up sampler, Down sampler, Decimation by a factor D, Interpolation by a factor I, Sampling Rate Conversion by a Rational Factor I/D, Implementation of Sampling Rate Conversion: Polyphase Filter Structures, Interchange of Filters and Down samplers/Up samplers, Sampling Rate Conversion with Cascaded Integrator Comb Filters, Polyphase Structures for Decimation and Interpolation Filters, Structures for Rational Sampling Rate Conversion.

Unit – II

Multirate Signal Processing Applications

Multistage Implementation of Sampling Rate Conversion, Sampling rate conversion by Bandpass signals, Sampling rate conversion by an arbitrary factor, Design of Phase Shifters, Interfacing of Digital Systems with Different Sampling Rates, Implementation of Narrowband Lowpass Filters, Subband Coding of Speech Signals, Digital Filter Banks , Two channel Quadrature Mirror Filter Bank

Unit – III

Linear Prediction

Forward and Backward Linear Prediction – Forward Linear Prediction, Backward Linear Prediction, Optimum reflection coefficients for the Lattice Forward and Backward Predictors. Solution of the Normal Equations: Levinson Durbin Algorithm, Schur Algorithm. Properties of Linear Prediction Filters

Unit – IV

Power Spectrum Estimation

Estimation of spectra from finite duration observation of Signals, Non parametric methods for power spectrum estimation, parametric methods for power spectrum estimation, Filter bank methods

Learning Resources

Text Books

1. J.G.Proakis & D.G.Manolokis Digital Signal Processing: Principles, Algorithms & Applications , 4th Ed., PHI

Reference Books

1. P.P.Vaidyanathan, Multirate Systems and Filter Banks, Pearson Education
2. S.Salivahanan, A.Vallavaraj, C.Gnanapriya, Digital Signal Processing, 2000,TMH
3. Transforms - Introduction to Theory and Applications, Pearson Education Asia,1999

E-Resources

1. https://nptel.ac.in/courses/108105055/
2. http://nptel.iitm.ac.in/courses/Webcourse- contents/ IITKANPUR/ Digi_Sign_Pro/ ui/TOC.htm

Modern Wireless Communications

22ECMC1T2 **Credits: 4**

Lecture: 4 periods/week **Internal assessment: 40 marks**

Semester end examination: 60 marks

Pre-Requisites: Communication Theory

Course Outcomes

After successful completion of the course, the student will be able to

- To understand wireless communication standards and different types of system models
- To learn diversity techniques
- To identify the different wireless channel models
- To know some information about OFDM systems

Unit – I

Introduction to 3G/4G Wireless Communications: Introduction, 2G Wireless Standards, 3G Wireless Standards, 4G Wireless Standards, Overview of Cellular Service Progression.
Principles of Wireless Communications: The Wireless Communication Environment, Modelling of Wireless Systems, System Model for Narrowband Signals, Rayleigh Fading Wireless Channel, BER Performance of Wireless Systems, Intuition for BER in a Fading Channel, Channel Estimation in Wireless Systems

Unit – II

Diversity in Wireless Communications: Multiple Receive Antenna System Model, Symbol Detection in Multiple Antenna Systems, BER in Multi-Antenna Wireless Systems, Diversity Order.

Unit – III

Wireless Channel: Basics of Wireless Channel Modelling, Average Delay Spread in Outdoor Cellular Channels, Coherence Bandwidth in Wireless Communications, Relation Between ISI and Coherence Bandwidth, Doppler Fading in Wireless Systems, Doppler Impact on a Wireless Channel, Coherence Time of the Wireless Channel, Jakes Model for Wireless Channel Correlation, Implications of Coherence Time

Unit – IV

Orthogonal Frequency-Division Multiplexing: Introduction, Motivation and Multicarrier Basics, OFDM Example, Bit-Error Rate (BER) for OFDM, MIMO-OFDM, Effect of Frequency Offset in OFDM, OFDM – Peak-to-Average Power Ratio (PAPR), SC-FDMA.

Learning Recourses

Text Books

1. Aditya K. Jagannatham, Principles of Modern Wireless Communication Systems Theory and Practice, McGraw Hill Education (India) Private Limited, New Delhi

2. Theodore Rappaport, Wireless Communications, 2nd Ed. Pearson

Reference Book

1. Simon O.Haykin , Michael Moher, Modern, Wireless Communications, Pearson

E-Resources

1. www.wirelesscommunicationstextbooks.com

2. https://nptel.ac.in/courses/117104115

Adaptive and Smart Antennas

22ECMC1T3 **Credits: 4**

Lecture: 4 periods/week **Internal assessment: 40 marks**

Semester end examination: 60 marks

Prerequisites: Antennas & Propagation

Course Outcomes:

At the end of the course Student will be able to

- Understand the concepts of smart antenna and adaptive antennas
- Learn different adaptive algorithms for the smart antennas
- Understand the direction of arrival estimation methods to combat fading in mobile communication.
- Learn the time-space processing of the antennas.

Unit-I

Smart Antennas: Introduction, Need for Smart Antennas, Overview, Smart Antenna Configurations, Space Division Multiple Access (SDMA), Architecture of a Smart Antenna System, Benefits and Drawbacks, Basic Principles, Mutual Coupling Effects

DOA Estimation Fundamentals: Introduction, Array Response Vector, Received Signal Model, Subspace-Based Data Model, Signal Auto covariance Matrices, Conventional DOA Estimation Methods, Subspace Approach to DOA Estimation: MUSIC Algorithm, ESPRIT Algorithm.Uniqueness of DOA Estimates.

Unit-II

Beamforming Fundamentals: Classical Beamformer, Statistically Optimum Beamforming Weight Vectors- Maximum SNR Beam former, Multiple Side lobe Canceller and the Maximum SINR Beamformer, Minimum Mean Square Error (MMSE), Direct Matrix Inversion (DMI), Linearly Constrained Minimum Variance (LCMV).Adaptive Algorithms for Beamforming- Least Mean-Square (LMS) Algorithm, Recursive Least-Squares (RLS) Algorithm, Constant-Modulus (CM) Algorithm, Affine-Projection (AP) Algorithm, Quasi-Newton (QN) Algorithm.

Unit-III

Integration and Simulation of Smart Antennas: Overview, Antenna Design, Mutual Coupling, Adaptive Signal Processing Algorithms, Trellis-Coded Modulation (TCM) for Adaptive Arrays, Smart Antenna Systems for Mobile Ad Hoc networks (MANETs).

Unit-IV

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

Learning Resources

Text Books

3. C. A. Balanis and P. I. Ioannides, Introduction to smart antennas, Morgan & Claypool Publishers, 2007

4. Robert A Monzingo, Randy L.Haupt and Thomas W.Miller, Introduction to Adaptive Arrays, 2nd Ed., Yesdee publishers

Reference Books

1. S. Chandran, Adaptive antenna arrays, Trends and Applications, Springer, 2009

E-Resources

https://nptel.ac.in/courses/117107035

Microwave Solid State Devices

22ECMC1T4 **Credits: 4**

Lecture: 4 periods/week **Internal assessment:40 marks**
Semester end examination: 60 marks

Prerequisites: Microwave Engineering

Course outcomes:

At the end of the course Student will be able to

- Understand characteristics of microwave transistors
- Apply BJTs and FETs in microwave circuits
- Apply Transferred-Electron Devices for electronic systems development
- Analyze operation of Avalanche Transit-Time Devices

Unit-I

Microwave Transistors: Introduction, Microwave Transistors- physical structure, Transistor Configurations, principle of operation, V-I characteristics, Equivalent circuit, Amplification phenomena, Power- frequency limitations, Hetero-junction Bipolar Transistors (HBTs)- physical structure, Operational Mechanism, Applications, Microwave Tunnel Diode-principle of operation, Microwave characteristics.

Unit-II

Microwave Field Effect Transistors: Introduction, Junction Field Effect Transistor (JFET)- structure, Principle of operation, V-I characteristics, Applications, Metal Semiconductor Field Effect Transistor (MESFET)- structure, principle of operation, Equivalent circuit, Drain current, cut-off frequency and Maximum oscillation frequency, High Electron Mobility Transistor (HEMT)- Structure, operational mechanism, performance characteristics, Applications, Metal Oxide Semiconductor Field Effect Transistor (MOSFET)- structure, principle of operation, Equivalent circuit, Drain current and Trans-conductance, Maximum operation frequency, Applications. MOS Transistors and Memory Devices.

Unit-III

Transferred-Electron Devices: Introduction, Gunn-Effect Diodes- GaAs Diode, Ridley-Watkins-Hilsum Theory, Modes of operation, LSA Diodes, InP Diodes, CdTe Diodes, Applications (Microwave Generation and Amplification).

Unit-IV

Avalanche Transit-Time Devices: Introduction, Read Diode- Structure, Operation, Carrier current and external current, Output power and Quality factor, IMPATT Diode- Structure, Different doping profile structures, Operation, Small-signal theory , Power output and Efficiency, applications. TRAPATT- Structure, Principle of Operation, Power output and Efficiency, BARITT- Structure, Principle of Operation, Performance and Applications. Parametric Devices - structure, Nonlinear Reactance and Manley –Rowe Power Relations, Parametric Amplifiers, and applications.

Learning Resources

Text Books

1. Samuel Y. Liao, Microwave Devices and Circuits, 3rd Ed., PHI.
2. R.E.Collin, Foundations for Microwave Engineering, 2nd Ed. Wiley

References

1. M.L. Sisodia, Vijay Lakshmi Gupta, Microwaves- Introduction to circuits, Devices and Antennas, New Age International Publishers

E-Resources

1. https://nptel.ac.in/courses/108103141

Cognitive Radio

22ECMC1T5A **Credits: 4**

Lecture: 4 periods/week **Internal assessment: 40 marks**

Semester end examination: 60 marks

Course Outcomes

At the end of the course, the student should be able to:

- Understand the design principles on software defined radio and cognitive radio
- Design and implement algorithms for cognitive radio spectrum sensing and dynamic spectrum access
- Apply the various routing protocols of cognitive radio in real time wireless applications
- Analyse the features of cognitive radio for real world applications

Unit- I

Introduction to software-defined radio and cognitive radio:

Evolution of Software Defined Radio and Cognitive radio: goals, benefits, definitions, architectures, relations with other radios, issues, enabling technologies, radio frequency spectrum and regulations.

Cognitive radio architecture

Cognition cycle – orient, plan, decide and act phases, Organization, SDR as a platform for Cognitive Radio – Hardware and Software Architectures, Overview of IEEE 802.22 standard for broadband wireless access in TV bands

Unit-II

Spectrum sensing and dynamic spectrum access

Introduction – Primary user detection techniques – energy detection, feature detection, matched filtering, cooperative detection and other approaches, Fundamental Tradeoffs in spectrum sensing, Spectrum Sharing Models of Dynamic Spectrum Access - Unlicensed and Licensed Spectrum Sharing, Fundamental Limits of Cognitive Radio.

Unit- III

MAC and network layer design for cognitive radio

MAC for cognitive radios – Polling, ALOHA, slotted ALOHA, CSMA, CSMA / CA, Network layer design – routing in cognitive radios, flow control and error control techniques.

Unit-IV

Cognitive Radio Platforms

Overview of security issues in cognitive radios, auction based spectrum markets in cognitive radio networks, public safety and cognitive radio, cognitive radio for Internet of Things.

Learning Resources

Text Books

1. Alexander M. Wyglinski, Maziar Nekovee, Thomas Hou,-Cognitive Radio Communications and Networks, Academic Press, Elsevier, 2010.
2. Huseyin Arslan (Ed.), Cognitive Radio, Software Defined Radio, and Adaptive Wireless Systems, Springer, 2007.

Reference Books

1. Linda E-Doyle, Essentials of Cognitive Radio, Cambridge University Press,2009
2. Bruce Fette, Cognitive Radio Technology, Newnes, 2006.
3. Kwang-Cheng Chen, Ramjee Prasad, Cognitive Radio Networks, John Wiley and Sons, 2009.
4. Ezio Biglieri, Professor Andrea J. Goldsmith, Dr Larry J. Greenstein, Narayan B. Mandayam, H. Vincent Poor, Principles of Cognitive Radio, Cambridge University Press, 2012.
5. Ekram Hossain, Dusit Niyato, Zhu Han, Dynamic Spectrum access and Management in Cognitive Radio Networks, Cambridge University Press
6. Joseph Mitola III, Software Radio Architecture: Object-Oriented Approaches to Wireless System Engineering, John Wiley & Sons Ltd. 2000.
7. Jeffrey H.Reed, Software Radio: A Modern Approach to radio engineering, Reprint by Pearson Education & Inc. 2002.

E-Resources

1. https://onlinecourses.nptel.ac.in/noc22_ee78/preview

Conformal Antennas

22ECMC1T5B **Credits: 4**

Lecture: 4 periods/week **Internal assessment: 40 marks**

Semester end examination: 60 marks

Prerequisites: Antennas and Propagation

Course Outcomes

Upon successful completion of the course, the student will be able to

- Interpret the fundamental parameters of conformal antennas in wireless communication (L2)
- Analyze the characteristics and shapes of conformal antennas(L4)
- Examine the single surface and double surface conformal antennas and its radiation patterns (L4)
- Utilize various feeding methods to improve performance the wireless communication system (L3)

Unit -1

Introduction: The definition of a conformal antenna, why conformal antennas, history, metal radomes, sonar arrays**.**

Unit -II

The Shapes of Conformal Antennas

Introduction, 360° Coverage, 360° Coverage Using Planar Surfaces, 360° Coverage Using Curved Surface, Hemispherical Coverage, Hemispherical Coverage Using Planar Surfaces Half Sphere Cone Ellipsoid Paraboloid and Comparing Shapes

Unit- III

Geodesics on Curved Surfaces

Introduction, Definition of a Surface and Related Parameters, The Geodesic Equation, Solving the Geodesic Equation and the Existence of Geodesics, Singly Curved Surfaces, Doubly Curved Surfaces-The Cone, Rotationally Symmetric Doubly Curved Surfaces, and Properties of Geodesics on Doubly Curved Surfaces Geodesic Splitting.

Unit- IV

Conformal Array Characteristics and Beam Forming

Introduction, Mechanical Considerations - Array Shapes, Element Distribution on a Curved Surface, Multifacet Solutions, Tile Architecture, Static and Dynamic Stress. Radiation Patterns - Introduction, Grating Lobes, Scan-Invariant Pattern, Phase-Scanned Pattern. Beam forming - Introduction, A Note on Orthogonal Beams, Analog Feed Systems - Vector Transfer Matrix Systems, Switch Matrix Systems, Butler Matrix Feed Systems, Digital Beam Forming

Learning Resources

Text Books

1. Lars Josefsson, Patrik Persson, Conformal Array Antenna Theory, Wiley-Inter science Publication4th Ed., 2021.
2. R C Hansen, Phased Array Antennas Conformal Antenna Array Design Handbook, Wiley

Reference Books

1. Constantine A. Balanis, Antenna Theory and Applications, John Wiley & Sons, 4th Ed., 2021

E-Resources

1. https://nptel.ac.in/courses/117107035

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Artificial Neural Networks

22ECMC1T5C **Credits: 4**
Lecture: 4 periods/week **Internal Assessment: 40 marks**
Semester end examination: 60 marks

Prerequisites: Linear Algebra, Statistics and Probability

Course Outcomes:
At the end of the course student will be able to:

- Understand fundamentals principles of artificial neural networks
- Develop back propagation algorithm for various neural networks problems
- Apply the principles and techniques of artificial neural networks for implementation of different digital systems using various neural network models
- Analyze the given pattern to match with the one of the patterns stored in the memory

Unit- I

Artificial Neural Networks: Basic Concepts: Introduction, Computation in terms of patterns, The McCulloch-Pitts Neural Model, The Perceptron, Neural Network Architectures, Activation Functions, Learning by Neural Nets

Unit- II

Pattern Classifiers: Hebb Nets, Perceptrons, Adaline, Madaline

Patern Associators: Auto-associative Nets, Hetero-Associative Nets, Hopfield Networks, Bi-directional Associative Memory

Unit- III

Competitive Neural Nets: The MAXNET, Kohonen's Self Organizing Map (SOM), Learning Vector Quantization (LVQ), Adaptive Resonance Theory (ART)

Back propagation: Multilayer Feed Forward Net, Generalized Delta Rule, Back Propagation Algorithm

Unit- IV

Applications Of Neural Networks: Applications of Neural Networks in Forecasting, Applications of Neural Networks in Healthcare, Applications of Neural Networks in Business, Applications of Neural Networks in image processing and compression, Applications of Neural Networks in control systems, Applications of Neural Networks in pattern recognition

Learning Recourses

Text Book

1. Samir Roy and Udit Chakraborty, Introduction to Soft Computing, Pearson Publications, 2013
2. S N Sivanandam, S Sumathi, S N Deepa, Introduction to Neural Networks using Matlab 6.0, Tata McGraw Hill Publications, 2008

References

1. Jang J.S.R., Sun C.T., Mizutani E., Neuro-Fuzzy and Soft Computing, Prentice Hall, 1997
2. Hertz J., Introduction to the Theory of Neural Computing, Addison-Wesley, 1991

E - Resources

1. https://nptel.ac.in/courses/117/105/117105084/

2. https://ocw.mit.edu/courses/brain-and-cognitive-sciences/9-641j-introduction-to-neural-networks-spring-2005/

Video Processing

22ECMC1T5D **Credits: 4**
Lecture: 4 periods/week **Internal assessment: 40 marks**
Semester end examination: 60 marks

Prerequisites: Digital Image Processing

Course outcomes:

After successful completion of the course, the students will be able to

- Identify the importance of digital video applications in today's world
- Analyze the standards of analog video and digital video formats and sampling process of video signal
- Apply different parametric models that describe the real world and image generation process.
- Analyze different video coding techniques and compression standards.

Unit-I

Video formation, perception and representation – color perception and specification – video capture and display – Analog video raster – Analog color television systems, Digital video, Frequency Domain characterization of Video Signals

Unit-II

Video sampling – Basics of the Lattice theory, Sampling of Video Signals, Conversion of Signals Sampled on Different Lattices, Sampling Rate Conversion of Video Signals

Unit-III

Video modeling-Camera model, Illumination model, Object model and Scene model, Two dimensional models, Two Dimensional motion estimation-Types, Optical Flow, Pixel Based Motion, Block matching Algorithm

Unit-IV

Waveform Based Video Coding- Region based video coding, Object based video coding, Predictive coding, Video coding using Temporal prediction and transform coding, Content Dependent Video Coding – Two dimensional shape coding, Texture coding for Arbitrarily shaped Regions. Video Compression Standards-MPEG-4, MPEG-7

Learning Resources

Text Book

1. Yao Wang, J. Ostermann, Ya Zhang, Video Processing and Communication, 1st Ed., Prentice Hall, 2001

Reference Book

1. Woods, Multidimensional, signal, image and video processing and coding, Elsevier, Academic press, 2006

E – Resources

1. https://nptel.ac.in/courses/117104020

EMI/EMC

22ECMC1T6A **Credits: 4**
Lecture: 4 periods/week **Internal assessment: 40 marks**
Semester end examination: 60 marks

Prerequisites: Basic knowledge of electronic components, circuits, electromagnetic fields and systems.

Course Outcomes:

At the end of the course Student will be able to

- Understand EMI/EMC standards, different sources of EMI/EMC, different mitigation techniques and testing of interference (L2)
- Analyze, measure and evaluate radiated and conducted emissions to examine the electromagnetic compatibility (L4)
- Evaluate the impact of EMI mitigation techniques (L3)
- Analyze different test setups for measuring radiation (L4)

Unit - I

Introduction: Electromagnetic environment, History, Concepts, Practical experiences and concerns, frequency spectrum conservations, an overview of EMI / EMC.
EMC Standards: Standards for EMI/EMC, IEEE/ANSI Standards, CISPR/ IEC Standards, FCC Regulations.

Unit – II

Natural and Nuclear Sources of EMI / EMC: Introduction, Celestial Electromagnetic Noise, Electrostatic Discharge, Electromagnetic Pulse.
EMI from Apparatus, Circuits: Electromagnetic emissions, Noise from relays and switches, Non-linearity in circuits, passive intermodulation, Cross talk in transmission lines, Transients in power supply lines, Electromagnetic interference.
Pulsed Interference Immunity: Pulsed EMI Immunity, Electrical fast transients / bursts, Electrical surges.

Unit - III

Grounding, Shielding, Bonding: EMC Technology, Grounding, Shielding, Electrical bonding.

Cables, Connectors, and Components: EMI suppression cables, EMC connectors, EMC gaskets.

Unit - IV

Open Area Test Sites: Open-Area Test Site Measurements, Measurement Precautions.

Radiated Interference Measurements: Anechoic chamber, TEM cell, Reverberating Chamber, Giga-Hertz TEM Cell

Conducted Interference Measurements: Characterization of conduction currents / voltages, Conducted EM noise on power supply lines, Conducted EMI from equipment, Immunity to conducted EMI, detectors and measurements

Text Books

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

Reference Books

1. C.R. Paul., Introduction to Electromagnetic Compatibility, Ny John Wiley, 1992

E – Resources

1. https://archive.nptel.ac.in/courses/108/106/108106138/

Soft Computing Techniques

22ECMC1T6B **Credits: 4**

Lecture: 4 periods/week **Internal assessment: 40 marks**

Semester end examination: 60 marks

Prerequisites: Linear Algebra, Statistics and Probability

Course Outcomes:

At the end of the course student will be able to:

- Understand the basic concepts of soft computing techniques and their applications
- Apply fuzzy logic to handle uncertainty and solve problems with an effective report
- Apply genetic algorithms to solve engineering problems
- Apply Nature Optimization algorithms for real-time problems

Unit- I

Introduction to Soft Computing: Concept of computing systems, "Soft" computing versus "Hard" computing, Characteristics of Soft computing

Applications of Soft computing techniques: Handwritten Script Recognition, Image Processing and Data Compression, Automotive Systems and Manufacturing, Soft computing based Architecture, Decision Support System

Unit- II

Fuzzy Set Theory: Fuzzy Versus Crisp, Crisp Sets, Fuzzy Sets, Crisp Relations, Fuzzy Relations. Fuzzy Systems: Crisp Logic, Predicate Logic, Fuzzy Logic, Fuzzy Rule Based Systems, Defuzzification Methods and Applications

Unit- III

Fundamentals of Genetic Algorithms : Genetic Algorithms: History, Basic Concepts, Creation of Offsprings, Working Principle, Encoding, Fitness Function, Reproduction

Genetic Modelling: Inheritance Operators, Cross Over, Inversion, And Deletion, Mutation Operator, Bit-Wise Operators, Bit-Wise Operators usedinGA,GenerationalCycle,ConvergenceofGeneticAlgorithms,Hybrid Systems

Unit- IV

Nature-Inspired Optimization Algorithms: Differential Evolution, Ant and Bee Algorithms, Particle Swam Optimization, the Firefly Algorithm, Cuckoo Search, The Bat Algorithm, The Flower Algorithm, Parameter Tuning and Parameter Control

Learning Resources

Text Book

1. Samir Roy and Udit Chakraborty, Introduction to Soft Computing, Pearson Publications, 2013
2. S. Rajasekaran, G. A. Vijayalakshmi Pai, Neural Networks, Fuzzy Logic and Genetic Algorithm, Synthesis and Applications, 2017, PHI Learning
3. XIN- SHE YANG, Nature-Inspired Optimization Algorithms, 2nd Ed., 2020, Elsevier

References

1. S.N.Deepa, Principles of Soft Computing, S.N. Sivanandam, Wiley India Pvt. Ltd., 2018
2. David E. Goldberg, Genetic Algorithms in Search, Optimization and Machine Learning, Kluwer Academic Publishers, Boston, MA, 1989
3. George J. Klir and Bo Yuan, Fuzzy Sets and Fuzzy Logic-Theory and Applications, Prentice Hall, 2015
4. Kwang H. Lee, First course on Fuzzy Theory and Applications, 2005, Springer
5. S. R. Jang, C.T. Sun and E. Mizutani, Neuro Fuzzy and Soft Computing, 2004, PHI / Pearson Education
6. James A. Freeman and David M. Skapura, Neural Networks Algorithms, Applications, and Programming Techniques, 2003, Addison Wesley

Web Resources:

1. https://nptel.ac.in/courses/106/105/106105173/
2. https://cse.iitkgp.ac.in/~dsamanta/courses/sca/index.html#resources
3. https://www.classcentral.com/course/youtube-introduction-to-soft-computing-47844

Microwave Integrated Circuits

22ECMC1T6C **Credits: 4**
Lecture: 4 periods/week **Internal assessment: 40 marks**
Semester end examination: 60 marks

Prerequisites: **Computer Networks**.

Course Outcomes:
At the end of the course Student will be able to

- Analyse various characteristics of microstrip lines
- Develop circuit models of various microstrip passive components
- Design microwave amplifiers for the required specifications
- Analyse microwave oscillators

Unit-I
Introduction of Strip Lines:
Review of development and application of the modem transmission line structure as interconnect and as a medium for realization of components for the MIC and MMIC: quasi – static and frequency dependent medium closed form models of microstrip line for effective relative permittivity, capacitance, characteristic impedance analysis and dielectric and conductor losses: Effect of conductor thickness, top shield and side walls on the propagation characteristics of a microstrip line

Unit-II
Microstrip Passive Components
Circuit models of discontinuities in microstrip lines and the coplanar wave guide, open ended, short ,gaps, step, bent, T- junction, Hybrid line coupler, parallel coupled line and directional couplers, filters

Unit-III
Microwave Amplifier Design
Microwave transistors, Stability considerations, Power-gain definitions, Simultaneous conjugate matching, Consideration for unilateral design

Unit-IV
Microwave Oscillator Design:
Negative Resistance Oscillators, Transistor Oscillators

Learning Resources

Text Book

1. Bharathi Bhat & Shiban K.Koul, Stripline – like Transmission Lines for Microwave Integrated Circuits, John Wiley
2. M.Samuel, Y.Lieo, Microwave Circuit Analysis and Amplifier Design, Prentice Hall

References

1. E.H Fooks & R.A. Zakarevicuis, Microwave Engineering using Microstrip Circuits. Prentice Hall. T.C.Edwards, Foundation for Microstrip Circuit Design, Jone Willy & sons

E – Resources

1. https://onlinecourses.nptel.ac.in/noc21_ee34/preview

Machine Learning

22ECMC1T6D` **Credits: 4**

Lecture: 4 periods/week **Internal assessment: 40 marks**

Semester end examination: 60 marks

Prerequisites:

Course Outcomes

Upon successful completion of the course, the student will be able to

- Understand the basic concepts of machine learning.
- Apply machine learning techniques on appropriate problems.
- Apply Evaluation, hypothesis tests and compare the performance of learning techniques for various problems.
- ApplyReinforcementlearningtoaddresstherealtimeproblemsindifferentareas.

Unit – I

Introduction: What is Machine learning, Designing a Learning System, Perspectives and Issues in Machine Learning, Applications of Machine learning

Unit–II

Supervised Learning: Decision Trees, Bayes Theorem, Naïve Bayes Classifier, Measuring Classifier Accuracy, Estimating Hypothesis, Accuracy

Unit–III

Instance Based Learning–Support vector machine, Ensemble Methods, k-Nearest Neighbor Learning, Expectation Maximization Algorithm and Case Based Reasoning

Unit–IV

Reinforcement learning: The learning Task, Elements of Reinforcement learning, Q-Learning, Model based Learning, Temporal Difference learning

Learning Resources

Text Books

1. Ethem Alpaydin, Introduction to Machine Learning, 2nd Ed., 2010, Prentice Hall of India
2. Anuradha Srinivasaraghavan, and Vincy Joseph, Machine Learning, Kindle Edition, 2020, WILEY
3. M.Gopal, Applied Machine Learning, McGraw Hill Education, 1st Ed., 2018

References

1. Tom M. Mitchell Machine Learning, International Edition 1997, McGraw Hill Education
2. Ian Good fellow, Yoshua Bengio, Aaron Courville, Deep Learning, 2016, MIT Press
3. Machine Learning a Probabilistic Perspective, 1st Ed.,2012, MIT Press

4. Kevin P .Murphy & Francis Bach – Introduction to Data Mining, Tan, Vipin Kumar, MichaelSteinbach,9th Ed.,2013,Pearson

E-Resources and other Digital Material

1. https://www.coursera.org/learn/machine-learning
2. https://nptel.ac.in/courses/106/106/106106139/

Wireless Communications and Signal Processing Lab

22ECMC1L1 **Credits: 2**
Lecture: --- **Internal assessment: 25 marks**
Lab: 3 periods/week **Semester end examination: 50 marks**

Prerequisites: Principles of Wireless Communications

Course Outcomes
After the completion of this course, a student will be able to:

- Demonstrate the concepts of wireless communications
- Analyse wireless communication systems with different modulation and demodulation schemes
- Develop and implement different types of digital communication systems using USRP
- Simulate digital communication systems

Part A: (Any 5 experiments)

Hardware Experiments

1. Frequency Division Multiplexing (FDM)
2. Amplitude Shift Keying (ASK)
3. Frequency Shift Keying (FSK)
4. Phase Shift Keying (PSK)
5. Quadrature Phase Shift Keying (QPSK)
6. Eye Diagram
7. Equalization

Part B: (Any 5 experiments)

MATLAB or LABVIEW based Simulation Experiments

1. Digital modulation schemes – ASK, FSK, PSK
2. Performance comparison of digital communication systems
3. Communication over fading channels – Rayleigh fading &Rician fading channels
4. CDMA systems
5. Matched filter, Correlation receiver & Equalizer
6. Multi carrier communication
7. Carrier recovery and bit synchronization

Learning Resources

Text Books

1. Simon Haykin, Introduction to Analog and Digital Communication System- John Wiley and Sons, 3rd Ed., 2009
2. John G. Proakis, Masoud Salehi, Fundamentals of Communication Systems - Pearson, 2nd Ed., 2013

Reference Books

1. H Taub & D. Schilling, Gautam Sahe, Principles of Communication Systems –TMH, 3rd Ed., 2007
2. Sam Shanmugam, Analog and Digital Communication System- John Wiley and Sons,3rd Ed., 2009

E – Resources

1. https://archive.nptel.ac.in/courses/108/106/106106167/

Term Paper

22ECMC1L2 **Credits: 2**
Lecture: --- **Internal assessment: 25 marks**
Lab: 3 periods/week **Semester end examination: 50 marks**

Course Objectives

- The student is introduced to the concept of validating a simple idea through model Preparation / Software package or solving a simple Industrial/ Theoretical problem.
- To develop problem solving, analysis, synthesis and evaluation skills.
- To encourage teamwork and improve students presentation and communication skills.

Course Outcomes

After completion of the course, student should be able to

- Formulate a real world problem and identify its requirements
- Express technical ideas, strategies and methodologies in oral and document form.
- Self-learn new software tools, methodologies and/or experimental techniques that contribute to the solution of the project.

Advanced Electromagnetic Fields

22ECMC2T1 **Credits: 4**

Lecture: 4 periods/week **Internal assessment: 40 marks**

Semester end examination: 60 marks

Prerequisites: Electromagnetic Fields and Waves

Course Outcomes

At the end of the course Student will be able to

- Understand the complex ε, μ, and σ in circuit and field analysis, nature of waves for different matter, theorems used in fields, modes and its properties in different types of rectangular wave guides (L2)
- Analyze wave behavior to different matter and components (L4)
- Apply theorems to construct solutions to radiation problems (L3)
- Analyze plane wave functions for calculation of various performance parameters in different kinds of rectangular wave guides(L4)

Unit-I

FundamentalConcepts: Introduction,BasicEquations,constitutiverelationships,generalizedcurrentconcepts,energyandpower,circuitconcepts,complexquantities,complexequations,complex constitutive parameters, complex power, A-C Characteristics of matter, A-C behavior circuit elements, Singularities of field.

Unit-II

Introduction to Waves: The Wave Equation, Waves in perfect dielectrics, Intrinsic wave constants, Waves in lossy matter, Reflection of waves, Waveguide concepts, Resonator concepts, Radiation, Antenna concepts.

Unit-III

Some Theorems & Concepts: The Source concept, Duality, Uniqueness, Image theory, Reciprocity, Green's functions, Integral equations, Construction of solutions, The radiation field.

Unit-IV

Plane Wave Functions: The Wave functions, Plane waves, The Rectangular waveguides, Alternative mode sets, Rectangular cavity, partially filled wave guide, dielectric- slab guide.

Learning Resources

Text Books

1. R.F.Harrington, Time Harmonic Electromagnetics,McGraw Hill,1961
2. R F Harrington, Field Computation by Moment Methods, New York: MacMillan,1968
3. E.C Jordan & K.G.Balmain, Electromagnetic Waves and Radiating Systems, 2nd Ed., Prentice Hall India, Pvt.Ltd. New Delhi.

Reference Books

1. WilliamH.HaytandJohnA.Buck,EngineeringElectromagnetics,8thEdition,McGrawHill,2010
2. C.A.Balanis,AdvancedEngineeringElectromagnetics,WileyIndia,Pvt.Ltd.,2005

E- Resources

1. https://nptel.ac.in/courses/108104087

Detection and Estimation Theory

22ECMC2T2 **Credits: 4**
Lecture: 4 periods/week **Internal Assessment: 40 marks**
Semester end examination: 60 marks

Prerequisites: Linear Algebra, Random Process

Course Outcomes:

At the end of the course student will be able to:

- Understand fundamentals of signal/ parameter detection and estimation principles
- Apply suitable detection and estimation techniques to solve the problems of different systems
- Analyse the signal and parameter estimation problems to make inferences
- Analyse the signal detection problems to support generalizations

Unit- I

Fundamentals of Estimation Theory: Role of Estimation in Signal Processing, Unbiased Estimation, Minimum variance unbiased (MVU) estimators, Finding MVU Estimators, Cramer-Rao Lower Bound, Linear Modelling, Sufficient Statistics, Use of Sufficient Statistics to find the MVU Estimator

Unit- II

Deterministic Parameter Estimation: Least Squares Estimation, Best Linear Unbiased Estimation, and Maximum Likelihood Estimation

Random Parameter Estimation: Bayesian Philosophy, Selection of a Prior PDF, Bayesian linear model, Minimum Mean Square Error Estimator, Maximum a Posteriori Estimation

Unit- III

Hypothesis Testing: Bayes' Detection, MAP Detection, ML Detection, Minimum Probability of Error Criterion, Neyman-Pearson Criterion, Multiple Hypothesis, Composite Hypothesis Testing: Generalized likelihood ratio test (GLRT), Receiver Operating Characteristic Curves.

Unit- IV

Detection of Signals in White Gaussian Noise (WGN): Binary Detection of Known Signals in WGN, M-ary Detection of Known Signals in WGN, Matched Filter Approach

Learning Resources

Text Book

1. S. M. Kay, Fundamentals of Statistical Signal Processing: Estimation Theory, Vol I, Prentice-Hall, 1993.
2. S. M. Kay, Fundamentals of Statistical Signal Processing: Detection Theory, Vol II, Prentice-Hall, 1998.

References

1. H. Vincent Poor, An Introduction to Signal Detection and Estimation, 2nd Ed., Springer, 1998

2. Harry L. Van Trees, Detection, Estimation and Modulation Theory, Part- I, II, & III, John Wiley & Sons, 2004

3. Louis L. Scharf, Statistical Signal Processing: Detection, Estimation and Time Series Analysis, Prentice Hall, 1991

4. Carl W. Helstrom, Elements of Signal Detection & Estimation, Prentice Hall, 1994

5. M. D. Srinath, P. K. Rajasekaran and R. Visawanath, Introduction to Statistical Signal Processing with Applications, Prentice Hall, 1995

6. Kung Yao, Flavio Lorenzelli, and Chiao-En Chen, Detection and Estimation for Communication and Radar Systems, Cambridge University Press, 2013

Web Resources:

1. https://nptel.ac.in/courses/117/103/117103018/

2. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-432-stochastic-processes-detection-and-estimation-spring-2004/

Microwave Networks

22ECMC2T3 **Credits: 4**
Lecture: 4 periods/week **Internal assessment: 40 marks**
Semester end examination: 60 marks

Prerequisites: Transmission lines &Wave guides, Microwave Engineering

Course Outcomes:

At the end of the course Student will be able to

- Apply different two port network parameters to microwave networks
- Analyze impedance matching networks using S matrix
- Apply various Excitation techniques to waveguides, and cavities
- Design various microwave filters

Unit- I

Introduction to Circuit Concepts: The Network concept, One-port network, Two-port network, Impedance and Equivalent voltages and currents, Impedance and Admittance Matrices, The Transmission (ABCD) Matrix-relation to Impedance Matrix, Equivalent circuits for two port networks, Parameter conversion, Signal flow graphs

Unit- II

Scattering Matrix and Matching Networks: Formulation for N-port network, S-Matrix for Reciprocal and Lossless junctions, shift in Reference plane, Generalized S-Matrix, conversion of S-parameters to other network parameters. Matching Networks: Matching with Lumped elements (L Networks), The Quarter wave Transformer, Single-stub tuning, Double-stub tuning

Unit- III

Excitation of Waveguides &Cavities: Waveguide Feeds, Excitation of waveguides-Electric and Magnetic current, Aperture coupling. Basics of Rectangular and Cylindrical cavities. Equivalent circuits for cavities-Aperture coupled cavity, Loop coupled cavity. Field expansion in a general cavity, Excitation of cavities

Unit- IV

Filters: Introduction, Filter Design- Image parameter and Insertion Loss methods. Filter Transformations, Filter Implementation (Richard's Transformation and Kuroda's Identities)

Learning Resources

Text Books

1. Robert E. Collin, Foundations for Microwave Engineering, 2nd Ed., Tata McGraw Hill
2. David M. Pozar, Microwave Engineering, 2nd Ed., Wiley student Edition

References

1. Jerome L. Altman, Microwave Circuits, The Von Nostrad Series

E – Resources

1. https://nptel.ac.in/courses/108103141

Optical Networks

22ECMC2T4 **Credits: 4**
Lecture: 3 Periods/week **Internal assessment: 40marks**
Semester end examination: 60marks

Prerequisites: Optical communications, computer networks.

Course Outcomes:
At the end of the course Student will be able to

- Understand layers of optical networks
- Design and construct WDM network elements
- Analyze optical networks
- Analyze the protection schemes of optical networks

Unit- I
Client Layers of Optical Networks: SONET / SDH – Multiplexing, Frame Structure, Physical Layer, Infrastructure, ATM – Functions, Adaptation layers, QoS, Flow Control Signaling and Routing, IP –Routing, QoS, MPLS, Storage Area Networks – ESCON, Fiber Channel, HIPPI, Gigabit Ethernet

Unit- II
WDM network Elements and Design: Optical Line Terminals and Amplifiers, Add/Drop Multiplexers, Optical Cross Connects, Cost trade-offs in Network Design, LTD and RWA Problems, Dimensioning – Wavelength Routing Networks

Unit- III
Network Control and Management: Network Management Functions, Optical Layer Services and Interfacing, Layers within Optical Layer, Multivendor Interoperability, Performance and Fault Management, Configuration Management, Optical Safety

Unit- IV
Network Survivability: Basic Concepts of Survivability, Protection in SONET/SDH Links and Rings, Protection in IP Networks, Optical Layer Protection – Service Classes, Protection Schemes, Interworking between Layers. Network Architecture, Enhanced HFC, FTTC

Learning Resources

Text Books

1. Rajiv Rama swami and Kumar N. Sivarajan, Optical Networks: A Practical Perspective, 2nd Ed., 2004, Elsevier Morgan Kaufmann Publishers
2. C. Siva Rama Murthy and Mohan Guruswamy WDM Optical Networks: Concepts, Design and Algorithms,2nd Ed., 2003,PEI

Reference Books

1. Harold Kolimbris, Fiber Optics Communication, 2nd Ed., 2004, PEI
2. Govind Agarwal, Optical Fiber Communications, 2nd Ed., 2004, TMH
3. S.C.Gupta, Optical Fiber Communications and Its Applications, 2004, PHI

E – Resources

1. https://archive.nptel.ac.in/courses/108/106/108106167/

Wireless MIMO Communications

22ECMC2T5A **Credits: 4**
Lecture: 4 periods/week **Internal assessment: 40 marks**
Semester end examination: 60 marks

Prerequisites: Signals & Systems, Digital Signal Processing**,** Digital Communications

Course Outcomes
At the end of the course Student will be able to

- Understand the fading channels and calculate Error Probability and Outage Probability
- Model a MIMO Channel and find its capacity
- Articulate basic equalization schemes commonly used in wireless system
- Analyze multiple antenna systems and techniques such as space time codes and singular value decomposition

Unit- I
Introduction: MIMO wireless communication, MIMO channel and signal model, A fundamental trade-off, MIMO transceiver design, MIMO in wireless networks, MIMO in wireless standards

Unit- II
Capacity limits of MIMO systems: Introduction, Mutual information and Shannon capacity, Single-user MIMO, Multi-user MIMO, Multi-cell MIMO..

Unit- III
Fundamentals of receiver design: Introduction, Reception of uncoded signals, Factor graphs and iterative processing, MIMO receivers for uncoded signals, MIMO receivers for coded signals, some iterative receivers

Unit- IV
Multi-user receiver design: Introduction, Multiple-access MIMO systems, Iterative space–time multi-user detection, Multi-user detection in space–time coded systems, Adaptive linear space–time multi-user detection

Learning Resources

Text Books

1. Ezio Biglieri, Robert Calder bank, Anthony Constantinides, Andrea Goldsmith, Arogyaswami Paulraj, H. Vincent Poor, MIMO Wireless Communications, Cambridge university press
2. Mimo Wireless Networks: Channels, Techniques And Standards For Multi-Antenna, Multi-User And Multi-Cell Systems, 2Nd Edition by Clerckx and Oestges, Elsevier Science

References

1. Rakhesh Singh Kshetrimayum Fundamentals of MIMO Wireless Communications

E – Resources

1. https://archive.nptel.ac.in/courses/117/105/117105132/

Underwater Communication

22ECMC2T5B **Credits: 4**
Lecture: 4 periods/week **Internal assessment: 40 marks**
Semester end examination: 60 marks

Prerequisites: Digital Signal Processing**,** Digital Communications

Course Outcomes:

At the end of the course Student will be able to

- Examine underwater acoustics
- Understand the characteristics of Sonar Systems
- Outline the importance of underwater acoustic Modems
- Analyze the performance of underwater sensor networks

UNIT- I

Fundamentals of Underwater Acoustics: The Ocean acoustic environment, measuring Sound level, Sources and receivers, Sound velocity in sea water, typical vertical profiles of sound velocity, Sound propagation in the Ocean, Deep water and Shallow water, Range dependent environment. Sound attenuation in sea water, Bottom Loss, Surface bottom and volume scattering, Snells law for range Dependent Ocean

Unit- II

Types of sonar systems: Active and Passive Sonar equations, Propagation characteristics of the medium, Transmission loss and Spreading effects, Beam forming and Steering, Detection Threshold, Target Angle Estimation, Array Shading

Ambient noise: Sources of ambient noise, Shallow water ambient noise, Effect of depth, Directional characteristics of deep water ambient noise, Electrical noise, Machinery noise, Flow noise, Propeller noise, Self-noise and Radiated noise

Unit- III

Acoustic Modem: Underwater Wireless Modem, Sweep spread carrier signal, transmission characteristics in shallow water channel, separation of time varying multipath arrivals, Typical acoustics modems, characteristics and specifications, Applications, Acoustic Releases, Real time wireless current monitoring system

Unit- IV

Underwater Sensor Network: Underwater Networking, Ocean Sampling Networks, Pollution Monitoring, Environmental Monitoring and Tactical surveillance systems, Major challenges in design of Underwater Sensor Networks, Factors that affect the UWSN, Sensor Node Architecture- GIBS, VRAP, DABSRAPT

Learning Resources

Text Books

1. Marco Lanzagorta, Underwater Communications, Morgan & Claypool Publishers, 2012
2. A.D. Waite John, SONAR for Practicing Engineers, Wiley & Sons, Ltd
3. Robert J Urick, Principles of Underwater Sound, 3rd Ed.,Penninsula Publishers

References

1. Lufen Xu Tianzeng Xu, Digital Underwater Acoustic Communications, 1st Ed, Elsevier
2. L. M. Brekhovskikh and Yu. P. Lysanov Fundamental of ocean acoustics, Modern Acoustics and signal processing

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E – Resources

1. https://nptel.ac.in/courses/106105160

DSP Processors

22ECMC2T5C **Credits: 4**
Lecture: 4 periods/week **Internal assessment: 40 marks**
Semester end examination: 60 marks

Prerequisites: Signals & Systems, Digital Signal Processing

Course Outcomes:
At the end of the course Student will be able to

- Design DSP filters suitable for real-time applications
- Understand the architecture and pipeline operations of DSP Processors
- Illustrate the features of on-chip peripherals and interrupts ofTMS320C54XXDSP Processor
- Implement various DSP algorithms using DSP processors

Unit- I
Introduction: Number formats for signals and coefficients in DSP systems, Dynamic Range and Precision, Sources of error in DSP implementations, A/D Conversion errors, DSP Computational errors, D/A Conversion Errors

Unit- II
Architectures for Programmable DSP Devices: Basic Architectural features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation Unit, Programmability and Program Execution, Hardware looping, Interrupts, Stacks, Relative Branch Support, Pipelining and Performance, Pipeline Depth, Interlocking, Branching effects, Interrupt effects, Pipeline Programming models

Unit- III
Programmable Digital Signal Processors: Commercial Digital Signal Processing Devices, Data Addressing modes of TMS320C54XX Processors, Memory space of TMS320C54XX Processors, Program Control, On-Chip Peripherals, Interrupts of TMS320C54XX Processors, Pipeline Operation of TMS320C54XX Processors

Unit- IV
Implementation of Basic DSP Algorithms: The Q-notation, FIR Filters, IIR Filters, Interpolation Filters, Decimation Filters, PID Controller, Adaptive Filters, 2-D Signal Processing. FFT Algorithm for DFT Computation, A Butterfly Computation, Overflow and scaling, Bit- Reversed index generation, An 8-Point FFT implementation on the TMS320C54XX, Computation of the signal spectrum

Learning Resources

Text Books

1. Avtar Singh and S.Srinivasan, Digital Signal Processing, Thomson Publications, 2004
2. B. Venkata Ramani and M. Bhaskar, Digital Signal Processors, Architecture, Programming and Applications - TMH, 2004

References

1. Jonatham Stein, Digital Signal Processing, John Wiley, 2005

2. Lapsley et al, DSP Processor Fundamentals, Architectures &Features -. S. Chand & Co, 2000

E – Resources

1. https://nptel.ac.in/courses/117102060

Wireless Sensor Networks

22ECMC2T5D **Credits: 4**
Lecture: 4 periods/week **Internal assessment: 40 marks**
Semester end examination: 60 marks

Pre requisites: ---

Course Outcomes
Upon successful completion of the course, the student will be able to

- Describe the overview of wireless sensor networks and enabling technologies for wireless sensor networks (L2)
- Apply the design parameters for the execution environments, with the help of working architectures and operating systems (L3)
- Explore the MAC Protocols for Wireless Sensor networks using various concepts for assignment of MAC addresses (L3)
- Select the appropriate infrastructure, topology, joint routing and information aggregation for wireless sensor networks (L3)
- Analyse the sensor network platform and tools state-centric programming (L4)

Unit-I
Overview of wireless sensor networks: Challenges for wireless sensor networks, characteristic requirements of wireless sensor networks, enabling technologies for wireless sensor networks, advantages of sensor networks, sensor network applications
Architectures
Single-node architecture, hardware components, energy consumption of sensor nodes, operating systems and execution environments, network architecture, sensor network scenarios, optimization goals and figures of merit, gateway concepts

Unit-II
Networking sensors: Physical layer and transceiver design considerations, MAC protocols for wireless sensor networks, low duty cycle protocols and wakeup concepts-S-MAC, the mediation device protocol, wakeup radio concepts, address and name management
Assignment of MAC addresses, naming and addressing, routing protocols, energy-efficient routing, geographic routing

Unit-III
Infrastructure establishment: Topology control, clustering, hierarchical networks by clustering time synchronization, localization and positioning, sensor tasking and control, joint routing and information aggregation

Unit-IV

Sensor network platform and tools: Sensor node hardware, Berkeley motes, programming challenges, node-level software platforms, node-level simulators, state-centric programming.

Learning Resources

Text Books

1. Holger Karl & Andreas Willig, Protocols and Architectures for Wireless Sensor Networks, John Wiley, 2005
2. Sudhakar, Feng Zhao & Leonidas J. Guibas, Wireless Sensor Networks- An Information Processing Approach, Elsevier, 1st Edition 2007
3. Jun Zheng, Abbas Jamalipour, Wireless Sensor Networks- A Networking Perspective, John Wiley & Sons, 1st Ed., 2009

Reference Books

1. Kazem Sohra by, Daniel Minoli, &Taieb Znati, Wireless Sensor Networks-Technology, Protocols, and Applications, John Wiley, 2007
2. Anna Hac, Wireless Sensor Network Designs, John Wiley, 2003
3. Waltenegus Dargie, Christian Poellabauer, Fundamentals of Wireless Sensor Networks, John Wiley & Sons, 1st Ed., 2010

e- Resources & other digital material

1. http://pages.di.unipi.it/bonuccelli/sensori.pdf
2. https://archive.nptel.ac.in/courses/106/105/106105160/

Electromagnetic Meta Materials

22ECMC2T6A **Credits: 4**
Lecture: 4 periods/week **Internal assessment: 40 marks**
Semester end examination: 60 marks

Prerequisites: Electromagnetic field theory, Antenna Theory

Course Outcomes:
At the end of the course Student will be able to

- Express the basic concepts of Meta materials
- Describe the fundamentals of LH Meta materials
- Apply Transmission line theory to Meta materials
- Describe and discuss concept of Two-Dimensional Meta materials

Unit- I
Introduction: Definition of Metamaterials (MTMs) and Left-Handed (LH) MTMs, Theoretical Speculation by Viktor Veselago, Experimental Demonstration of Left-Handedness, Further Numerical and Experimental Confirmations, "Conventional" Backward Waves and Novelty of LH MTMs, Terminology, Transmission Line (TL) Approach, Composite Right/Left-Handed (CRLH) MTMs, MTMs and Photonic Band-Gap (PBG) Structures, Historical "Germs" of MTMs

Unit- II
Fundamentals of LH MTMs: Left-Handedness from Maxwell's Equations, Entropy Conditions in Dispersive Media, Boundary Conditions, Reversal of Doppler Effect, Reversal of Vavilov-Cerenkov Radiation, Reversal of Snell's Law: Negative Refraction, Focusing by a "Flat LH Lens", Fresnel Coefficients, Reversal of Goos-Ḧanchen Effect, Reversal of Convergence and Divergence in Convex and Concave Lenses, Subwavelength Diffraction

Unit- III
TL Theory of MTM: Ideal Homogeneous CRLH TLs, LC Network Implementation, Real Distributed 1D CRLH Structures, Experimental Transmission Characteristics, Conversion from Transmission Line to Constitutive Parameters

Unit- IV
Two-Dimensional MTMs: Eigenvalue Problem, Driven Problem by the Transmission Matrix Method (TMM), Transmission Line Matrix (TLM) Modeling Method, Negative Refractive Index (NRI) Effects, Distributed 2D Structures

Learning Resources

Text Books

1. Christophe Caloz and Tatsuo Itoh, Electromagnetic Metamaterials, Wiley –Inter science, 2006
2. Enader Engheta, Richard W. Ziolkowski, Metamaterials Physics and Engineering, A John Wiley & Sons, Inc., Publication Explorations

References

1. Nader Engheta and Richard W. Ziolkowski, Metamaterials: Physics and Engineering Explorations", IEEE Press and Wiley –Interscience, 2006

E – Resources

1. https://nptel.ac.in/courses/112107290

RF IC Design

22ECMC2T6B **Credits: 4**
Lecture: 4 periods/week **Internal assessment:40 marks**
Semester end examination: 60 marks

Pre-requisites: Analog Electronic Circuits

Course Outcomes
At the end of the course Student will be able to

- Understanding passive components at RF frequencies and required circuit theory for analysis
- Analyze high frequency amplifier design techniques and low noise amplifier configurations
- Distinguish between different types of mixers
- Apply the design considerations of frequency synthesizers at RF frequencies.

Unit-I
Characteristics of passive IC components at RF frequencies – interconnects, resistors, capacitors, inductors and transformers – Transmission lines Classical two-port noise theory, noise models for active and passive components, Noise figure, Friis equation, Nonlinearity and cascaded stages, Sensitivity and dynamic range, Passive impedance transformation

Unit-II
High frequency amplifier design – zeros as bandwidth enhancers, shunt-series amplifier, fT doublers, neutralization and unilateralization Low noise amplifier design – LNA topologies, impedance matching, power constrained noise optimization, linearity and large signal performance, noise canceling LNAs, Constant gm biasing, current reusing technique

Unit-III
Mixers – multiplier-based mixers, subsampling mixers, diode-ring mixers

Unit- IV
Oscillators & synthesizers – describing functions, resonators, negative resistance oscillators, synthesis with static moduli, synthesis with dithering moduli, combination synthesizers – phase noise considerations

Learning Resources

Text Books

1. Thomas H. Lee, Cambridge, The Design of CMOS Radio-Frequency Integrated Circuits, UK: Cambridge University Press, 2004
2. Behzad Razavi, RF Microelectronics, Prentice Hall, 1998

Reference Books

1. Richard Chi-Hsi Li, RF Circuit Design, 2nd Ed., Wiley

E – Resources

1. https://archive.nptel.ac.in/courses/117/102/117102012/

Phased Arrays

22ECMC2T6C **Credits: 4**
Lecture: 4periods/week **Internal assessment: 40 marks**
Semester end examination: 60 marks

Prerequisites: Antennas

Course Outcomes:

At the end of the course Student will be able to

- Design linear arrays with required sidelobes, beam width, bandwidth etc., and determine their directivity
- Formulate the array patterns using Taylor narrow Beam design, Dolph-chebyshev array, Taylor one-parameter distribution, Bickmore-Spellmire two parameter distribution.
- Synthesize the circular planar arrays like flat plane slot array, Circular Bayliss difference pattern, Two-Dimensional Optimization, Ring sidelobe synthesis
- Apply different feeding mechanisms for resonant and travelling wave arrays, measure sidelobe patterns

Unit- I

Basic Array Characteristics: Uniformly Excited Linear Arrays: Patterns, Beam width, Sidelobes, Grating Lobes, Bandwidth, Planar Arrays: Array Coordinates, Beam width, Grating Lobes (Rectangular Lattice, Hexagonal Lattice), Beam Steering and Quantization Lobes: Steering Increment, Steering Bandwidth, Time Delay Deployment, Phaser Quantization Lobes, QL Decollimation: Overlapped Sub-Arrays, Directivity: Linear array directivity, Directivity of Arrays of short Dipoles, Directivity of Arrays of Resonant Elements, Planar array directivity

Unit- II

Linear Array Pattern Synthesis: Introduction: Pattern Formulations, Physics versus Mathematics, Taylor Narrow Beam Design Principles, Dolph-Chebyshev Arrays: Half wave spacing, Spacing less than half wave, Taylor one parameter Distribution: One-parameter design, Bickmore - Spellmire Two parameter distribution, Taylor N-Bar Aperture distribution, Low-sidelobe distributions: Comparison of distributions, Average sidelobe level, Shaped beam synthesis: Woodward-Lawson synthesis, Elliott Synthesis, Thinned Arrays: Parabolistic Design, Space Tapering, Minimum Redundancy Arrays

Unit- III

Planar and Circular Array Pattern Synthesis: Circular Planar Arrays: Flat plane slot array, Hansen One-parameter pattern, Taylor circular n pattern, Circular Bayliss Difference pattern, Difference pattern optimization, Noncircular Apertures: Two-Dimensional Optimization, Ring sidelobe synthesis

Unit- IV

Array feeds and Measurements: Series feeds: Resonant Arrays- Impedance and bandwidth, Resonant slot array design, Travelling Wave Arrays- Frequency Squint and Single Beam condition, Calculation of element conductance, TW slot array design Frequency scanning, Phaser scanning, Shunt feeds: Corporate feeds, distributed feeds, Measurement of Low-sidelobe patterns, Array diagnostics, Wave guide simulators

Learning Resources

Text books

1. R.C.Hansen, Phased Array Antennas, 2nd Ed., 2009, John Wiley & Sons Publications
2. Robert J. Mailloux, Phased Array Antenna Handbook, Second Edition (Artech House Antennas and Propagation Library) 2nd Ed.

Reference Book

1. Arun K. Bhattacharyya, Phased Array Antennas: Floquet Analysis, Synthesis, BFNs and Active Array Systems 1st Ed.

E – Resources

1. https://nptel.ac.in/courses/117107035

Research Methodology

22ECMC2T6D **Credits: 4**

Lecture: 4 periods/week **Internal assessment: 40 marks**

Semester end examination: 60 marks

Prerequisites: ---

Course Outcomes

Upon successful completion of the course, the student will be able to

- Understand basic concepts and its methodologies (L2)
- Demonstrate the knowledge of research processes (L3)
- Apply research articles in their academic projects (L3)
- Analyze various types of testing tools used in research (L4)
- Design a research paper (L4)

Unit-I

Introduction: Meaning of Research, Objectives of Research, Types of Research, Research Approaches.

Research Ethics: Objectives, codes, policies, conventions of publications, ethics for editors, reviewers and publishers, IPR.

Research Problem: What is a Research Problem? , Selecting the Problem, Necessity of Defining a problem.

Research Design –Features of Good Design, Important Concepts related to Research Design, Basic Principles of Experimental Designs

Unit-II

Sampling Design –Sample Design, Sampling and Non-Sampling errors, Goodness of Measurement scales, Sources of error in measurement.

Data Collection Methods – Collection of Primary Data – Collection of Secondary data.

Data Preparation: Data Preparation Process, Some problems in Preparation Process, Missing Values and Outliers, Types of Analysis, Statistics in Research.

Descriptive Statistics: Measures of Central Tendency, Measures of Dispersion, Measures of Skewness, Kurtosis, Measures of Relationship, Association in case of Attributes, Other Measures

Unit-III

Sampling and Statistical Inference: Parametric vs Statistic, Sampling and Non-Sampling errors, Sampling Distribution, Degrees of Freedom, Standard Error.

Testing of Hypothesis: What is a Hypothesis, Basic Concepts Concerning Testing of Hypothesis, Testing the Hypothesis, Test Statistic and Critical Region, Critical Value and Decision Value, Procedure for Hypothesis Testing.

Unit-IV

Interpretation and Report Writing: Meaning of Interpretation, Techniques of Interpretation, Precautions in Interpretation Significance of Report Writing, Different Steps in Writing Report, Layout of a Research Paper, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports

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Learning Resources

Text Books

1. C.R.Kothari, Research Methodology: Methods and Techniques, 2nd Ed., New Age International Publishers,2014.
2. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, An introduction to Research Methodology, RBSA Publishers, U.K., 2002

Reference Books

1. Day, R.A., How to Write and Publish a Scientific Paper, Cambridge University Press, 1992

2. Anthony, M., Graziano, A.M. and Raulin, M.L., Research Methods: A Process of Inquiry, Allyn and Bacon, 2009

e- Resources

1. https://www.youtube.com/watch?v=8iFfzYVuCuM

2. https://onlinecourses.nptel.ac.in/noc22_ge08

3. https://www.youtube.com/watch?v=GSeeyJVD0JU

Wireless Sensor Networks & Antenna Lab

22ECMC2L1 **Credits: 2**
Lecture: --- **Internal assessment: 25 marks**
Lab: 3 periods/week **Semester end examination: 50 marks**

Prerequisites: Microwave Engineering, Wireless Sensor Networks

Course Outcomes:

After the completion of this course, a student will be able to:

- Learn various parameters in microwave engineering and wireless sensor networks
- Analyze RF and microwave networks using various principles containing passive distributed components.
- Analyze the characteristic requirements of wireless sensor networks.
- Apply routing techniques to wireless sensor networks.

Part A: (Any 5 experiments)

Antennas Experiments:

1. Three Port Networks
2. Four-Port Networks
3. Microwave Solid State Devices and amplifiers
4. Electromagnetic Principles
5. Polarization Characteristics of microstrip antenna.
6. Radiation Characteristics of VHF and UHF antennas.

Part B: (Any 5 experiments)

Wireless Sensor Networks Experiments:

1. Distance between two nodes in WSN
2. Finding Shortest path between nodes
3. Node deployment
4. Node Localization
5. Fuzzy Inference System for WSN routing
6. Communication between the nodes for data transmission

Learning Resources

Text Book:

1. Sisodia, M L, and G S. Raghuvanshi, Basic Microwave Techniques and Laboratory Manual. New York: Wiley, 1987
2. Holger Karl & Andreas Willig, Protocols and Architectures for Wireless Sensor Networks, John Wiley, 2005.

Reference Books

1. Kazem Sohra by, Daniel Minoli, &Taieb Znati, Wireless Sensor Networks-Technology, Protocols, and Applications, John Wiley, 2007

1. Anna Hac, Wireless Sensor Network Designs, John Wiley, 2003

2. Waltenegus Dargie, Christian Poellabauer, Fundamentals of Wireless Sensor Networks, John Wiley & Sons, 1st Ed., 2010

e- Resources & other digital material

1. http://pages.di.unipi.it/bonuccelli/sensori.pdf
2. https://archive.nptel.ac.in/courses/106/105/106105160/
3. https://archive.nptel.ac.in/courses/108/101/108101092/

Mini Project

22ECMC2L2 **Credits: 2**
Lecture: --- **Internal assessment: 25 marks**
Lab: 3 periods/week **Semester end examination: 50 marks**

COURSE OUTCOMES:

After completion of the course, student should be able to

- Formulate a real world problem and identify its requirements
- Express technical ideas, strategies and methodologies in oral and document form.
- Self-learn new software tools, methodologies and/or experimental techniques that contribute to the solution of the project.

Guidelines:

Project Selection: Select a project topic that aligns with your interests and the specialization area the program. Consult with your faculty advisor to ensure the feasibility and relevance of the project.

Literature Review: Conduct a thorough literature review to understand the existing research and technologies related to your chosen project topic. This will help you identify the current state-of-the-art, potential challenges, and possible solutions.

Project Proposal: Prepare a project proposal outlining the objective, scope, methodology, and expected outcomes of your project. Submit the proposal to your faculty advisor for their feedback and approval.

Project Planning: Create a detailed project plan with a timeline, milestones, and tasks.

Research and Development: Carry out the necessary research and development activities to achieve the project objectives. This may involve designing and implementing algorithms, developing software or hardware systems, conducting experiments, or performing simulations.

Experimentation and Testing: If applicable, design experiments to validate your project's functionality or performance. Perform rigorous testing and collect relevant data to support your project's findings. Analyze the results and draw meaningful conclusions.

Implementation and Demonstration: Implement the project solution or prototype as planned. Prepare for a demonstration of your project to showcase its functionality and potential applications. Practice your presentation skills to effectively communicate your work.

Final Project Report: Write a comprehensive final project report detailing your project's objectives, methodology, implementation, results, and conclusions.

Presentation and Evaluation: Prepare a presentation summarizing your project work. Deliver a clear and concise presentation to a panel of evaluators, including your faculty advisor. Be prepared to answer questions and provide clarifications about your project during the evaluation process.

Pedagogy Training/ Industrial Training

22ECMC3TR **Credits: 2**

Interaction Session: -- **Internal assessment: 75marks**

Course Outcomes:

After completion of the course, student should be able to

Pedagogy

- Prepare lesson plans effectively
- Understand different teaching methods
- Deliver lectures

Industrial Training

- Understand the real working environment
- Apply technical knowledge to realistic situations
- Express technical ideas, strategies and methodologies in oral and document form

Pedagogy Training

First Week

Preparation of lesson plan

Second Week

Study of different teaching methods

Third Week

Demo Classes to be given for UG students

Fourth Week

Evaluation of teaching performance

Industrial Training

First Week

Identification of Industry for training

Second Week

Observation of the working strategies in the industries

Third Week

Identifying and demonstration of the effective methods to the existed methods

Fourth Week

Preparation of documentation

Dissertation Part-A

22ECMC3DS - **Credits: 6**
Lecture: --- **Internal assessment: 50 marks**
Lab: -- **Semester end examination: --**

Course Outcomes:

After completion of the course, student should be able to

- Exposure to research and development procedures, latest developments in the selected research area.
- Demonstrate technical ideas, strategies and methodologies to peer team

Week 1-10 (II Year- First Semester)

Literature Survey, Defining Problem & Proposed methodology along with Status Report-1

Week 11-20 (II Year- First Semester)

Analysis & Design along with Status Report-2

Dissertation Part-B

22ECMC4DS-B **Credits: 10**
Lecture: --- **Internal assessment: 50 marks**
Lab: -- **Semester end examination:100 marks**

Course Outcomes:

After completion of the project, student should be able to

- Get the solution to industrial / theoretical problems
- Publish research findings in National or International conference/ Journals.
- Express technical ideas, strategies and methodologies in oral and document form

Week 21-30 (II Year-Second Semester)

Development of methodology for considered problem with validation along with Status Report-3

Week 31-40 (II Year-Second Semester)

Testing & Paper Publishing along with Status Report-4