ANDHRA UNIVERSITY

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

PROGRAM : M.TECH(RADAR AND MICROWAVE ENGINEERING)

REGULATION AND SYLLABUS

EFFECTIVE FROM 2019-2020 BATCH

M.Tech (R&M), B.Tech+M.Tech(5/6 and 6/6), Two Year (Four Semesters)

Scheme to be valid with effect from the admitted batch of 2019 – 2020

I SEMESTER

Subject Code	Name of the Subject	Periods/Week		Max. Marks		Total	Credits
		Theory	Lab	Ext.	Int.		
MTRM-1.1	Digital Signal processing	3	-	70	30	100	3
MTRM-1.2	Microwave components and networks	3	-	70	30	100	3
MTRM-1.3	Elective – I Optical fiber and Communications/ Nano Technologies and Applications/ Modern RADAR Systems	3	-	70	30	100	3
MTRM-1.4	Elective – II EMI/EMC / Artificial intelligence and neural networks/Microprocessor Systems	3	-	70	30	100	3
MTRM-1.5	Research Methodology & IPR	3	-	70	30	100	2
MTRM-1.6	Audit Course	3	-	70	30	100	0
MTRM-1.7	Antenna LAB-I	-	3	-	100	100	2
MTRM-1.8	Signal Processing LAB	-	3	-	100	100	2
	Total	18	06	420	380	800	18

II SEMESTER

Subject Code	Name of the Subject	Periods/Week		Max. Marks		Total	Credits
		Theory	Lab	Ext.	Int.		
MTRM-2.1	RF and Microwave Engineering	3	-	70	30	100	3
MTRM-2.2	GPS and Applications	3	-	70	30	100	3
MTRM-2.3	Elective – III Cellular and Mobile Communications/ Stealth technologies/ Application Specific Integrated Circuits (ASIC)	3	-	70	30	100	3
MTRM-2.4	Elective – IV Micro controllers and Embedded Systems/Digital Image Processing/ Wireless communications and networks	3	-	70	30	100	3
MTRM-2.5	Audit Course	3	-	70	30	100	0
MTRM-2.6	Antenna LAB-II		3	-	100	100	2
MTRM-2.7	Microwave Engineering LAB	-	3	-	100	100	2
MTRM-2.8	Mini Project With Seminar	-	3	-	100	100	2
	Total	15	9	350	450	800	18

III SEMESTER

Subject Code	Name of the Subject	Periods/Week		Max. Marks		Total	Credits
		Theory	Lab	Ext.	Int.		
MTRM-3.1	Elective – V Phased Array Radar/ DSP processor and Architecture/ Remote Sensing and Sensors	3	-	70	30	100	3
MTRM-3.2	Open Elective Computer and Communications Networks /Business Analytics/Industrial Safety/ Operational Research/Cost Management of Engineering Projects	3	-	70	30	100	3
MTRM-3.3	Dissertation- I / Industrial Project	-	-	-	100	100	10
	Total	6	-	140	160	300	16

IV SEMESTER

Subject Code	Name of the Subject	Periods/Week		Max. Marks		Total	Credits
		Theory	Lab	Ext.	Int.		
MTRM-4.1	Dissertation- II	-	-	70	30	100	16
	Total	-	-	70	30	100	16

Note:

1. **At the end of 3rd semester project review is conducted by HOD with the committee consisting of the HOD, Chair Person of BOS and the Guide. In the Affiliated Colleges, Project (Preliminary) will be evaluated by concerned HOD and the thesis Guide of their respective colleges.**
2. **At the end of the 4th semester there will be a final viva voce for the project work conducted by the HOD with the committee consisting of HOD, Chair Person of BOS, the Guide and an External examiner nominated by the university.**

Audit Course 1 & 2

1. English for Research Paper Writing
2. Disaster Management
3. Sanskrit for Technical Knowledge
4. Value Education
5. Constitution of India
6. Pedagogy Studies
7. Stress Management by Yoga
8. Personality Development through Life Enlightenment Skills.

Andhra University College of Engineering

Andhra University

Department of Electronics and Communication Engineering

PROGRAMME: 1

PROGRAMME: B.Tech (Electronics and Communication Engineering)

Programme Specific Outcomes (PSOs)

The Graduate of ECE will be able to:

PSO-1	Graduates will be able to apply fundamental knowledge of Electronics and Communication Engineering to identify, investigate and solve various real-life problems in the field of Electronics.
PSO-2	Graduates will be able to design and develop systems in the emerging electronics and communication allied disciplines to meet out the industry challenges.
PSO-3	Graduates will be able to demonstrate the leadership qualities and strive for the betterment of organization, environment and society with professional and ethical responsibilities.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

The Graduates of ECE will be able to:

1. To provide an in-depth knowledge in the fundamental and advanced areas of electronics and communication engineering and there by excel in professional career and/or higher education.

2. To train students in the software/hardware design of electronics and communication systems and can promote the development of research activity as well as innovation and entrepreneurship that caters to theneed of Industry and Society.

3. To develop technical skill set for solving real life problems.

4. To develop qualities like creativity, leadership, team work, and professional ethics for contributing towards the growth and development of society.

5. To inculcate in students professional and ethical attitude, and an ability to relate engineering issues to broader social context.

PROGRAMME OUTCOMES (POs)

Program Outcomes		**ECE Graduates will be able to**
PO1	Engineering knowledge	Apply the knowledge of mathematics, science, engineering fundamentals to real time electronics and communication problems

PO2	Problem analysis	Provide solutions for ECE problems by Identify, formulate, review literature, analyze, designing and conducting experiments, interpreting and reporting the results.
PO3	Design/development of solutions	Design and develop solutions for complex engineering problems at feasible and optimal solutions that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	Conduct investigations of complex problems	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	Modern tool usage	Select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6	The engineer and society	Apply contextual knowledge to assess industrial, societal and safety related issues and understand consequent relevance to the professional engineering practice.
PO7	Environment and sustainability	Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	Ethics	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	Individual and team work	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	Communication	Communicate effectively on complex engineering activities with the engineering community and with societyat large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	Project management and finance	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	Life-long learning	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME: 2

PROGRAMME: B.Tech + M.Tech (Electronics and Communication Engineering)

Programme Specific Outcomes (PSOs)

The Graduate of ECE will be able to:

PSO-1	Graduates will be able to apply fundamental knowledge of Electronics and Communication Engineering to identify, investigate and solve various real-life problems in the field of Electronics.
PSO-2	Graduates will be able to design and develop systems in the emerging electronics and communication allied disciplines to meet out the industry challenges.
PSO-3	Graduates will be able to demonstrate the leadership qualities and strive for the betterment of organization, environment and society with professional and ethical responsibilities.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

The Graduates of ECE will be able to:

1. To provide an in-depth knowledge in the fundamental and advanced areas of electronics and communication engineering and there by excel in professionalcareer and/or higher education.

2. To train students in the software/hardware design of electronics and communication systems and can promote the development of research activity as wellas innovation and entrepreneurship that caters to theneed of Industry and Society.

3. To develop technical skill set for solving real life problems.

4. To develop qualities like creativity, leadership, team work, and professional ethics forcontributing towards the growth and development of society.

5. To inculcate in students professional and ethical attitude, and an ability to relate engineering issues to broader social context.

PROGRAMME OUTCOMES (POs)

Program Outcomes		**ECE Graduates will be able to**
PO1	Engineering knowledge	Apply the knowledge of mathematics, science, engineering fundamentals to real time electronics and communication problems.
PO2	Problem analysis	Provide solutions for ECE problems by Identify, formulate, review literature, analyze, designing and conducting experiments, interpreting and reporting the results.

PO3	Design/development of solutions	Design and develop solutions for complex engineering problems at feasible and optimal solutions that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	Conduct investigations of complex problems	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	Modern tool usage	Select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6	The engineer and society	Apply contextual knowledge to assess industrial, societal and safety related issues and understand consequent relevance to the professional engineering practice.
PO7	Environment and sustainability	Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	Ethics	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	Individual and team work	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	Communication	Communicate effectively on complex engineering activities with the engineering community and with societyat large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	Project management and finance	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	Life-long learning	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME: 3

PROGRAMME: M.Tech (Electronic Instrumentation)

Programme Specific Outcomes (PSOs)

The Post Graduate of EI will be able to:

PSO-1	Analyze specific problems relevant to Electronic Instrumentation by applying the knowledge of basic sciences, Instrumentation fundamentals and advancements to solve technical problems.
PSO-2	Electronic Instrumentation Engineers, including supportive and leadership roles in multidisciplinary domain and Design of electronic devices, software and hardware using the significant analytical knowledge in instrumentation by applying modern tools.
PSO-3	Apply and transfer interdisciplinary systems and Engineering approaches to the various areas like communication etc.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

The Post Graduates of EI will be able to:

1. Identify and apply appropriate experimental and analytical skills to solve real world problems in Electronic Instrumentation field to create innovative products and systems.
2. Develop technical skills and apply appropriate techniques to formulate and analyze engineering problems in Instrumentation and Process Control.
3. Pursue career in research in multidisciplinary areas of signal processing, image processing and instrumentation domain through self-learning and self-directed on futuristic cutting-edge technologies.
4. Analyze technical problems and develop feasible, optimal, environmentally and socially acceptable solutions by applying research skills, technological knowledge and modern tools while working individually and in teams.
5. Students will be able to function professionally in rapidly changing world due to advances in electronics and related technologies in order to contribute to the needs of the society.

PROGRAMME OUTCOMES (POs)

Program Outcomes		**EI Post Graduates will be able to**
PO1	Engineering knowledge	Acquire in depth knowledge in the domain of Electronic Instrumentation Engineering.

PO2	Problem analysis	Understand various Electronic and Instrumentation strategies and their applications for various types of systems.
PO3	Design/development of solutions	Design solutions for complex Electronic Instrumentation problems and design components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal and environmental considerations.
PO4	Conduct investigations of complex problems	Demonstrate implementation skills using advanced software and processing techniques.
PO5	Modern tool usage	Use recent state-of-the-art simulation tools in the field of BioMedical engineering such as MATLAB, MULTISIM, PYTHON, LABVIEW and other Tools.
PO6	The engineer and society	Be capable of contribute positively to collaborative and multidisciplinary research to achieve common goals.
PO7	Environment and sustainability	Demonstrate knowledge and understanding of Electronic Instrumentation engineering and management principles and Undertake research in emerging areas of Instrumentation with due consideration to economical, Environment and financial factors.
PO8	Ethics	Become aware of social issues and become socially responsible and follow ethical practices to contribute to the community for sustainable development of society.
PO9	Individual and team work	Capable of analyzing the work independently and reflective learning while developing project in the team with multidisciplinary settings.
PO10	Communication	Communicate confidently, make effective presentations and write good reports to engineering community and society.
PO11	Project management and finance	Independently observe and examine critically the outcomes of his/her actions, apply corrective measures subsequently and move forward positively through a self-corrective approach.
PO12	Life-long learning	Recognize the need for life-long learning and have the ability to do it independently in the domain of Electronic Instrumentation engineering.

PROGRAMME: 4

PROGRAMME: M.Tech (Radar and Microwave)

Programme Specific Outcomes (PSOs)

The Post Graduate of R&M will be able to:

PSO-1	To analyze, design and develop solutions for the real time problems and to apply the technical knowledge for developing quality products for Radar and Microwave industry.	
PSO-2	To adapt to emerging information and communication technologies and to develop innovative ideas and solutions in Radar and Microwave.	
PSO-3	To design Radar and Microwave containing devices, software, and hardware by applying relevant modern tools.	

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

The Post Graduates of R&M will be able to:

1. Work in educational, R&D institutes, industry, and as an entrepreneur in Radar & Microwave.

2. Pursue their doctoral studies and research in institutes of high repute in India & abroad and develop independent and lifelong learning skills for continuous professional development.

3. Analyze technical problems and develop feasible, optimal, environmentally, and socially acceptable solutions by applying research skills, technical knowledge, and modern tools while working individually and in teams.

4. To inculcate the culture of research-oriented projects in the Radar and Microwave field.

5. Demonstrate an ability to communicate effectively and practice professional ethics and Social responsibility in their career.

PROGRAMME OUTCOMES (POs)

Program Outcomes		R&M Post Graduates will be able to
PO1	Engineering knowledge	Acquire in-depth knowledge of RF and Microwave communication with an ability to evaluate, analyze and Synthesize complex problems.
PO2	Problem analysis	Conceptualize and solve engineering problems, to arrive at optimal solutions, considering public health and safety, societal and environmental factors.
PO3	Design/development of solutions	Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	Conduct investigations of complex problems	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	Modern tool usage	Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6	The engineer and society	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	Environment and sustainability	Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	Ethics	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	Individual and team work	Function effectively as an individual, and as a number or leader in diverse teams and in multidisciplinary settings.

PO10	Communication	Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations and give and receive clear instructions.
PO11	Project management and finance	Demonstrate knowledge and understanding of the engineering and management principles and apply there to one's own work, add a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	Life-long learning	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME: 5

PROGRAMME: M.Tech (VLSI)

Programme Specific Outcomes (PSOs)

The Post Graduate of VLSI will be able to:

PSO-1	An ability to understand the concepts of VLSI and to master the latest tools and techniques used in the field of research and industry.
PSO-2	To adapt to emerging information and communication technologies and to develop innovative ideas and solutions in VLSI.
PSO-3	An understanding of social awareness & environmental wisdom along with ethical responsibility to achieve a successful career and to sustain passion and zeal for real world applications.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

The Post Graduates of VLSI will be able to:

1. Identify and apply appropriate experimental and analytical skills to solve real world problems in VLSI to create innovative products and systems.

2. Pursue their doctoral studies and research in institutes of high repute in India & abroad and develop independent and lifelong learning skills for continuous professional development.

3. Students will be able to function professionally in rapidly changing world due to the advances in VLSI and related technologies in order to contribute to the needs of the society.

4. Develop an ability to analyze the problem, understand the technical requirements, design and deliver engineering solutions and create effective product design.

5. To inculcate the culture of research-oriented projects in VLSI.

PROGRAMME OUTCOMES (POs)

Program Outcomes		**VLSI Post Graduates will be able to**
PO1	Engineering knowledge	Apply the knowledge of mathematics, science, engineering fundamentals to real time electronics and communication problems.

PO2	Problem analysis	Provide solutions for ECE problems by Identify, formulate, review literature, analyze, designing and conducting experiments, interpreting and reporting the results.
PO3	Design/development of solutions	Design and develop solutions for complex engineering problems at feasible and optimal solutions that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	Conduct investigations of complex problems	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	Modern tool usage	Select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6	The engineer and society	Apply contextual knowledge to assess industrial, societal and safety related issues and understand consequent relevance to the professional engineering practice.
PO7	Environment and sustainability	Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	Ethics	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	Individual and team work	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	Communication	Communicate effectively on complex engineering activities with the engineering community and with societyat large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	Project management and finance	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	Life-long learning	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME: 6

PROGRAMME: M.Tech (BioMedical Engineering)

Programme Specific Outcomes (PSOs)

The Post Graduate of BME will be able to:

PSO-1	Analyze specific problems relevant to BioMedical Engineering by applying the knowledge of basic sciences, BioMedical Instrumentation fundamentals and advancements to solve technical problems.
PSO-2	To adapt emerging technologies and to develop innovative ideas and solutions in Biomedical Engineering.
PSO-3	An ability to make use of acquired technical knowledge to get employed in the field of BioMedical.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

The Post Graduates of BME will be able to:

1. Identify and apply appropriate experimental and analytical skills to solve real world problems in the field of BioMedical Engineering to create innovative products and systems.
2. Develop technical skills and apply appropriate techniques to formulate and analyze engineering problems in BioMedical Instrumentation.
3. Pursue career in research in multidisciplinary areas of Biomedical signal processing, Biomedical image processing and instrumentation domain.
4. Analyze technical problems and develop feasible, optimal, environmentally and socially acceptable solutions by applying research skills, technological knowledge and modern tools while working individually and in teams.
5. Students will be able to function professionally in rapidly changing world due to advances in Biomedical and related technologies in order to contribute to the needs of the society.

PROGRAMME OUTCOMES (POs)

Program Outcomes		**BME Post Graduates will be able to**
PO1	Engineering knowledge	Acquire in depth knowledge in the domain of BioMedical Engineering.
PO2	Problem analysis	Understand various BioMedical strategies and their applications for various types of systems.

PO3	Design/development of solutions	Design solutions for complex Biomedical problems and design components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal and environmental considerations.
PO4	Conduct investigations of complex problems	Demonstrate implementation skills using advanced software and processing techniques.
PO5	Modern tool usage	Use recent state-of-the-art simulation tools in the field of BioMedical engineering such as MATLAB, PYTHON, LABVIEW and other Tools.
PO6	The engineer and society	Be capable of contribute positively to collaborative and multidisciplinary research to achieve common goals.
PO7	Environment and sustainability	Demonstrate knowledge and understanding of BioMedical engineering and management principles and Undertake research in emerging areas of BioMedical with due consideration to economical, Environment and financial factors.
PO8	Ethics	Become aware of social issues and become socially responsible and follow ethical practices to contribute to the community for sustainable development of society.
PO9	Individual and team work	Capable of analyzing the work independently and reflective learning while developing project in the team with multidisciplinary settings.
PO10	Communication	Communicate confidently, make effective presentations and write good reports to engineering community and society.
PO11	Project management and finance	Independently observe and examine critically the outcomes of his/her actions, apply corrective measures subsequently and move forward positively through a self-corrective approach.
PO12	Life-long learning	Recognize the need for life-long learning and have the ability to do it independently in the domain of BioMedical engineering.

M.Tech (R&M), B.Tech+M.Tech(5/6 and 6/6), Two Year (Four Semesters)

Scheme to be valid with effect from the admitted batch of 2019 – 2020

I SEMESTER

Subject Code	Name of the Subject	Periods/Week		Max. Marks		Total	Credits
		Theory	Lab	Ext.	Int.		
MTRM-1.1	Digital Signal processing	3	-	70	30	100	3
MTRM-1.2	Microwave components and networks	3	-	70	30	100	3
MTRM-1.3	Elective – I Optical fiber and Communications/ Nano Technologies and Applications/ Modern RADAR Systems	3	-	70	30	100	3
MTRM-1.4	Elective – II EMI/EMC / Artificial intelligence and neural networks/Microprocessor Systems	3	-	70	30	100	3
MTRM-1.5	Research Methodology & IPR	3	-	70	30	100	2
MTRM-1.6	Audit Course	3	-	70	30	100	0
MTRM-1.7	Antenna LAB-I	-	3	-	100	100	2
MTRM-1.8	Signal Processing LAB	-	3	-	100	100	2
	Total	18	06	420	380	800	18

II SEMESTER

Subject Code	Name of the Subject	Periods/Week		Max. Marks		Total	Credits
		Theory	Lab	Ext.	Int.		
MTRM-2.1	RF and Microwave Engineering	3	-	70	30	100	3
MTRM-2.2	GPS and Applications	3	-	70	30	100	3
MTRM-2.3	Elective – III Cellular and Mobile Communications/ Stealth technologies/ Application Specific Integrated Circuits (ASIC)	3	-	70	30	100	3
MTRM-2.4	Elective – IV Micro controllers and Embedded Systems/Digital Image Processing/ Wireless communications and networks	3	-	70	30	100	3
MTRM-2.5	Audit Course	3	-	70	30	100	0
MTRM-2.6	Antenna LAB-II		3	-	100	100	2
MTRM-2.7	Microwave Engineering LAB	-	3	-	100	100	2
MTRM-2.8	Mini Project With Seminar	-	3	-	100	100	2
	Total	15	9	350	450	800	18

III SEMESTER

Subject Code	Name of the Subject	Periods/Week		Max. Marks		Total	Credits
		Theory	Lab	Ext.	Int.		
MTRM-3.1	Elective – V Phased Array Radar/ DSP processor and Architecture/ Remote Sensing and Sensors	3	-	70	30	100	3
MTRM-3.2	Open Elective Computer and Communications Networks /Business Analytics/Industrial Safety/ Operational Research/Cost Management of Engineering Projects	3	-	70	30	100	3
MTRM-3.3	Dissertation- I / Industrial Project	-	-	-	100	100	10
	Total	6	-	140	160	300	16

IV SEMESTER

Subject Code	Name of the Subject	Periods/Week		Max. Marks		Total	Credits
		Theory	Lab	Ext.	Int.		
MTRM-4.1	Dissertation- II	-	-	70	30	100	16
	Total	-	-	70	30	100	16

Note:

1. **At the end of 3rd semester project review is conducted by HOD with the committee consisting of the HOD, Chair Person of BOS and the Guide. In the Affiliated Colleges, Project (Preliminary) will be evaluated by concerned HOD and the thesis Guide of their respective colleges.**
2. **At the end of the 4th semester there will be a final viva voce for the project work conducted by the HOD with the committee consisting of HOD, Chair Person of BOS, the Guide and an External examiner nominated by the university.**

Audit Course 1 & 2

1. English for Research Paper Writing
2. Disaster Management
3. Sanskrit for Technical Knowledge
4. Value Education
5. Constitution of India
6. Pedagogy Studies
7. Stress Management by Yoga
8. Personality Development through Life Enlightenment Skills.

DIGITAL SIGNAL PROCESSING

Credits: 3

Subject Code: MTRM – 1.1 **Max. Marks:** 70

Semester-I **Sessionals:** 30

Course Educational Objective

To provide an insight into the basic concepts of

CEO 1 advanced digital filter design techniques
CEO 2 multirate DSP and linear prediction and optimum liner filters.
CEO 3 signal Processing Hardware
CEO 4 applications of DSP

Course Outcomes

By the end of the course the student will be able to

CO 1 advanced digital filter design techniques
CO 2 multirate DSP and linear prediction and optimum liner filters.
CO 3 signal Processing Hardware
CO 4 applications of DSP

Chapter – I : Advanced digital filter design techniques : Multiple band optimal FIR filters – design of filters with simultaneous constraints in time and frequency response, optimization methods for designing IIR filters, comparison of optimum FIR filters and delay equalized elliptic filters.

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand various multiple band optimal FIR filters

LO2 Outline comparison of optimum FIR filters and delay equalized elliptic filters.

Chapter – II : Multirate DSP : The basic sample rate alteration – time – domain characterization, frequency – domain characterization : Cascade equivalences, filters in sampling rate alteration systems, digital filter banks and their analysis and applications, multi level filter banks, estimations of spectra from finite – duration observation of signals.

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand various multi level filter banks

LO2 Outline multirate DSP.

Chapter – III: linear prediction and optimum liner filters : forward and backward linear prediction, AR Lattice and ARMA lattice – ladder filters, Wieners filters for filtering prediction.

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand linear prediction and optimum liner filters

LO2 Outline multirate DSP.

Chapter – IV : DSP Algorithms : The Goertzel algorithm, the chirp – z transform algorithm the Levinson – Durbin algorithms, the Schur algorithm, and other algorithms, computations of the DFT, concept of tunable digital filters.

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand DSP Algorithms

LO2 Outline concept of tunable digital filters.

Chapter – V: Signal Processing Hardware : Multipliers, dividers, different forms of FIR Hardware, multiplexing, DTTR, TDM to FDM translator, realization of frequency synthesizer, FET hardware realization, different FFT architectures, special FFT processors, convolvers, Lincoln laboratory FDP and the compatible computer configurations.

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand the compatible computer configurations

LO2 Outline concept of Signal Processing Hardware.

Chapter – VI: Applications of DSP :

a) Speech : Model of speech production, speech analysis – synthesis system vocoder analyzers and synthesizers, linear prediction of speech.

b) DTMF System

Text Books :

1. Theory and applications of digital signal processing by Lawrence R. Rabiner and Bernard Gold, PHI

2. Digital Signal Processing. Principles, algorithms, and applications by John G. Proakis and Dimitris G. Manolakis, PHI, 1997.

3. Digital Signal Processing, A Computer – Based approach, by Sanjit K. Mitra, Tata Mc Graw- Hill, 1998

MICROWAVE COMPONENTS AND NETWORKS

Credits: 3

Subject Code: MTRM – 1.2 **Exam Marks:** 70

Semester-I **Sessionals:** 30

Course Educational Objective

To provide an insight into the basic concepts of

CEO 1 microwaves and applications
CEO 2 microwave tubes.
CEO 3 scattering matrix parameters of microwave networks
CEO 4 microwave Passive components.
CEO 5 microwave Integrated Circuits
CEO 6 microwave measurements

Course Outcomes

By the end of the course the student will be able to discuss about

CO 1 microwaves and applications
CO 2 microwave Tubes.
CO 3 scattering matrix parameters of microwave networks
CO 4 microwave Passive components.
CO 5 microwave Integrated Circuits
CO 6 microwave measurements

1. Introduction to microwaves and applications, advantages of microwaves, EM spectrum domain, electric and magnetic fields static electric and magnetic fields, time varying electric and magnetic fields, electromagnetic field equations, Maxwell's equations for time-varying fields, meaning of Maxwell's equations, characteristics of free space, power flow by microwaves, expression for propagation constant of a microwave in conductive medium, microwave applications, relation between dB, dBm, dBw.

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand microwaves and its applications

LO2 Outline comparison of electric and magnetic fields.

2. Microwave Tubes

Limitation of conventional tubes, microwave tubes, velocity modulation, method of producing the velocity modulation, principle of operation of two cavity klystron, reflex klystron principle of operation, velocity modulation in reflex klystron, applegate diagram with gap voltage for a reflex klystron. Principle of operation of magnetron, hull cutoff condition, advantages of slow wave devices, principle of operation of TWT.

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand various principle operations of microwave devices.

LO2 Outline comparison of microwave Tubes.

3. Microwave Semiconductor Devices

Microwave bipolar transistor, FET, Principle of Operation and application of tunnel diode, Principle of operation of gunn diode, application of gunn diode advantages of gunn diode, principle of operation of PIN diode, applications of PIN diode.

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand principle operation of semiconductor devices

LO2 Understand various semiconductor devices.

4. Scattering Matrix Parameters of microwave networks

Definition of scattering matrix, characteristics of S-matrix, scattering matrix of a two-port network, salient features of S-matrix, salient features of multiport network, losses in microwave circuits, return loss, insertion loss, transmission loss, reflection loss, impedance
matrix, short circuit admittance parameters of a -network, S-matrix of series element in the transmission line, S-matrix for E-plane Tee junction, S-matrix for H-plane Tee junctions, S- matrix for directional coupler.

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand various scattering matrix parameters of microwave networks

LO2 Outline concepts of elements in the transmission line.

5. Microwave Passive components

Rectangular waveguides resonator isolator, types of attenuators, fixed attenuators, step attenuators, variable attenuators, salient features of directional coupler, parameters of directional coupler, coupling factor, directivity, applications of directional coupler.

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand various microwave passive components

LO2 Outline applications of directional coupler.

6. Microwave Integrated Circuits

Salient features of MICs, types of electronic circuits, monolithic microwave integrated circuits (MMICs), film integrated circuit, advantages of MMICs, Basic materials used in MMIC fabrication, examples, characteristics and properties of substrate, conductor, dielectric and resistive materials, MMIC fabrication techniques, diffusion and ion implantation, oxidation and film deposition, epitaxial growth, lithography, etching and photo resist, deposition methods, steps involved in the fabrication of MOSFET

7. Microwave measurements

Measurement of VSWR, attenuation and frequency.

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand various microwave integrated circuits

LO2 Understand various microwave measurements

Textbooks

1. "Microwave and Radar Engineering" by Gottapu Sasi Bhushana Rao, ISBN – 978813179944 Pearson Education, 2013.
2. “Microwave Engineering” by Prof. GSN Raju, IK International Publishers, 2007

References Books

1. “Microwave Engineering” by P.A. Rizzi, PHI, 1999.
2. “Microwave Engineering : Non-reciprocal active and passive circuits” by Joseph Helszajin, McGraw Hill, 1992.

ELECTIVE I

OPTICAL FIBERS AND APPLICATIONS

Credits : 3

Subject Code : MTRM – 1.3 **Max. Marks :** 70

Semester-I **Sessionals :** 30

Course Educational Objective

To provide an insight into the basic concepts of

CEO 1 optic fiber waveguides
CEO 2 light sources and detectors.
CEO 3 couplers and connectors
CEO 4 modulation, noise and detection.
CEO 5 system design and fiber optical applications

Course Outcomes

By the end of the course the student will be able to discuss about

CO 1 optic fiber waveguides
CO 2 light sources and detectors.
CO 3 couplers and connectors
CO 4 modulation, noise and detection.
CO 5 system design and fiber optical applications

1. Optic Fiber Waveguides

Step – Index Fiber, Graded – Index Fiber, Attenuation, Modes in Step-Index Fibers, Modes in Graded – Index Fibers, Pulse Distortion and Information Rate in Optic Fibers, Construction of Optic Fibers, Optic Fibers, Optic Fiber Cables,

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts of optic fiber waveguides

LO2 Outline construction of optic fibers

2. Light Sources and Detectors

Light-Emitting Diodes, Light-Emitting – Diodes Operating Characteristics, Laser Principles, Laser Diodes, Laser-Diode Operating Characteristics, Distributed – Feedback Laser Diode, Optical Amplifiers, Fiber Laser, Vertical-Cavity Surface-Emitting Laser Diodes

Principles of Photodetection, Photomultiplier, Semiconductor Photodiode, PIN Photodiode, Avalanche Photodiode,

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts of light sources and detectors

LO2 Outline construction principles of various diodes

3. Couplers and Connectors

Principles, Fiber end Preparation, Splices, Connectors, Source Coupling, Distribution Networks and Fiber Components, Distribution Networks, Directional Couplers, Star Couplers, Switches, Fiber Optical Isolator, Wavelength-Division Multiplexing, Fiber Bragg Gratings, Other Components : Attenuator, Circulator and Polarization Controlleroptic fiber waveguides

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts of couplers and connectors

LO2 Outline Other Components

4. **Modulation, Noise and Detection**

Light-Emitting-Diode Modulation and Circuits, Laser-Diode Modulation and Circuits, Analog-Modulation Formats, Digital-Modulation Formats, Optic Heterodyne Receivers, Thermal and Shot Noise, Signal-to-Noise Ratio, Error Rates, Modal Noise, Amplifier Noise, Laser Noise, and Jitter, Additional Noise Contributors, receiver Circuit Design

5. **System Design and Fiber Optical Applications**

Analog System Design, Digital System Design, Applications of Fiber Optics

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts of modulation, noise and detection

LO2 Outline various microwave measurements.

Text Book :

1. Fiber Optic Communications, Joseph. C. Palais, Pearson Education, Asia, 2002

References :

1. Fiber Optic Systems, John Powers, Irwin Publications, 1997

2. Optical Fiber Communication, Howes M.J., Morgen, D.V John Wiely

ELECTIVE I

NANOTECHNOLOGY AND APPLICATIONS

Credits : 3

Subject Code : MTRM – 1.3 **Exam Marks :** 70

Semester-I **Sessionals :** 30

Course Educational Objective

To provide an insight into the basic concepts of

CEO 1 essence of nanotechnology
CEO 2 concepts of nano materials.
CEO 3 carbon nano structures
CEO 4 diagnosing personal health and medical applications.
CEO 5 biological materials

Course Outcomes

By the end of the course the student will be able to discuss about

CO 1 essence of nanotechnology
CO 2 concepts of nano materials.
CO 3 carbon nano structures
CO 4 diagnosing personal health and medical applications.
CO 5 biological materials

Unit 1 : Introduction to Nanotechnology

Essence of Nanotechnology, Nano in daily life, Brief account of nano applications, Properties of nano materials, Metal nano clusters, Semiconductor nano particles.

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts of semiconductor nano particles

LO2 Outline concepts of nanotechnology

Unit 2 : Nano Materials

Nano composites, Nanofying electronics, Sensing the environment, Mechanising the micro world, Energy and cleaner environment with nano technology.

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts of nano materials

LO2 Outline concepts of environment with nano technology

Unit 3 : Carbon Nano Structures

Introduction, Carbon molecules, Carbon clusters, Carbon nanotubes, Applications of carbon nanotubes.

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts of carbon nano structures

LO2 Outline concepts of carbon nanotubes.

Unit 4 : Diagnosing Personal Health and Medical Applications

Lab on a chip, Super X-ray vision, Mapping the genes, Understanding how pharmaceutical company develops drugs, Delivering a new drug the Nanotech way, Cooking cancer with nano cells, Biomimetics.

Learning Outcomes: By the end of this unit students will be able to:

LO1 Outline concepts of nano cells, biomimetics.

LO2 Discuss concepts of diagnosing personal health and medical applications

Unit 5 : Biological Materials

Introduction, Biological building blocks, Nucleic acids, Biological nanostructures.

Learning Outcomes: By the end of this unit students will be able to:

LO1 Outline concepts of biological materials

LO2 Discuss concepts of biological nanostructures

Textbooks

1. Nanotechnology by Richard Booker, Earl Boysen, Wiley Publishing Inc., 2006.
2. Introduction to Nanotechnology by Charles P. Poole Jr., Frank J. Owens, John Wiley & Sons Publications, 2003.

ELECTIVE I

MODERN RADAR SYSTEMS

Credits : 3

Subject Code : MTRM – 1.3 **Max. Marks :** 70

Semester-I **Sessionals :** 30

Course Educational Objective

To provide an insight into the basic concepts of

CEO 1 fundamentals of surveillance radar and design
CEO 2 tracking radar.
CEO 3 radar waveform design
CEO 4 principles of secondary surveillance radar.

Course Outcomes

By the end of the course the student will be able to discuss about

CO 1 fundamentals of surveillance radar and design
CO 2 tracking radar.
CO 3 radar waveform design
CO 4 principles of secondary surveillance radar.

Fundamentals of Surveillance Radar and Design :

Bandwidth considerations, prf, Unambiguious range and velocity, Pulse length and Sampling, Radar Cross-section and Clutter.

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts of fundamentals of surveillance radar and design
LO2 Outline concepts of radar cross-section and clutter

Tracking Radar :

Tracking and Search Radars, Antenna beam shapes required, Radar guidance, Frequency agility, Importance of Monopulse Radar.

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts of Tracking and Search Radars
LO2 Outline Importance of Monopulse Radar

Radar waveform design :

Bandwidth and pulse duration requirements, Range and Doppler accuracy uncertainty relation, pulse compression and phase coding.

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts of radar waveform design
LO2 Outline Importance of pulse compression and phase coding

Principles of Secondary Surveillance Radar :

Radar studies of the atmosphere, OHR and Radar jamming, EC, ECC measures and stealth applications.

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts of radar studies of the atmosphere
LO2 Outline principles of secondary surveillance radar

Text Books :

1. "Microwave and Radar Engineering" by Gottapu Sasi Bhushana Rao, ISBN – 978813179944 Pearson Education 2013.

2. “Understanding of Radar Systems”, Simon Kingsley and Shaun Quegan, McGraw Hill, 1993.

3. Radar Handbook by Skolnik.

ELECTIVE –II

EMI / EMC

Credits : 3

Subject Code : MTRM – 1.4 **Max. Marks :** 70

Semester-I **Sessionals :** 30

Course Educational Objective

To provide an insight into the basic concepts of

CEO 1 natural and nuclear sources of emi / emc
CEO 2 EMI from apparatus, circuits and open area test sites.
CEO 3 radiated and conducted interference measurements and ESD
CEO 4 grounding, shielding, bonding and EMI filters.
CEO 5 cables, connectors, components and EMC standards

Course Outcomes

By the end of the course the student will be able to discuss about

CO 1 natural and nuclear sources of emi / emc
CO 2 tracking radar.
CO 3 radiated and conducted interference measurements and ESD
CO 4 grounding, shielding, bonding and EMI filters.
CO 5 cables, connectors, components and EMC standards

I. Introduction, Natural and Nuclear sources of EMI / EMC :

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

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts of natural and nuclear sources of emi / emc

LO2 Outline concepts of electromagnetic environment

II. EMI from apparatus, circuits and open area test sites :

Electromagnetic emissions, noise from relays and switches, non-linearities in circuits, passive intermodulation, cross talk in transmission lines, transients in power supply lines, electromagnetic interference (EMI). Open area test sites and measurements.

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts of EMI from apparatus, circuits and open area test sites.

LO2 Outline concepts of open area test sites and measurements

III. Radiated and conducted interference measurements and ESD :

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

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts of radiated and conducted interference measurements and ESD

LO2 Outline concepts of electrical fast transients / bursts, electrical surges.

IV. **Grounding, shielding, bonding and EMI filters :**

Principles and types of grounding, shielding and bonding, characterization of filters, power lines filter design.

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts of grounding, shielding, bonding and EMI filters

LO2 Outline concepts of grounding, shielding and bonding

V. **Cables, connectors, components and EMC standards :**

EMI suppression cables, EMC connectors, EMC gaskets, Isolation transformers, optoisolators, National / International EMC standards.

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts of cables, connectors, components and EMC standards

LO2 Outline concepts of National / International EMC standards

Text Books :

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

Reference :

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

ELECTIVE –II

ARTIFICIAL INTELLIGENCE AND NEURAL NETWORKS

Credits: 3

Subject Code: MTRM – 1.4 **Max. Marks:** 70

Semester-I **Sessionals:** 30

Course Educational Objective

To provide an insight into the basic concepts of

CEO 1 artificial intelligence as representation and search
CEO 2 Neural Networks and Fuzzy Systems
CEO 3 Neural dynamics
CEO 4 Synaptic Dynamics.

Course Outcomes

By the end of the course the student will be able to discuss about

CO 1 artificial intelligence as representation and search
CO 2 Neural Networks and Fuzzy Systems
CO 3 Neural dynamics
CO 4 Synaptic Dynamics.

Artificial Intelligence as Representation and Search

Introduction to AI, Roots and Scope of AI, Definition, Turing Test, Application Areas of AI, Predicate Calculus , Structures and Strategies for State Space Search , Heuristic Search , Control and Implementation of State Space Search

Representation and Inference

Knowledge Representation , Strong Methods for Problem Solving , Reasoning in Uncertain , Situations, Machine Learning : Symbol-Based: Framework for Symbol – Based Learning, Version Space Search, ID3 Algorithm, Un-supervised learning, Reinforcement Learning , Connectionist: Perceptron Learning, Backpropagation Learning, Competitive Learning, Hebbian Coincidence Learning, Attractor Networks

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts of artificial intelligence as representation and search

LO2 Outline concepts of perceptron learning

Neural Networks and Fuzzy Systems

Neural and Fuzzy machine intelligence, fuzziness as multivalence, the dynamical-systems approach to machine intelligence, intelligent behaviour as adaptive model-free estimation.

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts of Neural Networks and Fuzzy Systems

LO2 Outline concepts of intelligent behaviour as adaptive model-free estimation

Neural Dynamics

I. Activations and signals : Neurous as functions, signal monotonicity, biological activations and signals, neuron fields, neuronal dynamical systems, common signal functions, pulse-coded signal functions, Neuronal dynamics II : Activation Models : neuronal dynamical systems, additive neuronal dynamics, additive neuronal feedback, additive bivalent models, BAM Connection matrices, additive dynamic and the noise-saturation dilemma, general neuronal activations : Cohen- grossberg and multiplicative models

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts of Neural dynamics

LO2 Outline concepts of activation models

Synaptic Dynamics

I. Unsupervised Learning : Learning as encoding, change, and quantization, four unsupervised learning laws, probability spaces and random processes, stochastic unsupervised learning and stochastic equilibrium, signal hebbian learning, competitive learning, differential hebbian learning, differential competitive learning. Synaptic Dynamics II : Supervised learning : Supervised function estimation, supervised learning as operant conditioning, supervised learning as stochastic pattern learning with known class memberships, supervised learning as stochastic approximation, the back propagation algorithm.

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts of Synaptic Dynamics.

LO2 Outline concepts of unsupervised learning, supervised learning

Text Book:

1. "Artificial Intelligence – Structures and Strategies for Complex Problem Solving", George F. Luger, 4th Edition, Pearson Education , 2003.

2. Neural Networks & Fuzzy Systems, Bark Kosko, PHI Published in 199

Reference Books:

1. "Artificial Intelligence", Knight, Tata McGraw Hill
2. "Artificial Intelligence 'a Modern Approach" Russell & Norvig, second edition , Pearson Education , 2003.
3. Fundamentals of Artificial Neural Networks, Mohamad H Hassoum, PHI
4. Neural Network Design, Hagan, Demuth and Beale, Vikas Publishing House

ELECTIVE –II

MICROPROCESSOR SYSTEMS

Credits : 3

Subject Code : MTRM –1. 4 **Max. Marks :** 70

Semester-I **Sessionals :** 30

Course Educational Objective

To provide an insight into the basic concepts of

CEO 1 Addressing modes, Memory and Architecture of 8048, 8049.
CEO 2 Addressing modes, Memory and Architecture of 8051 and 8052.
CEO 3 Addressing modes, Memory and Architecture of 8086, 8088, 80186 / 80188.
CEO 4 Addressing modes, Memory and Architecture of 80286, 80386, 80486.

Course Outcomes

By the end of the course the student will be able to discuss about

CO 1 Addressing modes, Memory and Architecture of 8048, 8049.
CO 2 Addressing modes, Memory and Architecture of 8051 and 8052
CO 3 Addressing modes, Memory and Architecture of 8086, 8088, 80186 / 80188.
CO 4 Addressing modes, Memory and Architecture of 80286, 80386, 80486.

Introduction : Historical background, Microprocessor based personal computer systems, RISC processor, Micro controllers, comparison of 8048, 8049, 8051 and 8052, Architecture of 8051.

Introduction and comparison of 8086, 8088, 80186 / 80188, 80286, 80386, 80486, Pentium and Pentium – Pro Processors, Addressing modes, Memory and Architecture. 8086 / 8088 Hardware specifications – Memory interface – I/O Interface – Interrupts – DMA – The Arithmetic Coprocessor Bus Interface - 8086 / 8088 Addressing Modes – Instructions – Programming.

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts of Addressing modes, Memory and Architecture of 8048, 8049

LO2 Outline concepts of 8051 and 8052

LO3 Discuss concepts of Addressing modes, Memory and Architecture of 8086, 8088, 80186 / 80188

LO4 Apply concepts of Addressing modes, Memory and Architecture of 80286, 80386, 80486

References :

1. The Intel Microprocessors 8086 / 8088, 80186, 80188, 80286, 80386, 80486, Pentium and Pentium – Pro Processor Architecture, Programming and Interface by Barray B. Berry, 4th Edition, PHI.

2. Microprocessors Principles and Applications by Gilmore, 2nd Edition, TMH.

3. Microprocessors and Interfacing Programming and Applications by Douglas V. Hall, McGraw Hill.

4. Microprocessors / Microcomputers Architecture, Software and Systems by A.J. Khambata, John Wiely & Sons.

5. Advanced Microprocessors by Daniel Tabak, Mc Graw Hill, 1995.

RESEARCHMETHODOLOGY AND IPR

Credits: 2

Subject Code: MTR&M – 1.5 **Exam Marks:** 70

Semester-I **Sessional:** 30

Course educational Objectives: The objectives of this course is

CEO 1: To give the student an understanding of basics Research Methodology.
CEO 2: To give the student an understanding of basics IPR.
CEO 3: To give the student an understanding of basics to patents, trademark and copyright.

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

CO 1: Formulate a research problem for a given engineering domain.
CO 2: Analyse the available literature for given research problem.
CO 3: Develop technical writing and presentation skills.
CO 4: Comprehend concepts related to patents, trademark and copyright.
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SYLLABUS

Unit 1: Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

Learning Outcomes: At the end of the unit, the student will be able to
LO 1: The student an understanding of basics Errors in selecting a research problem
LO 2: Approaches of investigation of solutions for research problem, data collection, analysis.

Unit 2: Effective literature studies approaches, analysis Plagiarism, Research ethics,

Learning Outcomes: At the end of the unit, the student will be able to
LO 1: The student an understanding of basics literature studies.
LO 2: The student an understanding of basics Research ethics.

Unit 3: Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

Learning Outcomes: At the end of the unit, the student will be able to
LO 1: The student an understanding of basics developing a Research Proposal.
LO 2: The student an understanding of basics technical writing, write report.

Unit 4: Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

Learning Outcomes: At the end of the unit, the student will be able to
LO 1: the student an understanding of basics technological research, innovation, patenting.
LO 2: Discuss about the International cooperation on Intellectual Property.

Unit 5: Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.
Learning Outcomes: At the end of the unit, the student will be able to
LO 1: the student an understanding of basics Patent Rights.
LO 2: the student an understanding of basics Geographical Indications

Unit 6: New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.
Learning Outcomes: At the end of the unit, the student will be able to
LO 1: the student an understanding of basics Administration of Patent System.
LO 2: the student an understanding of basics IPR of Biological Systems, Computer Software.

References Books:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'.
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 2007.
5. Mayall , "Industrial Design", McGraw Hill, 1992.
6. Niebel , "Product Design", McGraw Hill, 1974.
7. Asimov, "Introduction to Design", Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.
9. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008
10. Asimov, "Introduction to Design", Prentice Hall, 1962.
11. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New
12. Technological Age", 2016.
13. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

AUDIT COURSE 1&2

Credits: 0

Subject Code: MTEI – 1.6 **Exam Marks:** 70

Semester-I **Sessional:** 30

ENGLISH FOR RESEARCH PAPER WRITING

1. Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and

Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.

2. Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction.
3. Review of the Literature, Methods, Results, Discussion, Conclusions, the Final Check.
4. Key skills are needed when writing a Title, key skills are needed when writing an abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature.
5. Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, and skills are needed when writing the Conclusions
6. Useful phrases, how to ensure paper is as good as it could possibly be the first- time Submission.

REFERENCES:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook .
4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

DISASTER MANAGEMENT

1 **Introduction:** Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.

2 **Repercussions Of Disasters And Hazards**: Economic Damage, Loss Of Human And Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

3 **Disaster Prone Areas In India :**Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special

Reference To Tsunami; Post-Disaster Diseases And Epidemics

4 **Disaster Preparedness And Management** Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

5 **Risk Assessment** Disaster Risk: Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co-Operation In Risk Assessment And Warning, People's Participation In Risk Assessment. Strategies for Survival.

6 **Disaster Mitigation** Meaning, Concept And Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India.

REFERENCES:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.

2. Sahni, PardeepEt.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi.

3. Goel S. L. , Disaster Administration And Management Text And Case Studies" ,Deep &Deep Publication Pvt. Ltd., New Delhi.

SANSKRIT FOR TECHNICAL KNOWLEDGE:

1 Alphabets in Sanskrit, Past/Present/Future Tense, Simple Sentences

2 Order

Introduction of roots

Technical information about Sanskrit Literature

3 Technical concepts of Engineering-Electrical, Mechanical,Architecture, Mathematics

REFERNCES:

1. "Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi

2. "Teach Yourself Sanskrit" Prathama Deeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication

3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

VALUE EDUCATION

1 Values and self-development –Social values and individual attitudes.

Work ethics, Indian vision of humanism.

Moral and non- moral valuation. Standards and principles.

Value judgements

2 Importance of cultivation of values.

Sense of duty. Devotion, Self-reliance. Confidence, Concentration.

Truthfulness, Cleanliness.

Honesty, Humanity. Power of faith, National Unity.

Patriotism. Love for nature, Discipline

3 Personality and Behavior Development - Soul and Scientific attitude.

Positive Thinking. Integrity and discipline.

Punctuality, Love and Kindness.

Avoid fault Thinking.

Free from anger, Dignity of labour.

Universal brotherhood and religious tolerance.

True friendship.

Happiness Vs suffering, love for truth.

Aware of self-destructive habits.

Association and Cooperation.

Doing best for saving nature

4 Character and Competence –Holy books vs Blind faith.

Self-management and Good health.

Science of reincarnation.

Equality, Nonviolence, Humility, Role of Women.

All religions and same message.

Mind your Mind, Self-control.

REFERNCES:

1 Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi

CONSTITUTION OF INDIA

1 History of Making of the Indian Constitution:

History

Drafting Committee, (Composition & Working)

2 Philosophy of the Indian Constitution:

Preamble

Salient Features

3 Contours of Constitutional Rights & Duties:

Fundamental Rights

Right to Equality

Right to Freedom

Right against Exploitation

Right to Freedom of Religion

Cultural and Educational Rights

Right to Constitutional Remedies

Directive Principles of State Policy

Fundamental Duties.

4 Organs of Governance:

Parliament

Composition

Qualifications and Disqualifications

Powers and Functions

Executive

President

Governor

Council of Ministers

Judiciary, Appointment and Transfer of Judges, Qualifications

Powers and Functions

5 Local Administration:

District's Administration head: Role and Importance,

Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation.

Pachayati raj: Introduction, PRI: ZilaPachayat.

Elected officials and their roles, CEO ZilaPachayat: Position and role.

Block level: Organizational Hierarchy (Different departments),

Village level: Role of Elected and Appointed officials,

Importance of grass root democracy

6 Election Commission:

Election Commission: Role and Functioning.

Chief Election Commissioner and Election Commissioners.

State Election Commission: Role and Functioning.

Institute and Bodies for the welfare of SC/ST/OBC and women.

REFERNCES:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

PEDAGOGY STUDIES

1 **Introduction and Methodology:**

Aims and rationale, Policy background, Conceptual framework and terminology

Theories of learning, Curriculum, Teacher education.

Conceptual framework, Research questions**.**

Overview of methodology and Searching.

2 Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries.Curriculum, Teacher education.

3 Evidence on the effectiveness of pedagogical practices

Methodology for the in depth stage: quality assessment of included studies.

How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

Theory of change.

Strength and nature of the body of evidence for effective pedagogical practices.

Pedagogic theory and pedagogical approaches.

Teachers' attitudes and beliefs and Pedagogic strategies.

4 Professional development: alignment with classroom practices and follow support

Peer support.

Support from the head teacher and the community.

Curriculum and assessment.

Barriers to learning: limited resources and large class sizes.

5 Research gaps and future directions

Research design

Contexts

Pedagogy

Teacher education

Curriculum and assessment

Dissemination and research impact.

REFERENCES:

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, ‘learning to read’ campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

STRESS MANAGEMENT BY YOGA

1 Definitions of Eight parts of yog. (Ashtanga) 8

2 Yam and Niyam.

Do`s and Don't's in life.

i) Ahinsa, satya, astheya, bramhacharya and aparigraha

ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

3 Asan and Pranayam

i) Various yog poses and their benefits for mind & body

ii)Regularization of breathing techniques and its effects-Types of pranayam

REFERENCES

1. 'Yogic Asanas for Group Tarining-Part-I" :Janardan Swami Yogabhyasi Mandal, Nagpur

2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, AdvaitaAshrama (Publication Department), Kolkata.

PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

1 Neetisatakam-Holistic development of personality

Verses- 19,20,21,22 (wisdom)

Verses- 29,31,32 (pride & heroism)

Verses- 26,28,63,65 (virtue)

Verses- 52,53,59 (dont's)

Verses- 71,73,75,78 (do's)

2 Approach to day to day work and duties.

Shrimad BhagwadGeeta: Chapter 2-Verses 41, 47,48,

Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17,23, 35,

Chapter 18-Verses 45, 46, 48.

3 Statements of basic knowledge.

Shrimad BhagwadGeeta: Chapter2-Verses 56, 62, 68

Chapter 12 -Verses 13, 14, 15, 16,17, 18

Personality of Role model. Shrimad BhagwadGeeta:

Chapter2-Verses 17, Chapter 3-Verses 36,37,42,

Chapter 4-Verses 18, 38,39

Chapter18 – Verses 37,38,63

REFERENCES

1. “Srimad Bhagavad Gita” by Swami SwarupanandaAdvaita Ashram (Publication Department), Kolkata

2. Bhartrihari’s Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

Antenna LAB-I

Credits: 2

Subject Code: MTR&M – 1.7 **Exam Marks: 100**
Semester-I

Course Educational Objective

To provide an insight into the basic implementation of

CEO 1 radiation pattern of Dipole antenna and folded dipole
CEO 2 radiation pattern of Yagi-Uda antenna
CEO 3 find the radiation pattern of Monopole antenna
CEO 4 Co and Cross Polarization using vertical and horizontal polarization antennas
CEO 5 inverse square law and Reciprocity theorem

Course Objective

By the end of the course the student will be able to implement

CO 1 radiation pattern of Dipole antenna and folded dipole
CO 2 radiation pattern of Yagi-Uda antenna
CO 3 find the radiation pattern of Monopole antenna
CO 4 Co and Cross Polarization using vertical and horizontal polarization antennas
CO 5 inverse square law and Reciprocity theorem

1. To find the radiation pattern of Dipole antenna.
2. To find the radiation pattern of Folded Dipole antenna.
3. To find the radiation pattern of Yagi-Uda antenna.
4. To find the radiation pattern of Monopole antenna.
5. Determine Co-polarization and Cross Polarization using vertical and horizontal polarization Antennas.
6. Verify inverse square law.
7. Verify Reciprocity theorem

SIGNAL PROCESSING LAB

Credits: 2

Subject Code: MTR&M – 1.8 **Exam Marks: 100**

Semester-I

Course Educational Objective

To provide an insight into the basic implementation of

CEO 1 generation of basic signals using MATLAB
CEO 2 find DFT/IDFT of a given signal s
CEO 3 Implementation of FFT for a given sequence
CEO 4 LP FIR & HP FIR, LP IIR & HP IIR implementation
CEO 5 Computation of FFT, LP FIR & HP FIR,LP IIR & HP IIR using DSP Processor

Course Outcomes

By the end of the course the student will be able to implement

CO 1 generation of basic signals using MATLAB
CO 2 find DFT/IDFT of a given signal s
CO 3 Implementation of FFT for a given sequence
CO 4 LP FIR & HP FIR, LP IIR & HP IIR implementation
CO 5 Computation of FFT, LP FIR & HP FIR,LP IIR & HP IIR using DSP Processor

Using MATLAB

1. Generation of Basic signals Using MATLAB.
2. To Find DFT/IDFT of a given signal.
3. Implementation of FFT for a given sequence.
4. Implementation of LP FIR & HP FIR filter for a given sequence.
5. Implementation of LP IIR & HP IIR filter for a given sequence.
6. Implementation of interpolation and decimation process.
7. Impulse response of first & second order systems.

Using DSP Processor

1. Computation of N-point DFT for a given sequence.
2. Implementation of FFT for a given sequence.
3. Implementation of LP FIR & HP FIR filter for a given sequence.
4. Implementation of LP IIR & HP IIR filter for a given sequence.
5. Implementation of interpolation and decimation process.
6. Impulse response of first & second order systems.

RF AND MICROWAVE ENGINEERING

Credits : 3

Subject Code : MTRM – 2.1 **Max. Marks :** 70

Semester-II **Sessionals :** 30

Course Educational Objective

To provide an insight into the basic concepts of

CEO 1 RF and Microwave concepts and applications
CEO 2 RF Electronics Concepts
CEO 3 Smith Chart and its Applications
CEO 4 RF and Microwave Amplifiers Small and Large Signal Design
CEO 5 Radio Frequency and Microwave Oscillator Design

Course Outcomes

By the end of the course the student will be able to

CO 1 RF and Microwave concepts and applications
CO 2 RF Electronics Concepts
CO 3 Smith Chart and its Applications
CO 4 RF and Microwave Amplifiers Small and Large Signal Design
CO 5 Radio Frequency and Microwave Oscillator Design

Chapter 1 : Introduction to RF and Microwave concepts and applications

Introduction, Reasons for using RF/Microwaves, RF/Microwave applications, Radio frequency waves, RF and Microwave circuit design, The unchanging fundamentals versus the ever-evolving structure, General active circuit block diagrams.

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts of RF and Microwave concepts and applications

LO2 Discuss concepts of General active circuit block diagrams

Chapter 2 : RF Electronics Concepts

Introduction, RF/Microwaves versus DC or low AC signals, EM spectrum, Wave length and frequency, Introduction to component basics, Resonant circuits, Analysis of a simple circuit in phasor domain, Impedance transformers, RF impedance matching, Three element matching.

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts and analysis of a simple circuit in phasor domain

LO2 Discuss concepts of RF Electronics Concepts

Chapter 3 : Smith Chart and its Applications

Introduction, A valuable graphical aid the smith chart, Derivation of smith chart, Description of two types of smith charts, Smith charts circular scales, Smith charts radial scales, The normalized impedance-admittance (ZY) smith chart introduction, Applications of the smith chart, Distributed circuit applications, Lumped element circuit applications.

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts and analysis normalized impedance-admittance (ZY) smith chart introduction

LO2 Discuss concepts of Smith Chart and its Applications

Chapter 4 : RF and Microwave Amplifiers Small and Large Signal Design

Introduction, Types of amplifiers, Small signal amplifiers, Design of different types of amplifiers, Multistage small signal amplifier design.

Introduction, High-power amplifiers, Large signal amplifier design, Microwave power combining/dividing techniques, Signal distortion due to inter modulation products, Multistage amplifiers, Large signal design

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts and analysis of RF and Microwave Amplifiers Small and Large Signal Design

LO2 Discuss concepts of Microwave power combining/dividing techniques

Chapter 5 : Radio Frequency and Microwave Oscillator Design

Introduction, Oscillator versus amplifier design, Oscillation conditions, Design of transistor oscillators, Generator-tuning networks.

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts and analysis of generator-tuning networks

LO2 Discuss concepts of Radio Frequency and Microwave Oscillator Design

Text Book :

1. "Radio Frequency and Microwave Electronics", by Mathew M. Radmanesh, Person Education Inc., New Delhi

Reference

1. "Microwave Engineering, Active and Non-reciprocal Circuits", by Joseph Helszain, McGraw Hill International Edition, 1992

GLOBAL POSITIONING SYSTEM AND APPLICATIONS

Credits : 3

Subject Code : MTRM – 2.2 **Max. Marks :** 70

Semester-II **Sessionals :** 30

Course Educational Objective

To provide an insight into the basic concepts of

CEO 1 GPS
CEO 2 GPS Signals
CEO 3 GPS coordinate frames
CEO 4 GPS orbits and satellite position determination
CEO 5 GPS Errors

Course Outcomes

By the end of the course the student will be able to

CO 1 GPS
CO 2 GPS Signals
CO 3 GPS coordinate frames
CO 4 GPS orbits and satellite position determination
CO 5 GPS Errors

Unit I

Overview of GPS :

Basic concept, system architecture, space segment, user segment, GPS aided Geo-augmented navigation (GAGAN) architecture.

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts and overview of GPS

LO2 Discuss concepts of navigation architecture

Unit II

GPS Signals

Signal structure, anti spoofing (AS), selective availability, Difference between GPS and GALILEO satellite construction.

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts and overview of GPS Signals

LO2 Discuss concepts of satellite construction

Unit III

GPS coordinate frames, Time references : Geodetic and Geo centric coordinate systems, ECEF coordinate world geodetic 1984 (WGS 84), GPS time.

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts and overview of GPS coordinate frames

LO2 Discuss concepts of Time references

Unit IV

GPS orbits and satellite position determination : GPS orbital parameters, description of receiver independent exchange format (RINEX) – Observation data and navigation message data parameters, GPS position determination.

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts and overview of GPS orbits and satellite position determination

LO2 Discuss concepts of GPS position determination

Unit V

GPS Errors :

GPS error sources – clock error, ionospheric error, tropospheric error, multipath, ionospheric error estimation using dual frequency GPS receiver.

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts and overview of GPS Errors

LO2 Discuss concepts of GPS error sources

Textbooks :

1. G S RAO, Global Navigation Satellite Systems, McGraw-Hill Publications, New Delhi,2010

Reference Books :

1. B. Hoffman – Wellenhof, H. Liehtenegger and J. Collins, 'GPS – Theory and Practice', Springer – Wien, New York (2001).

2. James Ba – Yen Tsui, 'Fundamentals of GPS receivers – A software approach', John Wiley& Sons (2001).

ELECTIVE-III
CELLULAR AND MOBILE COMMUNICATIONS

Credits : 3

Subject Code : MTRM – 2.3 **Max. Marks :** 70
Semester-II **Sessionals :** 30

Course Educational Objective

To provide an insight into the basic concepts of

CEO 1 wireless communications
CEO 2 Multiple access techniques for wireless communications
CEO 3 Wireless systems and standards
CEO 4 Personal access communication systems
CEO 5 Mobile Radio propagation

Course Outcomes

By the end of the course the student will be able to

CO 1 wireless communications
CO 2 Multiple access techniques for wireless communications
CO 3 Wireless systems and standards
CO 4 Personal access communication systems
CO 5 Mobile Radio propagation

Unit-1: Introduction to wireless communications , examples of wireless communication system , the Cellular concept and system design fundamentals, Frequency reuse, Channel assignment strategies, Handoff strategies , Interference and system capacity , Trunk and grade services , Methods for improving coverage and capacity in cellular system.

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts and overview of wireless communications

LO2 Discuss concepts of Methods for improving coverage and capacity in cellular system

Unit-2: Multiple access techniques for wireless communications FDMA , TDMA, Spread spectrum techniques , SDMA , Packet Radio , CSMA , Capacity of cellular CDMA with multiple cells and capacity of SDMA.

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts and overview of Multiple access techniques for wireless communications

LO2 Discuss concepts of Capacity of cellular CDMA with multiple cells and capacity of SDMA.

Unit-3: Wireless systems and standards , AMPS , IS-94, GSM traffic, Examples of GSM cell , Frame structure of GSM cell, details of forward and reverse CDMA channels.

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts of wireless systems and standards

LO2 Discuss concepts and examples of GSM cell

Unit-4: Personal access communication systems , Personal Mobile satellite communications , Integrating GEO, LEO, MEO Satellite and terrestrial mobile systems , Rake receiver and Advanced Rake receiver,

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts personal access communication systems

LO2 Discuss concepts of Personal Mobile satellite communications.

Unit-5: Mobile Radio propagation , Large scale path loss , Reflection , Diffraction , Scattering , Outdoor and Indoor propagation models , Small signal fading and multi path , measurement of small scale path loss , parameters of multi path channels , fading due to multi path , fading effect due to Doppler spread , small scale fading models , equalization , Diversity .

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts of Mobile Radio propagation

LO2 Discuss concepts of fading

Text Book :

1. Mobile Cellular Communication by Gottapu Sasibhushana Rao, PEARSONInternational, 2012.

Recommended Books:

1. Wireless Communications Principles and Practice , Second Edition , THEODORE S.REPPAPORT .
2. Wireless Digital Communications , DR. KAMILO FEHER .
3. Electronic Communication system , WAYNE TOMASI.
4. Wireless Communications , SANJY SHARMA.

ELECTIVE-III
STEALTH TECHNOLOGIES

Credits : 4

Subject Code : MTRM – 2.3 **Max. Marks :** 70

Semester-II **Sessionals :** 30

Course Educational Objective

To provide an insight into the basic concepts of

CEO 1 Stealth Systems
CEO 2 Interceptability Parameters and Analysis
CEO 3 Stealth Waveforms
CEO 4 Stealth Antennas and Radomes
CEO 5 Signal Processing for Stealth

Course Outcomes

By the end of the course the student will be able to

CO 1 Stealth Systems
CO 2 Interceptability Parameters and Analysis
CO 3 Stealth Waveforms
CO 4 Stealth Antennas and Radomes
CO 5 Signal Processing for Stealth

Unit 1 : Introduction to Stealth Systems

Introduction, Introduction to low probability of intercept systems, A little history of stealth systems, Basic LPI equations, Introduction to radar cross-section, Introduction to signature balance

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts of Stealth Systems

LO2 Discuss concepts of LPI equations.

Unit 2 : Interceptability Parameters and Analysis

Interceptability parameters, Interceptability analysis, Example mode interceptability, Footprint calculation

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts of Interceptability Parameters and Analysis

LO2 Discuss concepts of Footprint calculation.

Unit 3 : Stealth Waveforms

Waveform criteria, Frequency diversity, Power management, Pulse compression, Discrete phase codes, Hybrid waveforms, Noise propagation in pulse compressors

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts of Stealth Waveforms

LO2 Discuss concepts of Waveform criteria.

Unit 4 : Stealth Antennas and Radomes

Introduction, Antenna parameters, Single radiators, Antenna arrays, Electronically scanned arrays, Antenna scattering, Low RCS radomes

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts of Stealth antennas and radomes

LO2 Discuss concepts of low RCS radomes

Unit 5 : Signal Processing for Stealth

Introduction to stealth signal processing, Air target search, acquisition, track, Terrain following/terrain avoidance, Doppler beam sharpening, Synthetic aperture radar (SAR) mapping, Ground MTI and MTT

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts of Signal Processing for Stealth

LO2 Discuss concepts of air target search

Textbook

Introduction to RF Stealth by David Lynch, Jr., Scitech Publishing Inc., 2003., www.scitechpub.com

ELECTIVE-III

APPLICATION SPECIFIC INTEGRATED CIRCUITS (ASIC)

Credits: 3

Subject Code: MTRM – 2.3 **Max. Marks:** 70

Semester-II **Sessionals:** 30

Course Educational Objective

To provide an insight into the basic concepts of

CEO 1 ASICs
CEO 2 ASIC Library Design
CEO 3 Low-level design entry
CEO 4 ASIC construction
CEO 5 CMOS System Core Studies
CEO 6 Practical Realities and Ground Rules

Course Outcomes

By the end of the course the student will be able to

CO 1 ASICs
CO 2 ASIC Library Design
CO 3 Low-level design entry
CO 4 ASIC construction
CO 5 CMOS System Core Studies
CO 6 Practical Realities and Ground Rules

1. Introduction to ASICs – Types of ASICs, Design flow, Economics of ASICs, ASIC cell libraries, CMOS Logic, CMOS design rules, Logic cells, I/O cells, cell compilers.

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts of ASICs

LO2 Discuss concepts and types of ASICs

2. ASIC Library Design – Transistors as resistors, Transistor parasitic capacitance, Logical effort, Cell design, Programmable ASICs, Programmable ASIC logic cells, Programmable ASIC I/O cells, Programmable ASIC interconnect, Programmable ASIC design software.

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts of ASIC Library Design

LO2 Discuss concepts and types of ASIC interconnect

3. Low-level design entry, Schematic entry, low-level design languages, PLA tools, EDIF, An overview of VHDL and verilog, Logic synthesis, Simulation.

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts of Low-level design entry

LO2 Discuss concepts and types of synthesis and simulation

4. ASIC construction, Floor planning and placement.
5. CMOS System Core Studies

Dynamic Warp Processors : Introduction, The problem, the algorithm, a functional overview, detailed functional specification, structural floor plan, physical design, fabrication, Hierarchical layout and design of single chip 32 bit CPU : Introduction, Design methodology, Technology updatability and layout verification.

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts of ASIC construction

LO2 Discuss concepts and types of CMOS System Core Studies

6. Practical Realities and Ground Rules

Further thoughts on floor plans/layout, floor plan layout of the four bit processors, input/output (I/O) pads, "Real estate", further thoughts on system delays, ground rules for successful design, scaling of MOS circuits.

Textbooks

1. Application Specific Integrated Circuits by J.S. Smith, Addison Wesley, 1997.

Reference Books

1. Basic VLSI Design : Systems and Circuits, Doublas A. Puckness & Kamran Eshraghian, Prentice Hall of India Private Ltd., New Delhi, 1989.
2. Principles of CMOS VLSI Design : A system perspective, N. Westle & K. Eshraghian, Addition – Wesley Pub. Co. 1985.
3. Introduction to VLSI System, C. Mead & L. Canway, Addison Wesley Pub Co. 1990.
4. The Design & Analysis of VLSI Circuits, L.A. Glassey & D.W. Dobbephl, Addison Wesley Pub Co. 1985.
5. Introduction to NMOS & VLSI System Design, A. Mukharjee, Prentice Hall, 1986.
6. VLSI Design Techniques for analog and digital circuits, R.L. Geiger, P.E. Allen & N.R.Streder, McGraw Hill Int. 1990.
7. Digital Integrated Circuits, A Design Perspective, Jan A. Rabey, Prentice Hall of India Pvt. Ltd., 997.
8. Application specific integrated circuits, J.S. Smith, Addison Wesley, 1997.

ELECTIVE-IV
MICRO CONTROLLERS AND EMBEDDED SYSTEMS

Credits: 3

Subject Code: MTRM – 2.4 **Exam Marks:** 70
Semester-II **Sessionals:** 30

Course Educational Objective

To provide an insight into the basic concepts of

CEO 1 Embedded systems
CEO 2 Custom single-purpose processors: Hardware
CEO 3 General purpose processors : Software
CEO 4 Memory
CEO 5 Microcontrollers
CEO 6 An Exemplary Embedded Systems using Microcontrollers
CEO 7 State Machine and Concurrent process models

Course Outcomes

By the end of the course the student will be able to

CO 1 Embedded systems
CO 2 Custom single-purpose processors: Hardware
CO 3 General purpose processors : Software
CO 4 Memory
CO 5 Microcontrollers
CO 6 An Exemplary Embedded Systems using Microcontrollers
CO 7 State Machine and Concurrent process models

1. Introduction

Embedded systems overview, Design challenge, Processor Technology, IC Technology, Design Technology, Trade-offs.

2. Custom single-purpose processors: Hardware

Introduction, Combinational logic, Sequential logic, Custom single-purpose processor Design , RT-level custom single-purpose processor design, Optimizing custom single-purpose processors.

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts of Embedded systems

LO2 Discuss concepts and types Custom single-purpose processors: Hardware

3. General purpose processors : Software

Introduction, Basic Architecture, Operation, Programmer's view, Development environment, Application-Specific Instruction-set Processors, Selecting a Microprocessor.

4. Memory:

Introduction, Memory types, Memory Hierarchy and cache, Advanced Memory Interfacing Communication Basics, Memory Access, I/O addressing, Interrupts, DMA, Arbitration, Multilevel Architecture, Protocols.

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts of General purpose processors : Software
LO2 Discuss concepts CO 4 Memory

5. Microcontrollers:

Review 8051 Microcontroller Architecture & Programming. Peripherals:
Timers, Counters and Watchdog Timers, UART, Pulse width Modulators, LCD controllers, Stepper Motor Controllers, Analog to Digital converters, Real-Time clocks.

6**. An Exemplary Embedded Systems using Microcontrollers:**
Digital Camera Introduction, Specifications, Design.

7. State Machine and Concurrent process models: Introduction, Models Vs. Languages, Text Vs. Graphics:Textual Languages Vs. Graphical Languages, an Example, A Basic State Machine Model, FSM, FSM with Datapath Model: FSMD, Using State Machines, Concurrent Process Model, Communication among Processes.

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts of Microcontrollers
LO2 Discuss concepts of an Exemplary Embedded Systems using Microcontrollers
LO3 Discuss concepts of State Machine and Concurrent process models

Text Books:

1. Embedded System Design: A Unified Hardware/Software Introduction ByFrank vahid / Tony Givargis John wiley & sons
2. The 8051 Microcontroller & Embedded Systems ByMuhammad Ali Mazidi & Janice Gillispie Mazidi PHI

References:

1. Embedded Systems Architecture, Programming and Design By Raj Kamal TMH
2. Embedded Software Priner By Simon.
3. The 8051 Microcontroller: Architecture, Programming & Applications. By Kenneth .Ayala Penram International. 2nd edn.

ELECTIVE-IV
DIGITAL IMAGE PROCESSING

Credits : 3

Subject Code : MTRM – 2.4 **Exam Marks :** 70

Semester-II **Sessionals :** 30

Course Educational Objective

To provide an insight into the basic concepts of

CEO 1 Digital Image Fundamentals
CEO 2 Image Transforms
CEO 3 Image Enhancement & Restoration
CEO 4 Image Encoding Image Compression
CEO 5 Image Segmentation
CEO 6 Image Representation
CEO 7 Image Construction from Projections

Course Outcomes

By the end of the course the student will be able to

CO 1 Digital Image Fundamentals
CO 2 Image Transforms
CO 3 Image Enhancement & Restoration
CO 4 Image Encoding and Image Compression
CO 5 Image Segmentation
CO 6 Image Representation
CO 7 Image Construction from Projections

1. **Digital Image Fundamentals**

An image model – sampling & quantization – basic relation between pixels : imaging geomentry.

2**. Image Transforms**

Properties of 2-D fourier transforms, FFT algorithm and other separable image transforms, Walsh transforms, Hadamard, Cosine, Haar, Slant Transforms, RL Transforms and their properties.

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts of Digital Image Fundamentals
LO2 Discuss concepts of Image Transforms

3. **Image Enhancement & Restoration**

Spatial domain methods, Frequency domain methods, Histogram Modification technique, Neighbourhood averaging, Median filtering, Low pass filtering, Averaging of Multiple Images, Image sharpening by differenctiation, High pass Filtering, Degradation model for Continuous functions, Discrete Formulation, Diagonalization of Circulant and Block – Circulant Matrices, Effects of Diagonalization, Constrained and unconstrained Restorations Inverse filtering, Wiener Filter, Constrained least Square Restoration.

4**. Image Encoding**

Objective an subjective Fidelity Criteria, the encoding process, the Mapping, the Quantizer and the Coder, Contour Encoding, Run length Encoding, Image Encoding relative to a Fidelity Criterion, Differential Pulse Code Modulation, Transform Encoding.

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts Image Enhancement & Restoration
LO2 Discuss concepts of Image Encoding

5. **Image Compression**

Fundamentals, Image compression models, error free compression, lossy compression, image compression standards.

6. **Image Segmentation**

The detection of Discontinuities, Point Line and Edge Detections, Gradient Operators, Combined Detection, Thresholding.

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts of Image Compression

LO2 Discuss concepts of Image Segmentation

7. **Image Representation**

Representation Schemes, Chain Codes, Polygon Approximation, Boundary Descriptors, Simple Descriptors, Shape Numbers, Fourier Descriptors.

8. **Image Construction from Projections**

Radon Transforms, Convolution/filterback Projection.

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts of Image Representation

LO2 Discuss concepts of Image Construction from Projections.

Textbooks

1. Gonzalez RC & Woods RE, Digital Image Processing, Addison Wesley Publishing Company.
2. Jain AK, Fundamentals of Digital Image Processing, PHI
3. Rosefeld & Kak AC, Digital Picture Processing Academic Press Inc.

ELECTIVE-IV

WIRELESS COMMUNICATIONS AND NETWORKS

Credits : 3

Subject Code : MTRM – 2.4 **Max. Marks :** 70
Semester-II **Sessionals :** 30

Course Educational Objective

To provide an insight into the basic concepts of

CEO 1 wireless communication and system fundamentals
CEO 2 multiple access techniques for wireless communication
CEO 3 wireless networking
CEO 4 Wireless Data Services
CEO 5 mobile ip and wireless application protocol
CEO 6 blue tooth and mobile data networks

Course Outcomes

By the end of the course the student will be able to

CO 1 wireless communication and system fundamentals
CO 2 multiple access techniques for wireless communication
CO 3 wireless networking
CO 4 Wireless Data Services
CO 5 mobile ip and wireless application protocol
CO 6 blue tooth and mobile data networks

UNIT -I

WIRELESS COMMUNICATION AND SYSTEM FUNDAMENTALS: Introduction to Wireless
Communication Systems, Examples of Wireless Communications, Comparisons of Common Wireless Communication Systems, Trends in Cellular Radio and Personal Communications, Cellular Concepts, Frequency Reuse, Handoff Strategies, Interference and System Capacity,
Trucking and Grade of Service, Improving Coverage & Capacity In Cellular Systems.

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts of wireless communication and system fundamentals
LO2 Discuss concepts of frequency reuse

UNIT-II

MULTIPLE ACCESS TECHNIQUES FOR WIRELESS COMMUNICATION: FDMA, TDMA, SSMA
(FHMA/CDMA/Hybrid Techniques) SDMA Technique (As Applicable to Wireless Communications), Packet Radio Access Protocols, CSMA Protocols, Reservation Protocols, Capture Effect in Packet Radio, Capacity of Cellular Systems.

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts of Capacity of Cellular Systems
LO2 Discuss concepts of multiple access techniques for wireless communication

UNIT-III

WIRELESS NETWORKING: Introduction, Differences Between Wireless and Fixed Telephone Networks, Traffic Routing in Wireless Networks, Circuit Switching, Packet Switching, The X.25 protocol.

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts of differences between wireless and fixed telephone networks
LO2 Discuss concepts of wireless networking

UNIT-IV

Wireless Data Services, Cellular Digital Packet Data (CDPD), Advanced Radio Data Information
Systems (ARDIS), RAM Mobile Data (RMD), Common Channel Signaling (CCS), Broad Band ISDN and ATM, Signaling System .No.7 (SS7), Network Services Part (NSP), SS7 User Part, Signaling Traffic in SS7, SS7 Services, Performance of SS7.

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts of Advanced Radio Data Information
LO2 Discuss concepts of Wireless Data Services

UNIT-V

MOBILE IP AND WIRELESS APPLICATION PROTOCOL: Mobile IP Operation of Mobile IP, Co-located Address, Registration, Tunneling, WAP Architecture, Overview, WML Scripts, WAP Service, WAP Session protocol, Wireless Transaction, Wireless Datagram,Infrared LAN's, Spread Spectrum LAN's, Narrowband Microwave LAN's, IEEE 802 Protocol Architecture, IEEE
802 Architecture and Services, 802. 11 Medium Access Controls, 802.11 Physical Layers.

UNIT-VI

BLUE TOOTH AND MOBILE DATA NETWORKS: Overview, Radio Specification, Baseband
Specification, Links Manager Specification, Logical Link Control and Adaptation Protocol, Introduction to WLL Technology, Introduction, and Data Oriented CDPD Network, GPRS and Higher Data Rates, Short Messaging Service in GSM, Mobile Application Protocol.

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts of mobile ip and wireless application protocol
LO2 Discuss concepts of blue tooth and mobile data networks

TEXT BOOKS:

1. Wireless communication and Networking -William Stallings, PHI, 2003
2. Wireless Communications, Principles, Practice - Theodore, S. Rappaport, PHI, 2nd Edition, 2002.

REFERENCES:

1. Wireless Digital Communications-Karnilo feher,PHI, 1999.

2. Principles of Wireless Networks - Kavehpahlaven and P.Krishna Murthy, Pearson Education, 2002

Antenna LAB-II

Credits: 2

Subject Code: MTR&M – 2.6 **Exam Marks: 100**

Semester-II

Course Educational Objective

To provide an insight into the basic concepts of implementation of HFSS for

CEO 1 Rectangular Microstrip Antenna
CEO 2 Circular Microstrip antenna
CEO 3 Micro strip Monopole.

CEO 4 Microstrip Tee.

CEO 5 Cylindrical Horn antenna

CEO 6 Pyramidal Horn antenna.

CEO 7 Microstrip Filters.

Course Outcomes

By the end of the course the student will be able to implement HFSS

CO 1 Rectangular Microstrip Antenna
CO 2 Circular Microstrip antenna
CO 3 Micro strip Monopole.

CO 4 Microstrip Tee.

CO 5 Cylindrical Horn antenna

CO 6 Pyramidal Horn antenna.

CO 7 Microstrip Filters.

Using HFSS Software testing of:

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

MICROWAVE ENGINEERING LAB

Credits: 2

Subject Code: MTR&M – 2.7 **Exam Marks: 100**

Semester-II

Course Educational Objective

To provide an insight into the basic concepts of implementation of

CEO 1 Gunn Oscillation characteristics

CEO 2 Reflex Klystron Characteristics, Frequency and Wavelength measurement using slotted line method

CEO 3 Determination of low and high VSWR.

CEO 4 Microstrip Tee.

CEO 5 Cylindrical Horn antenna

CEO 6 S-parameters of a 3-port Circulator.

CEO 7 S-parameters of a 4-port Direction coupler.

Course Outcomes

By the end of the course the student will be able to implement

CO 1 Gunn Oscillation characteristics

CO 2 Reflex Klystron Characteristics, Frequency and Wavelength measurement using slotted line method

CO 3 Determination of low and high VSWR.

CO 4 Microstrip Tee.

CO 5 Cylindrical Horn antenna

CO 6 S-parameters of a 3-port Circulator.

CO 7 S-parameters of a 4-port Direction coupler.

1. Gunn Oscillation characteristics.
2. Reflex Klystron Characteristics.
3. Reflex Klystron – Frequency and Wavelength measurement using slotted line method.
4. Reflex Klystron – Frequency and Wavelength measurement using Direct method.
5. Determination of low VSWR.
6. Determination of high VSWR.
7. Determination of S-parameters of a 3-port Circulator.
8. Determination of S-parameters of a 4-port Direction coupler.

ELECTIVE-V
PHASED ARRAY RADARS

Credits : 3

Subject Code : MTRM – 3.1 **Max. Marks :** 70

Semester-III **Sessionals :** 30

Course Educational Objective

To provide an insight into the basic concepts of

CEO 1 Phased Arrays in Radar and Communication Systems
CEO 2 Pattern characteristics of Linear and Planar Arrays
CEO 3 Pattern Synthesis for Linear and Planararrays
CEO 4 Electronic Scanning Radar Systems

Course Outcomes

By the end of the course the student will be able to

CO 1 Phased Arrays in Radar and Communication Systems
CO 2 Pattern characteristics of Linear and Planar Arrays
CO 3 Pattern Synthesis for Linear and Planar Arrays
CO 4 Electronic Scanning Radar Systems

Phased Arrays in Radar and Communication Systems :

System requirements for radar and communication antennas, Array characterization for radar and communication systems, Fundamental results from array theory, Array size determination, Time-delay compression.

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts of system requirements for radar and communication antennas
LO2 Discuss concepts of phased arrays in radar and communication systems

Pattern characteristics of Linear and Planar Arrays :

Array analysis, characteristics of linear and planer arrays, Scanning to end- fire, Thinned arrays

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts of Pattern characteristics of Linear and Planar Arrays
LO2 Discuss concepts of phased arrays analysis

Pattern Synthesis for Linear and Planar Arrays :

Linear arrays and planar arrays with separable distributions, circular planar arrays and adaptive arrays.

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts of Pattern Synthesis for Linear and Planar Arrays

LO2 Discuss concepts of planar arrays

Electronic Scanning Radar Systems :

Frequency and phase scanning, Phase design techniques.

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts of electronic Scanning Radar Systems

LO2 Discuss concepts of phase design techniques

Text Books :

1. Phased Array Antenna Hand Book – Robert J. Mailloux, Artech House, Boston, London, 1994.
2. Radar Engineering Hand Book – Skolnic, McGraw Hill, 1970

Reference Book:

1. Electronic Scanning Radar Systems Design Hand Book – Peter J. Kahrilas, Artech House, 1976.

ELECTIVE-V
DSP PROCESSORS AND ARCHITECTURES

Credits: 3

Subject Code: MTRM –3.1 **Max. Marks:** 70
Semester-III **Sessionals:** 30

Course Educational Objective

To provide an insight into the basic concepts of

CEO 1 digital signal procesing
CEO 2 computational accuracy in dsp implementations
CEO 3 architectures for programmable dsp devices and execution
CEO 4 programmable digital signal processors
CEO 5 implementations of basic dsp algorithms and fft algorithms

Course Outcomes

By the end of the course the student will be able to

CO 1 digital signal procesing
CO 2 computational accuracy in dsp implementations
CO 3 architectures for programmable dsp devices and execution
CO 4 programmable digital signal processors
CO 5 implementations of basic dsp algorithms and fft algorithms

UNIT I

INTRODUCTION TO DIGITAL SIGNAL PROCESING

Introduction, A Digital signal-processing system, The sampling process, Discrete time sequences Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT), Linear time-invariant systems, Digital filters, Decimation and interpolation, Analysis and Design tool for DSP Systems MATLAB, DSP using MATLAB.

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts of digital signal procesing
LO2 Discuss concepts of analysis and design tool

UNIT II

COMPUTATIONAL ACCURACY IN DSP IMPLEMENTATIONS

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, Compensating filter.

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts of computational accuracy in dsp implementations
LO2 Discuss concepts of sources of error in DSP implementations

UNIT III

ARCHITECTURES FOR PROGRAMMABLE DSP DEVICES AND EXECUTION

Basic Architectural features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation Unit, Programmability and Program Execution, Speed Issues, Features for External interfacing, Hardware looping, Interrupts, Stacks, Relative Branch support, Pipelining and Performance, Pipeline Depth, Interlocking, Branching effects, Interrupt effects, Pipeline Programming models

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts of architectures for programmable dsp devices and execution
LO2 Discuss concepts of architectural features

UNIT IV

PROGRAMMABLE DIGITAL SIGNAL PROCESSORS

Commercial Digital signal-processing Devices, Data Addressing modes of TMS320C54XX DSPs, Data Addressing modes of TMS320C54XX Processors, Memory space of TMS320C54XX Processors, Program Control, TMS320C54XX instructions and Programming, On-Chip Peripherals, Interrupts of TMS320C54XX processors, Pipeline Operation of TMS320C54XX Processors.

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts of programmable digital signal processors

LO2 Discuss concepts of addressing modes

UNIT V

IMPLEMENTATIONS OF BASIC DSP ALGORITHMS AND FFT ALGORITHMS

The Q-notation, FIR Filters, IIR Filters, Interpolation Filters, Decimation Filters, PID Controller, Adaptive Filters, 2-D Signal Processing, An 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

UNIT VI

INTERFACING MEMORY AND I/O PERIPHERALS TO PROGRAMMABLE DSP DEVICES

Memory space organization, External bus interfacing signals, Memory interface, Parallel I/O interface, Programmed I/O, Interrupts and I/O, Direct memory access (DMA). A Multichannel buffered serial port (McBSP), McBSP Programming, a CODEC interface circuit, CODEC programming, A CODEC-DSP interface example.

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts of implementations of basic dsp algorithms and fft algorithms

LO2 Discuss concepts of interfacing memory and i/o peripherals to programmable dsp devices

TEXT BOOKS:

1. Digital Signal Processing – Avtar Singh and S. Srinivasan, Thomson Publications, 2004.
2. DSP Processor Fundamentals, Architectures & Features – Lapsley et al. S. Chand & Co, 2000.

REFERENCES:

1. Digital Signal Processors, Architecture, Programming and Applications – B. Venkata Ramani and M.Bhaskar, TMH, 2004.
2. Digital Signal Processing – Jonatham Stein, John Wiley, 2005.

ELECTIVE-V
REMOTE SENSING AND SENSORS

Credits : 3

Subject Code : MTRM – 3.1 **Max. Marks :** 70

Semester-III **Sessionals :** 30

Course Educational Objective

To provide an insight into the basic concepts of

CEO 1 basics of remote sensing
CEO 2 Platforms and sensors
CEO 3 microwave remote sensing
CEO 4 thermal imaging system
CEO 5 satellite characteristics and their orbits

Course Outcomes

By the end of the course the student will be able to

CO 1 basics of remote sensing
CO 2 Platforms and sensors
CO 3 microwave remote sensing
CO 4 thermal imaging system
CO 5 satellite characteristics and their orbits

Unit-I Basics of Remote Sensing

a) Principles of Remote sensing, History of Remote sensing, Remote sensing in India, Electromagnetic Radiation and Electromagnetic Spectrum, EMR quantities: Nomenclature and Units Thermal Emission of Radiation, Radiation Principles (Plank's Law, Stephen Boltezman law), Interaction of EMR with the Earth Surface (Wien's displacement law, Kirchoffs Law) Spectral signature, Reflectance characteristics of Earths cover types, Remote sensing systems.

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts of basics of remote sensing
LO2 Discuss concepts of principles of Remote sensing

Unit - II

Platforms and sensors

Platforms, Remote sensing sensors, resolutions Across track and along the track scanning, Optical sensors, Thermal scanners Microwave sensing radar satellite missions Landsat series, SPOT series, IRS satellite series, IKNOS,

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts of platforms and sensors
LO2 Discuss concepts of principles of Remote sensing sensors

Unit-III Microwave Remote Sensing

Airborne and Space borne radar systems basic instrumentation. System parameters - Wave length, Polarization, Resolutions, Radar geometry. Target parameters - Back scattering, Point target, Volume scattering, Penetration, Reflection, Bragg resonance, Cross swath variation. Speckie radiometric calibration. Radar - Grametry - Introduction, Mosaicing Stereoscope. Application : Geology, Forestry, Land use, Soils etc. Future trends and Research

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts of airborne and Space borne radar systems basics
LO2 Discuss concepts of principles of microwave remote sensing

Unit-IV Thermal Imaging system

Thermal Imaging System: Introduction - IR region of the Electromagnetic spectrum, Atmospheric transmission, Kinetic and radiant temperature, Thermal properties of materials, Emissivity, Radiant temperature. Thermal conductivity. Thermal capacity, thermal inertia, Apparent thermal inertia, Thermal diffusivity.

IR - radiometers, Airborne and Satellite TTR scanner system

Characteristics of IR images

i) Scanner distortion, ii) image irregularities, iii) Film density and recorded iv)Temperature ranges Effects of weather on images i) Clouds, ii) Surface winds, iii) Penetration of smoke plumes Interpretation of thermal imagery Advantages of Thermal imagery

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts of thermal imaging system

LO2 Discuss concepts of principle characteristics of IR images

Unit-V

Meteoro s Meteorological satellite characteristics and their orbits, TIROS, NIMBUS, NOAA, TIROS logical N, SEASAT, GOES, METEOSAT, INSAT Measurement of Earth and Atmospheric satellite energy and Radiation budget parameters from satellites

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts of satellite characteristics and their orbits

LO2 Discuss concepts and principles of radiation budget parameters

Text books

1. Imaging Radar for Resource Survey: Remote Sensing Applications, 3, W Travelt, Chapman & Hall
2. Remote Sensing: The quantitative approach, P.H. Swain and S.M. Davis, McGraw Hill
3. Floyd, F. Sabins, Jr: Remote Sensing Principles and Interpretation, Freeman and Co.San Franscisco, 1978
4. Applied Remote Sensing C.P.L.O., Longman Scientific and Technical Publishers.
5. Introduction to Environmental Remote Sensing, E.C. Barrett & L.F Curtis, Chapman and Hall, London
6. Fundamentals of remote sensing, George Joseph, Universities Press

OPEN ELECTIVE

Credits : 3

Subject Code : MTRM – 3.2 **Max. Marks :** 70

Semester-III **Sessionals :** 30

COMPUTER AND COMMUNICATION NETWORKS

Course Educational Objective

To provide an insight into the basic concepts of

CEO 1 basics of computer networks
CEO 2 transmission media and digital signaling
CEO 3 wireless communication
CEO 4 error detection and CRC polynomial codes
CEO 5 data link layer protocols and multiplexing
CEO 6 circuit switching and packet switching

Course Outcomes

By the end of the course the student will be able to

CO 1 basics of computer networks
CO 2 transmission media and digital signaling
CO 3 wireless communication
CO 4 error detection and CRC polynomial codes
CO 5 data link layer protocols and multiplexing
CO 6 circuit switching and packet switching

1. Introduction to Computer Networks, OSI Reference Model: A Layered Approach,Intro to TCP/IP Protocol Suite.

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts of computer networks
LO2 Discuss concepts of to TCP/IP Protocol Suite.

2. Transmission Media and Digital Signaling, Analog vs. Digital Transmission, Nyquist And Shannon Limits, Digital or Analog Data to Digital Signals.

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts of transmission media and digital signaling
LO2 Discuss concepts of Analog vs. Digital Transmission

3. Wireless Communication, Advances in cellular, personal communications systems (PCS), global system for mobile communications (GSM), wireless LANs - applications, satellites, and fixed wireless networks.

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts of wireless communication
LO2 Discuss concepts of fixed wireless networks.

4. Error Detection and CRC Polynomial Codes. Data Link Control, Stop & Wait, SlidingWindow ARQ, Go-back-N, Selective Reject.

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts of Error Detection and CRC Polynomial Codes
LO2 Discuss concepts of Data Link Control.

5. Data Link Layer Protocols and Multiplexing, HDLC, LAP-B, ARPANET DLC, Frequency and Time Division Multiplexing.

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts of data link layer protocols and multiplexing
LO2 Discuss concepts of multiplexing

6. Circuit Switching and Packet Switching, Digital Switching Concepts, Packet Switching Principles, Virtual Circuits and Datagrams, X.25, Frame and Cell Relay, ATM.

Learning Outcomes: By the end of this unit students will be able to:

LO1 Understand basic concepts of circuit switching and packet switching
LO2 Discuss concepts of Virtual Circuits

Text Book:

1. William Stallings, “Wireless Communications and Networks”, Prentice Hall, 2004

2. Stallings, William Data and Computer Communications, 8th Edition PrenticeHall, 2007,

Reference Books:

1. T.S. Rappaport, "Wireless Communications: Principles & Practice", Second Edition, PrenticeHall, 2002.

2. J R. Prasad, W. Mohr, and W. Konhauser (Editors), "Third Generation Mobile Communication Systems", Artech House Publishers, 2000.

3. W.C.Y. Lee, "Mobile Communication Engineering, Theory and Applications", Second Edition, McGraw-Hill, 1998.

BUSINESS ANALYTICS

Unit1: Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organisation, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.

Unit 2: Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.

Unit 3: Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

Unit 4: Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

Unit 5: Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, the Value of Information, Utility and Decision Making.

Unit 6: Recent Trends in: Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.

Reference:

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.

2. Business Analytics by James Evans, persons Education.

INDUSTRIAL SAFETY

Unit-I: Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

Unit-II: Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

Unit-III: Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

Unit-IV: Fault tracing: Fault tracing-concept and importance, decision treeconcept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic,automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

Unit-V: Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

Reference:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.

2. Maintenance Engineering, H. P. Garg, S. Chand and Company.

3. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.

4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

OPERATIONS RESEARCH

Unit 1: Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

Unit 2: Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

Unit 3: Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

Unit 4: Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

Unit 5: Competitive Models,Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

References:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008

2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.

3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008

4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009

5. Pannerselvam, Operations Research: Prentice Hall of India 2010 6. Harvey M Wagner,

Principles of Operations Research: Prentice Hall of India 2010

COST MANAGEMENT OF ENGINEERING PROJECTS

Introduction and Overview of the Strategic Cost Management Process Cost concepts in decision-making; relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making. Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process

Cost Behaviour and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

References:

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi

2. Charles T. Horngren and George Foster, Advanced Management Accounting

3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting.

COMPOSITE MATERIALS

UNIT–I:

INTRODUCTION: Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT – II:

REINFORCEMENTS: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.

UNIT – III:

Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

UNIT–IV:

Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

UNIT – V:

Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

TEXT BOOKS:

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.

2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.

References:

1. Hand Book of Composite Materials-ed-Lubin.

2. Composite Materials – K.K.Chawla.

3. Composite Materials Science and Applications – Deborah D.L. Chung.

4. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi.

WASTE TO ENERGY

Unit-I:

Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

Unit-II:

Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

Unit-III:

Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

Unit-IV:

Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

Unit-V:

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

References:

1. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.

2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.

3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.

4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.