**Scheme of Studies/Examination**
**Semester VIII**

| S. No. | Course No. | Subject | L:T:P | Hours/ Week | Examination Schedule (Marks) | | | | Duration of Exam (Hrs) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Theory | Sessionals | Practical | Total | |
| 1 | ECE-402N | Wireless & Mobile | 4:0:0 | 4 | 75 | 25 | 0 | 100 | 3 |
| 2 | ECE-404N | Microwave Engineering | 3:0:0 | 3 | 75 | 25 | 0 | 100 | 3 |
| 3 | ECE- 420N | Core Elective –III: Transducers &ItsApplications ** | 3:0:0 | 3 | 75 | 25 | 0 | 100 | 3 |
| 4 | ECE- 422N | Core Elective –IV: Radar Engineering ** | 3:0:0 | 3 | 75 | 25 | 0 | 100 | 3 |
| 5 | ECE-406N*** | Project-II | 0:0:14 | 14 | 0 | 100 | 100 | 200 | 3 |
| 6 | ECE-408N | Wireless & Mobile | 0:0:3 | 3 | 0 | 40 | 60 | 100 | 3 |
| 7 | ECE-410N | Microwav e | 0:0:3 | 3 | 0 | 40 | 60 | 100 | 3 |
| 8 | ECE-412N* | Seminar & Report Writing | 2:0:0 | 2 | 0 | 100 | 0 | 100 | 3 |
| | | **Total** | | **35** | **300** | **380** | **220** | **900** | |
| 9 | ECE-440N**** | General Fitness & Professional Aptitude | | | | | | 100 | 3 |

** The performance of the student will be evaluated by the presentation delivered and the report submitted by the student related to Industrial/Research problems &its suggested solutions.*

****The project should be initiated by the student in continuation of the 7th semester and will be evaluated in the end of the semester on the basis of a presentation and Report.*

*****A viva of the students will be taken by external examiner (Principal/Director/Professor/or any senior Person with Experience more than10 years) at the end of the semester and grades will be given according to the grade*

**Vision of the Department**:

The Electronics and communication Engineering Department is looking forward to cater the latest industrial needs to produce skilful engineers who are innovative, entrepreneurial and result oriented.

**Mission of the Department:**

To provide the students with lifelong learning needed for a productive career on the grounds of ethics, good governance, and quality and to disseminate knowledge by upholding innovative services to provide collective environment that inspires every stakeholder.

1. **Program Specific Outcomes (PSO):**

| | |
|---|---|
| PSO1 | Study and implementing the fundamental concepts of electronics and communication systems. |
| PSO2 | Design, develop and analyze advance model of electronics and communication system |

2. **Program Outcomes (PO)**

1. Apply knowledge of mathematics, science, engineering fundamentals and electronics communication and engineering for the solution of engineering problems.

2. Problem analysis- Identify, analyze complex engineering problems reaching substantiated conclusions using basic of electronics engineering & mathematics.

3. Conduct Investigations of complex problems:- Developing presumed concept & providing valid facts behind using experiments, analysis and interpretation of data and synthesis of information.

4. Design and construct a electronic system or process to meet industry, domestic society needs, safety and sustainability.

5. Modeling &implementing complex engineering activities using modern tools & techniques.

6. The engineer and society:- Apply acquired knowledge to address the societal issue in relevance to professional engineering practices.

7. Environment & sustainability: - Understand the impact of professional engineering solutions in environmental contexts and demonstrate knowledge of and need for visible sustainability.

8. Work as professionals in accordance with the norms of electronics practices and commit to social, ethical and professional responsibilities.

9. Individual & Team work:- To inculcate an effective behavior in leader in diverse team and in multidisciplinary settings.

10. To converse effectively various engineering activity to various modes to all levels of society.

11. Understand and implement project management techniques, tools and methods to finalize.

12. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning. Imparting the ability individual for lifelong learning and working independently in changing technological environment.

**3**. **PEOs**

1. To prepare ECE graduates for supporting and leadership roles in multi deplaning domain with ethical values.

2. To prepare ECE graduates with a zeal for continuing, high degrees research and other professional developments.

3. To prepare ECE graduate with entrepreneurial skills and to encourage implementation and services via technical & communicational attributes.

**CONTENTS**

| ECE-402N | WIRELESS & MOBILE COMMUNICATION | | | | | |
|---|---|---|---|---|---|---|
| **Lecture** | **Tutorial** | **Practical** | **Theory** | **Sessionals** | **Total** | **Time** |
| **4** | **0** | **0** | **75** | **25** | **100** | **3** |
| **Purpose** | To introduce the concepts of wireless / mobile communication using cellular environment. To make the students to know about the various modulation techniques, propagation methods, and multi access techniques used in the mobile communication. | | | | | |
| **Course Outcomes** | | | | | | |
| **CO 1** | It deals with the fundamental cellular radio concepts such as frequency reuse and | | | | | |
| **CO 2** | This also demonstrates the principle of trunking efficiency and how trunking and interference issues between mobile and base stations combine to affect the overall capacity of cellular systems. | | | | | |
| **CO 3** | It provides idea about analog and digital modulation techniques used in wireless communication. | | | | | |
| **CO 4** | It presents different ways to radio propagation models and predict the large – scale effects of radio propagation in many operating environment. | | | | | |
| **CO 5** | Classify multiple access techniques in mobile communication. | | | | | |
| **CO 6** | Describe GSM architecture and protocols. | | | | | |

**Unit–I**

Introduction to Wireless Communication Systems: Evolution of mobile radio communications, examples of wireless comm. systems, paging systems, Cordless telephone systems, comparison of various wireless systems.

Modern Wireless Communication Systems: Second generation cellular networks, third generation wireless networks, wireless in local loop, wireless local area networks, Blue tooth and Personal Area networks.

**Unit–II**

Introduction to Cellular Mobile Systems: Spectrum Allocation, basic Cellular Systems, performance Criteria, Operation of cellular systems, analog cellular systems, digital Cellular Systems.

Cellular System Design Fundamentals: Frequency Reuse, channel assignment strategies, handoff Strategies, Interference and system capacity, tracking and grade off service, improving coverage and capacity.

**Unit– III**

Multiple Access Techniques for Wireless Communication: Introduction to Multiple Access, FDMA, TDMA, Spread Spectrum multiple Access, space division multiple access, packet ratio, capacity of a cellular systems.

**Unit–IV**

Wireless Standards-GSM, IS-95, UMTS-IMT-2000, Signaling, Call Control, Mobility Management and location Tracing.

Suggested Books:


1. Theodore S.Reppaport, Wireless Communications Principles and Practice, IEEE Press, Prentice Hall.
2. William C.Y.Lec, Mobile Cellular Telecommunications, Analog and Digital Systems, Mc-Graw Hill Inc.
3. Kamilo Feher, Wireless Digital Communications, Modernization & Spread Spectrum Applications, Prentice Hall of India, New Delhi.
4. Kaveh Pahlavan and Allen H. Levesque “Wireless Information Networks”, Wiley Series, John Wiley and Sons Inc.

## LECTURE PLAN

| Lecture | Topic |
|---|---|
| L1 | INTRODUCTION TO SUBJECT |
| L2 | EVOLUTION OF MOBILE RADIO COMMUNICATIONS |
| L3 | EXAMPLES OF WIRELESS COMM. SYSTEMS, PAGING SYSTEMS |
| L4 | CORDLESS TELEPHONE SYSTEMS, COMPARISON OF VARIOUS WIRELESS SYSTEMS. |
| L5 | SECOND GENERATION CELLULAR NETWORKS, THIRD GENERATION WIRELESS NETWORKS |
| L6 | WIRELESS IN LOCAL LOOP, WIRELESS LOCAL AREA NETWORKS |
| L7 | BLUE TOOTH AND PERSONAL AREA NETWORKS. |
| L8 | REVISION OF UNIT 1 |
| L9 | SPECTRUM ALLOCATION, BASIC CELLULAR SYSTEMS |
| L10 | PERFORMANCE CRITERIA, OPERATION OF CELLULAR SYSTEMS |
| L11 | ANALOG CELLULAR SYSTEMS, DIGITAL CELLULAR SYSTEMS. |
| L12 | FREQUENCY REUSE, CHANNEL ASSIGNMENT STRATEGIES, |
| L13 | HANDOFF STRATEGIES, INTERFERENCE AND SYSTEM CAPACITY, |
| L14 | TRACKING AND GRADE OFF SERVICE |
| L15 | IMPROVING COVERAGE AND CAPACITY. |
| L16 | REVISION OF UNIT 2 |
| L17 | DISCUSSION OF SESSIONAL 1 |
| L18 | INTRODUCTION TO MULTIPLE ACCESS |
| L19 | FDMA |
| L20 | TDMA |
| L21 | SPREAD SPECTRUM MULTIPLE ACCESS |
| L22 | SPACE DIVISION MULTIPLE ACCESS |
| L23 | PACKET RATIO, CAPACITY OF A CELLULAR SYSTEMS. |
| L24 | REVISION OF UNIT 3 |
| L25 | GSM |
| L26 | IS-95 |
| L27 | UMTS-IMT-2000 |
| L28 | SIGNALING, CALL CONTROL |
| L29 | MOBILITY MANAGEMENT AND LOCATION TRACING. |
| L30 | REVISION OF UNIT 4 |
| L31 | DISCUSSION OF SESSIONAL 2 |
| L32 | CONTENT BEYOND CURRICULUM |

### Tutorial Sheet 1

Q1. Briefly explain the different generation of wireless communication systems.
Q2. Write a brief note on wireless local area network.
Q3. Differentiate personal area network and Bluetooth.
Q4. Give an account of various Radio channels.

### Tutorial Sheet 2

Q1. Explain various diversity techniques.

Q2. Explain spread spectrum techniques.
Q3. Describe various digital modulation techniques for mobile radio.
Q4. Compare different Multiple Access Techniques.
Q5. What is the concept of Digital Modulation for Mobile Radio?

**Tutorial Sheet 3**

Q1. Explain basic cellular concept and frequency reuse.
Q2. Compare FDMA, CDMA, and TDMA.
Q3. Explain spectrum efficiency.
Q4. What is handover analysis?
Q5. Which of the Multiplexing techniques is better? Give reasons.

**Tutorial Sheet 4**

Q1. Explain UMTS-IMT-2000.
Q2. Explain lS-95
Q3. What is call control & Mobility management?
Q4. What is soft capacity and Erlang capacity?
Q5. What is location tracing?

Roll No. ..... Total Pages : 04

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# WIRELESS AND MOBILE COMMUNICATION

## ECE-402N

Time : Three Hours] [Maximum Marks : 75

**Note** : Attempt *Five* questions in all, selecting at least *one* question from each Section.

### Section I

1. (a) Explain the principle of Cellular Networks and various types of Handoff techniques. 8

   (b) Under what circumstances, static channel assignment is normally used ? 4

   (c) Distinguish between a cell and a cell site. 3

2. (a) What are advantages of cellular mobile communication systems over conventional mobile telephone system ? 8

   (b) Describe the step-by-step procedure for placing a call from a calling mobile subscriber to a called landline telephone subscriber. 7

## Section II

3. (a) Discuss the similarities and differences between a conventional cellular radio system and a space-based (satellite) cellular radio system. What are the advantages and disadvantages of each system ? Which system could support a larger number of users for a given frequency allocation ? Why ? How would this impact the cost of service for each subscriber ? **8**

(b) Explain in detail capacity of cellular system. Explain the benefits of Frequency Re-use and using Hexagonal cells and give the concept of Handoff and Handover ? **7**

4. (a) Discuss, what are the problems encountered in implementing handoff strategies and how they are resolved ? **8**

(b) A cellular system has a total 500 duplex voice channels without frequency reuse. The service area is divided into uniform 150 cells. The required C/I value is 18 dB. Determine the cell cluster size, number of cell clusters in the given service area, and maximum number of users at any instant in the service area. Assume the path-loss exponent as 3. 7

## Section III

5. (a) The basic TDMA frame structure of GSM cellular system comprises of 156.25 bits in a time slot, of which 40.25 bits are overhead (ignoring the 2 flag bits), compute the frame efficiency. 8

   (b) Explain the main properties of the basic multiple access techniques-FDMA, TDMA, and CDMA. 7

6. (a) In IS-136 TDMA cellular system, the one-way allocated RF bandwidth is 12.5 MHz. The channel spacing is 30 kHz. There are 395 voice channels in the system. The TDMA frame duration is 40 ms, with 6 time-slopts per frame. The system offers an individual user data rate of 16.2 kbps in which the speech with error protection is @ 13 kbps. Compute the overall system efficiency. 8

   (b) Compare similarities and differences in the fundamental concepts of a DS-SS system versus FH-SS System. 7

## Section IV

7. (a) What is the different between a physical channel and a logical channel ? Describe the important functions of various types of logical channels in GSM. **8**

   (b) With the help of a block diagram draw the GSM network architecture and identify various interfaces used in its different entities. **7**

8. Explain the following in detail :

   (a) FDMA **5**

   (b) IMT-2000 **5**

   (c) IS-95. **5**

| ECE-404N | MICROWAVE ENGINEERING | | | | | |
|---|---|---|---|---|---|---|
| **Lecture** | **Tutoria** | **Practical** | **Theory** | **Sessional** | **Total** | **Time** |
| **3** | **0** | **0** | **75** | **25** | **100** | **3 Hrs** |
| **Purpose** | As a part of RF communication technology the purpose of this course is to create awareness about conventional microwave resonators, generators, components and devices along with the importance of scattering parameters so that the learner is able to design and apply these basic approaches in commercial | | | | | |
| **Course Outcomes** | | | | | | |
| CO1 | **Learner will be able to mathematically design basic resonator cavities and will be able to measure microwave parameters such as impedance, frequency and VSWR etc.** | | | | | |
| CO2 | **Learner will learn the conventional methods to generate the microwaves.** | | | | | |
| CO3 | **Learner will be able to know the basic understanding of construction & principle of working of microwave generator.** | | | | | |
| CO4 | **Learner will know about the importance of scattering parameters along with its applications in the analysis of basic microwave components.** | | | | | |
| CO5 | **Learner will learn about transferred electron and avalanche transit time devices in detail.** | | | | | |
| CO6 | **Learner will be able to know the application area of microwaves.** | | | | | |

## Unit-I

**Microwave Resonators**: Brief description of waveguides, coplanar waveguides, cavity resonators: rectangular, cylindrical, spherical and coaxial, excitation and coupling of cavities, Q factor. Microwave Measurements: Measurement of Frequency, Impedance (using slotted section) attenuation, power, dielectric constant, measurement of V.S.W.R., insertion loss and permeability

## Unit-II

**Microwave Generators**: Construction, characteristics, operating principle and typical applications of Klystron (two cavity, multicavity), Reflex Klystron, magnetron (Cylindrical magnetron and description of Π mode applications) and Traveling Wave Tube (TWT).

## Unit-III

**Matrix Description of Microwave Circuits**: Scattering Matrix: properties, measurement of scattering coefficients, scattering matrices for common microwave systems. Microwave Components: Waveguide tees- E-plane, H-plane, magic tee, rat race, directional coupler, tuning screws and stubs, isolators and circulators- their constructional features and applications. Microwave filters, Phase shifters, attenuators and frequency meter.

## Unit-IV

**Solid State Microwave Devices:** Transferred Electron Devices-Gunn Effect; negative differential resistance phenomenon, field domain formation, Gunn diode structure. Avalanche transit time devices: IMPATT, TRAPATT, BARITT diodes, parametric amplifiers.

**Text Book:**

1. Samuel Y. Liao, Microwave Engineering, Pearson Education 3rd/4th/ higher Ed.

**Reference Books:**

2. Annapurna & Sisir K. Das, Microwave Engineering, Tata McGraw-Hill.
3. David M. Pozar, Microwave Engineering, John Wiley and Sons Inc.

## LECTURE PLAN

| Lecture | Topic |
|---|---|
| L1 | **Microwave Resonators**: Brief description of waveguides |
| L2 | Coplanar waveguides |
| L3 | Cavity resonators: rectangular, cylindrical, |
| L4 | Cavity resonators: spherical and coaxial |
| L5 | Excitation and coupling of cavities |
| L6 | Q-factor. |
| L7 | Microwave Measurements: Measurement of Frequency |
| L8 | Measurement of Impedance (using slotted section), attenuation, |
| L9 | Microwave Measurements: power, dielectric constant |
| L10 | Measurement of V.S.W.R. |
| L11 | Measurement of Insertion loss and permeability |
| L12 | **Microwave Generators**: Construction, characteristics |
| L13 | operating principle and typical applications of Klystron (two cavity, multicavity) |
| L14 | Reflex Klystron |
| L15 | Magnetron (Cylindrical magnetron and description of Π mode applications) |
| L16 | Magnetron (Cylindrical magnetron and description of Π mode applications) contd. |
| L17 | Traveling Wave Tube (TWT). |
| L18 | **Matrix Description of Microwave Circuits**: Scattering Matrix: properties |
| L19 | Measurement of scattering coefficients |
| L20 | Scattering matrices for common microwave systems |
| L21 | Microwave Components: Waveguide tees- E-plane |
| L22 | H-plane, magic tee |
| L23 | rat race, directional coupler |
| L24 | Tuning screws and stubs |

L25 Isolators and circulators- their constructional features

L26 Isolators and circulators- Applications

L27 Microwave filters, Phase shifters

L28 Attenuators and frequency meter.

L29 **Solid State Microwave Devices:** Transferred Electron Devices-Gunn Effect

L30 Negative differential resistance phenomenon

L31 Field domain formation

L32 Gunn diode structure

L33 Avalanche transit time devices

L34 IMPATT diode

L35 TRAPATT, BARITT diodes

L36 Parametric amplifiers.

**Tutorial Sheet – 1**

Q1. Explain the construction and operation of microwave transistors giving the emphasis on their performance characteristics.

Q2. Discuss the power frequency, current frequency and voltage frequency limitation with respect to microwave transistors.

Q3. Explain microwave cavity.

Q4. Explain the working of rectangular cavity resonator.

Q5. Explain Q factor.

**Tutorial Sheet – 2**

Q1. Explain process of velocity modulation in reflex klystron.

Q2. Obtain expressions for power output and efficiently of the reflex klystron.

Q3. Give the difference between TWT and klystron.

Q4. Explain construction and working of helical TWT.

Q5. What is meant by mode jumping?

**Tutorial Sheet –3**

Q1. What are the scattering parameters? Give their importance in microwave work..

Q2. Explain advantages and disadvantages of parametric devices.

Q3. Explain the interaction between dictions and fields wrt electric field only.

Q4. Explain insertion loss & Permeability.

Q5. Explain microwave circulator with its scattering matrix.

## Tutorial Sheet- 4

Q1. Give the electronics application of MOSFET.

Q2. Define waveguide microwave junction.

Q3. Explain LSA diode.

Q4. Explain Rat Race.

Q5. Explain phase shifter. Where it is used in microwave.

## Tutorial Sheet- 5

Q1. Explain TRAPTT and BARITT diodes.

Q2. Explain microwave filters.

Q3. Explain magic Tee.

Q4. What is the function of idler circuit in a parametric circuit?

Q5. Define field domain formation.

Roll No. ..... Total Pages : 03

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# MICROWAVE ENGINEERING

## ECE-404N Opt. (II)

Time : Three Hours] [Maximum Marks : 75

**Note :** Attempt *Five* questions in all, selecting at least *one* question from each Unit.

### Unit I

1. (a) Find the lowest four cut off frequencies for an air filled rectangular wave guide when $a/b = 2$ with $a = 4$ cm. Also find the modes that can be used to transit 8 GHz. 8

   (b) Derive the unloaded quality factor of rectangular cavity for its dominant mode. 7

2. (a) Explain the slotted line method of impedance measurement. 8

   (b) Explain the down conversion method of frequency measurement. 7

## Unit II

3. (a) A Reflex Klystron operates under the following condition Beam Voltage ($V_0$) = 600 V, drift space length (L) = 1 mm, shunt resistance of the cavity (Rsh) = 15 KΩ and $f_r$ = 9 GHz. The tube is oscillating at $f_r$ at the peak of the $n$ = 2 mode or 1(3/4) mode. Beam loading and transit time effects are neglected. Determine (i) Repeller Voltage (ii) Direct current necessary to give a microwave gap voltage of 200 V. (ii) Electronic efficinecy. **9**

   (b) Explain the π-mode oscillation phenomenon and its importance for Cylindrical Magnetron. **6**

4. (a) Explain the bunching process with necessary expressions of Two Cavity Klystron amplifier ? **8**

   (b) A helix travelling wave tube is operated with a beam current of 300 mA beam voltage of 5 kV and characteristics impedance of 20Ω. Find the length of the helix to give an output power gain of 50 dB at $f$ = 10 GHz ? **7**

## Unit III

5. (a) Describe the operation of E-plane Tee and derive its S-matrix. **8**

   (b) Explain the working of precision phase shifter and its s-Matrix in detail. **7**

6. (a) Explain Faraday rotation isolator in detail. 8

(b) Explain the operation of Directional coupler and derive its S-matrix. 8

## Unit IV

7. (a) Explain the negative differential phenomenon of GUNN Diode using two valley model theory ? 8

(b) Explain the construction and operation of IMPACT diode in detail. 8

8. (a) An IMPATT diode has the following parameters : Carrier drift velocity = $10^5$ m/s, length of drift space is 5 μm, maximum operating current is 150 mA, maximum operating voltage is 80 volt, and efficiency is 10%. Calculate (i) CW Power output, (ii) Frequency of oscillation produced. 8

(b) Explain the construction and operation of TRAPATT diode. 8

| ECE-420N | Transducers & Its Applications | | | | | | |
|---|---|---|---|---|---|---|---|
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major** | **Minor** | **Total** | **Time** |
| **3** | | **-** | **3** | **75** | **25** | **100** | **3** |
| | **Understanding the structural and functional principles of sensors and transducers used for various physical and nonelectric quantities and how to use them to measure these quantities.** | | | | | | |
| **Course Outcomes** | | | | | | | |
| **CO 1** | **Explain the principles of operation of the sensor parameters and generators** | | | | | | |
| **CO 2** | **Interpretation of the measurement results by using transducers.** | | | | | | |
| **CO 3** | **Development of measurement schemes for different non electrical quantities** | | | | | | |
| **CO 4** | **Assimilating knowledge about the implementation of sensors and transducers.** | | | | | | |
| **CO 5** | **Analyze the performance characteristics of each instrument** | | | | | | |
| **CO 6** | **Explain the terminologies of sensors and their applications in industry** | | | | | | |

**Unit-I**

Definition of transducer. Advantages of an electrical signal as out-put. Basic requirements of transducers, Primary and Secondary Transducer, Analog or digital types of transducers. Resistive, inductive, capacitive, piezoelectric, photoelectric and Hall Effect transducers.

**Unit-II**

Measurement of Pressure – Manometers, Force summing devices and electrical transducers Measurement of Temperature – Metallic resistance thermometers, semi conductor resistance sensors (Thermistors), thermo-electric sensors, pyrometers.

**Unit-III**

Measurement of Displacement – Potentiometric resistance type transducers, inductive type transducers, differential transformer (L.V.D.T), capacitive transducers, Hall Effect devices, strain gage transducers.

Measurement of Velocity – variable reluctance pick up, electromagnetic tachometers, photoelectric tachometer, toothed rotor tachometer generator.

**Unit-IV**

Measurement of Force – Strain-gage load cells, pneumatic load cell, LVDT type force transducer. Measurement of Torque – Torque meter, torsion meter, absorption dynamometers, inductive torque transducer, digital methods.

**Suggested Books:**

1.B.C. Nakra, K.K. Chaudhry, "Instrumentation Measurement and Analysis," Tata McGraw-Hill Publishing Company Limited, New Delhi.

2.Thomas G. Beckwith etc. all, "Mechanical Measurements (International Student Edition), Addison-Wesley Longman, Inc. England.

3.A.K. Sawhney, "A Course in Electrical and Electronic Measurements and Instrumentation," Dhanpat Rai & Sons, Delhi-6.

**LECTURE PLAN**

| **LECTURE** | TOPIC |
|---|---|
| L1 | Definition of Transducer |
| L2 | Advantages of an Electrical Signal as Output |
| L3 | Basic Requirements of Transducers |
| L4 | Primary and Secondary Transducer. |
| L5 | Analog or Digital Types of Transducers |
| L6 | Resistive |

L7 Inductive
L8 Capacitive
L9 Piezoelectric
L10 Photoelectric
L11 Hall Effect Transducers
L12 Measurement of Pressure- Manometers
L13 Force Summing Devices and Electrical Transducers
L14 Measurement of Temperature- Metallic Resistance Thermometers
LI 5 Semi Conductor Resistance Sensors
L16 Thermistors
L1T Thermoelectric Sensors
L18 Pyrometers
L19 Measurement of Displacement- Potentiometric Resistance Type Transducers
L20 Inductive Type Transducers
L21 Differential Transformer (LVDT)
L22 Capacitive Transducers
L23 Hall Effect Devices
L24 Strain Gauge Transducers
L25 Measurement of Velocity- Variable Reluctance Pick Up
L26 Electromagnetic Tachometers
L27 Photoelectric Tachometer
L28 Toothed Rotor Tachometer Generator
L29 Measurement of Force - Strain Gauge Load Cells
L30 Pneumatic Load Cell
L31 LVDT Type Force Transducer
L32 Measurement of Torque- Torque Meter
L33 Torsion Meter
L34 Absorption Dynamometers
L35 Inductive Torque Transducer
L36 Digital Methods

**TUTORIAL SHEET -1**

Q1. Define transducers. What are the basic requirements of transducers?
Q2. Explain analog and digital transducers.
Q3. Explain resistive and inductive transducers.
Q4. Differentiate between piezoelectric and photoelectric transducers.
Q5. What are primary and secondary transducers?

**TUTORIAL SHEET -2**

Q1. Explain method of measuring high pressure.
Q2. Explain force summing devices.
Q3. Explain metallic resistance thermometer for measuring temperature.
Q4. What are thermistors?
Q5. What is the principle of pyrometer?

**TUTORIAL SHEET -3**

Q1. Explain potentiometric resistance type transducers.
Q2. Explain the principle of LVDT.
Q3. Differentiate between inductive type and capacitive type transducers.
Q4. What is Hall Effect?
Q5. What is the principle of electromagnetic tachometers?

**TUTORIAL SHEET -4**

Q1. What is photoelectric tachometer?
Q2. Explain strain gauge load cells.
Q3. Explain pneumatic load cells.
Q4. What is torque? Explain working of torque meter.
Q5. A variable reluctance type tachometer has 120 teeth on rotor. The speed of the shaft on which the rotor is mounted is 1500 rpm. Determine the frequency of output pulses.

## TUTORIAL SHEET -5

Q1. Explain torsion meter.
Q2. Explain absorption dynamometers.
Q3. Explain inductive torque transducers.
Q4. Explain digital methods of measuring torque.
Q5. Explain LVDT type force transducers.

Roll No. ..... Total Pages : 03

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# TRANSDUCER AND ITS APPLICATIONS
# ECE-420N

Time : Three Hours] [Maximum Marks : 75

**Note :** Attempt *Five* questions in all, selecting at least *one* question from each Unit. All questions carry equal marks.

## Unit I

1. (a) Discuss the basic requirements of a Transducer. 7½

   (b) Differentiate between active and passive transducers. 7½

2. Describe the properties of a material used for piezoelectric transducers. Also, discuss in detail the construction, working and applications of Photoelectric transducers. 15

## Unit II

3. What are Manometers ? How are they used to measure pressure ? Define the terms force constant and pressure constant relative to an elastic pressure diaphragm. 15

4. Differentiate between Optical pyrometer and radiation pyrometers. Draw appropriate diagrams to support your answer. 15

## Unit III

5. Discuss the construction and working principle of a Linear Variable Differential Transformer (LVDT). Also discuss how a LVDT can be used to measure the position and displacement. 15

6. Describe the working of a photoelectric tachometer with a neat diagram. Describe its construction details also. 15

## Unit IV

7. How does a pneumatic load cell work ? Discuss the differences between a pneumatic load cell and a strain-gauge load cell. **15**

8. Write short notes on any *two* of the following :

   (a) Absorption dynamometers

   (b) Digital methods to Torque measurement

   (c) Inductive torque transducer. **15**

| ECE-422N | Radar Engineering | | | | | | |
|---|---|---|---|---|---|---|---|
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major** | **Minor** | **Total** | **Time** |
| **3** | **0** | **0** | **3** | **75** | **25** | **100** | **3 Hr.** |
| **Purpose** | **To familiarize the students with the concepts of radar, various types of radar, radar mixers and various other technologies.** | | | | | | |
| **Course Outcomes** | | | | | | | |
| **CO 1** | **To understand the concept of basics of radar, its equation and signals associated with radar** | | | | | | |
| **CO 2** | **To understand the concept of CW and MTI radar.** | | | | | | |
| **CO 3** | **To understand the concept of Pulse Doppler radar.** | | | | | | |
| **CO 4** | **To familiarize with the concept of tracking radar.** | | | | | | |
| **CO 5** | **To familiarize with the concept of radar receiver, mixers and duplexers.** | | | | | | |
| **CO 6** | **To familiarize with the concept of protectors.** | | | | | | |

**Unit- I**

Radar BASICS: Radar Block Diagram & operation, Applications of Radar.

Radar Equation: Simple form of Radar Equation, Detection of signals in noise, Signal to Noise ratio, Transmitter Power. Pulse repetition frequency)' & range ambiguities, System losses, Propagation effects.

**Unit- II**

CW & Frequency Modulated Radar: The Doppler effect, CW Radar, FM- CW Radar, Multiple Frequency CW Radar.

MTI & Pulse Doppler radar: Introduction, Delay Line Cancellors. Multiple or staggered Pulse repetition frequencies. Range-Gated Doppler Filters, Limitation of MTI performance, Noncoherent MTI, Pulse Doppler radar, MTI from a moving platform.

**Unit-III**

Tracking Radar: Tracking with Radar, Sequential Lobbing, Conical Scan, Monopulse Tracking Radar, Tracking in range, Acquisition, Low angle tracking.

**Unit-IV**

Receivers, Displays & Duplexers: Radar Receivers, Noise Figure, Mixer Low-noise Front ends. Displays, Duplexer, Receiver protectors.

**Text Book:**

1. Introduction to Radar Systems: Merrill. Skolnik, MGH

**Reference Book:**

1. Electronic Communication Systems: Kennedy; TMH.

**LECTURE PLAN**

| LECTURE | TOPIC |
|---|---|
| L1 | Radar Basics: Radar Block Diagram & operation |
| L2 | Application of Radar |
| L3 | Simple form of Radar Equation, |
| L4 | Minimum Detectable Signal |
| L5 | Receiver Noise |
| L6 | Signal to Noise Ratio |
| L7 | Transmitter Power |
| L8 | Pulse Repetition Frequency |
| L9 | Range Ambiguities |

| | |
|---|---|
| L10 | System Losses |
| L11 | Propagation effects |
| L12 | CW & Frequency Modulated Radar, The Doppler Effect |
| L13 | CW Radar |
| L14 | FM- CW Radar |
| L15 | Multiple Frequency CW Radar |
| L16 | Introduction to MTI and Pulse Doppler Radar |
| L17 | Delay Line Cancellors, Multiple or Staggered |
| LI 8 | Pulse Repetition frequencies |
| LI 9 | Range-Gated Doppler Filters |
| L20 | MTI Delay Line |
| L21 | Limitation of MTI performance |
| L22 | Noncoherent MTI Pulse, Doppler Radar |
| L23 | MTI from a moving platform |
| L24 | Tracking with Radar |
| L25 | Sequential Lobbing |
| L26 | Conical Scan |
| L27 | Monopulse Tracking Radar |
| L28 | Tracking in range |
| L29 | Acquisition |
| L30 | Introduction to Receivers, Displays & Duplexers |
| L31 | Radar Receivers |
| L32 | Noise Figure |
| L33 | Mixer |
| L34 | Low-Noise Front Ends |
| L35 | Displays |
| L36 | Duplexer, Receiver Protectors |

**TUTORIAL SHEET -1**

1. Discuss the construction of Radar System and explain each part in detail.
2. Derive the standard equation for Radar system.
3. Define Signal to Noise Ratio, Transmitted power.
4. Explain in detail the propagation effects in Radar system.
5. - Write a note on system losses that occur in Radar system.

**TUTORIAL SHEET -2**

1. Explain Doppler effect?
2. Discuss the working principle of multiple frequencies CW Radar.
3. Explain Delay line cancellors.
4. Discuss the limitations of MTI performance.
5. Write a note on MTI with moving platform system.
6. Differentiate between CW and frequency modulated CW Radar. Explain the range measurement and Doppler measurement with frequency modulated Radar.

**TUTORIAL SHEET -3**

1. Explain different type of Tracking Radar System. Discuss anyone in detail help of block diagram.
2. What is Radar Tracking.
3. Explain the conical scan and sequential lobbing?
4. Explain the terms tracking in range and target acquisition?
5. Explain Monopulse Tracking Radar System.

**TUTORIAL SHEET -4**

1. What is different Radar Receiver? Discuss each of them.
2. Describe the low frequency RF amplifiers, mixers and detectors.
3. What are Requirements for Radar Receiver?
4. Write a note on
a) Duplexer
b) Display
c) Receiver Protector
5. Define Noise-figure in case of Radar Receiver.

Roll No. ..... Total Pages : 03

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# RADAR ENGINEERING

## ECE-422N

Time : Three Hours] [Maximum Marks : 75

**Note :** Attempt *Five* questions in all, selecting at least *one* question from each Section. All questions carry equal marks.

### Section I

1. (a) Explain the operation of Radar with the help of its block diagram. 7

   (b) A radar transmitter has a peak powder of 400 kW, a PRF of 1500 PPS and pulse width of 0.8s. Calculate :

   (i) Maximum unambiguous range

   (ii) Duty cycle

   (iii) Average power

   (iv) Suitable bandwidth. 4×2=8

2. (a) Calculate the maximum radar range in terms of signal to noise ratio. 8

(b) What is the peak power of a radar whose average power is 200 W, pulse width of 1 μs and pulse repetition frequency is 1 kHz. It has to detect the target of cross section 2 $m^2$ when it operates at a frequency of 3 GHz with the antenna diameter of 2 m, antenna aperture efficiency of 0.6 and mds is $10^{-12}$ W. Also calculate the maximum range in nmi ? 7

## Section II

3. (a) Explain the working of Multiple Frequency CW radar with the help of block diagram. 8

(b) Discuss the limitations of CW Radar. 7

4. (a) Explain staggered Pulse repetition frequency ? 7

(b) Explain the operation of Coherent MTI Pulse Doppler Radar. 8

## Section III

5. (a) Explain Sequential Lobbing method of tacking of an acquired target in detail. 8

(b) Explain Tracking with radar in detail. 7

6. (a) Explain conical scanning method of tacking of an acquired target in detail. 8

(b) Explain the acquisition of target and mono pulse tracking technique. 7

## Section IV

7. (a) Explain the purpose of mixer of and write different types of mixtures used in radar. 7

(b) Explain different types of Radar display in brief. 8

8. Write short notes on the following :

(a) Low Noise Front Ends. 7

(b) Radar Protectors. 8

| ECE-410N | MICROWAVE ENGINEERING LAB | | | | | |
|---|---|---|---|---|---|---|
| **Lecture** | **Tutorial** | **Practical** | **Sessionals** | **Practical** | **Total** | **Time** |
| **-** | | **3** | **40** | **60** | **100** | **3Hour** |
| **Purpose** | ***To give the students an idea about the study and analysis of components used in Microwave Engg.*** | | | | | |
| **Course Outcomes** | | | | | | |
| CO1 | ***Students will learn the steps to analyze microwave components.*** | | | | | |
| CO2 | ***Students will be able to find the characteristics of microwave components.*** | | | | | |
| CO3 | ***Students will learn the steps to analyze various antennas.*** | | | | | |
| CO4 | ***Students will be able to find the characteristics of various antennas.*** | | | | | |

**List of Experiments:**

1. To study microwave components.
2. To study the characteristics of the reflex Klystron tube and to determine its electronic tuning range.
3. To determine the frequency and wavelength in a rectangular waveguide working in $TE_{10}$ mode.
4. To determine the standing wave ratio and reflection coefficient.
5. To study the I-V characteristics of gunn diode.
6. To study the magic Tee.
7. To study the isolator and attenuator.
8. To measure the coupling coefficient and directivity of a waveguide directional coupler.
9. To measure the polar pattern and the gain of a waveguide horn antenna.
10. To measure the insertion loss and attenuation.

| ECE-408N | WIRELESS&MOBILECOMMUNICATIONLAB | | | | | |
|---|---|---|---|---|---|---|
| **Lecture** | **Tutorial** | **Practical** | **Sessionals** | **Practical** | **Total** | **Time** |
| **-** | | **3** | **40** | **60** | **100** | **3Hour** |
| **Purpose** | ***To give the students an idea about the Wireless communication theory and technology using the NI-Labview software and RF communication module.*** | | | | | |
| **Course Outcomes** | | | | | | |
| CO1 | ***To study the wireless communication using NI-Labview*** | | | | | |
| CO2 | ***To learn about the functioning of Universal Software Radio Peripheral (USRP)*** | | | | | |
| CO3 | ***To learn the implementation of different analog modulation schemes using the USRP.*** | | | | | |
| CO4 | ***To learn the implementation of different digital modulation schemes using the USRP.*** | | | | | |

## List of Experiments:

1. Introduction to NI-LabVIEW and familiarization with its basic functions.
2. Study of modulation toolkit and its usage in Wireless Communication.
3. Study the interfacing of hardware (USRP module) with the PC and configuring the same.
4. Implementation of AM using Software Defined Radio(SDR).
5. Implementation of FM using SDR with application such as transfer of files
6. Implementation of M-PSK transmitter using SDR concept.
7. Implementation of M-PSK receiver using SDR
8. Implementation of M-QAM transmitter using SDR.
9. Demonstrates the use of the Bluetooth functions to set up data transfer via Bluetooth between a server VI and a client VI.
10. Design two-dimensional convolution to perform image edge detection.
11. Implementation of M-QAM receiver using SDR.
12. Implementation of PSK Modulation system with Convolutional Coding.
13. Implementation of FSK Modulation system with BCH Coding.
14. Implementation of QAM Modulation system with Golay Coding