**Course File**

***Subject Title/Subject Code: Antennas and Propagation/6EC4-04***

Semester: VI Year: III

|  |  |  |
| --- | --- | --- |
| Name of the Faculty: Ms. Akansha Suthar |  | |
|  |  | |
| E-mail id: akansha.suthar@technonjr.org |  |

**Class Schedule**

**Total Number of Lectures:** 42

i**)Course Objective**

**Student will study the fundamental concepts and application of antennas and its radiation parameter. Also, they will study designing, different measurement and calculations related to various antenna. Other than this, they will also learn about radio wave propagation and smart antennas used in recent technologies.**

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**VISSION & MISSION OF INSTITUTE**

## Vision

Empowering student with recent and emerging technologies to create innovative technical leaders capable of contributing to industrial and societal needs for betterment of mankind across the globe.

## Mission

**M1**: To provide dynamic learning environment to students by providing constant exposure to latest technologies by linking closely with the industries.

**M2**: To establish effective interface with industry to obtain live problems to enhance critical thinking and problem solving skills among students and consultancy projects for faculty.

**M3**: To provide avenues and opportunities to faculty for domain specific trainings and qualification upgradation.

**M4**: To develop ethical leaders with strong communication skills.

**VISION & MISSION OF DEPARTMENT**

**Department Vision**

To increase student’s learning of fundamentals of programming and latest technologies of IOT through industry-aligned project-based learning transforming students to be good Embedded and IT Professionals leading to innovation and incubation of new ideas.

**Department Mission**

**M1:** To create experimental learning through solving problems of Government, Society, Smart Cities, Industry and other entities.

**M2:** To teach the latest technologies of IOT and Programming Skills to the students as beyond the syllabus activity so that they are updated and industry ready.

**M3:** To enable engineering students understand industry-aligned technologies and learn to find solutions from their early engineering days and this is the only way to produce globally relevant engineers solving real-life problems applying current technologies.

**M4:** To enable students to generate projects through problem faced by and requirement of Smart cities, industry, Government and other entities whereby those outlined problem statements are to be studied deeply by a group of faculty members to convert them into real-time project format.

**PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)**

**PEOs1:** Core Knowledge Development: Be competent in applying electronics and communication engineering principles to develop socially and environmentally acceptable engineering solutions.

**PEOs2:** Professional development: Have fulfilling career in electronic and communication engineering or associated industries or higher education and research, or as entrepreneurs.

**PEOs3:** Attitude towards lifelong learning: Enhance the ability and attitude to adapt to evolving technological and social challenges

**PROGRAM SPECIFIC OUTCOMES (PSO's)**

**PSO1**: To be aware of and initiate some work on programming and new developments which may impact future embedded and IT industry jobs.

**PSO2**: Design and development of Embedded and IOT based systems.

**PSO3**: Get exposure to Embedded and IT Industry work culture

**PROGRAMME OUTCOMES (POs)**

**A student will develop:**

**PO01. ENGINEERING KNOWLEDGE:** Acquire the knowledge of mathematics, science, engineering fundamentals, and electronics and communication engineering, with an ability to understand, analyze and apply to the solution of engineering problems..

**PO02. PROBLEM ANALYSIS:** Identify, formulate, research literature, analyse and solve electronics and communication engineering problems.

**PO03. DESIGN/ DEVELOPMENT OF SOLUTION:** Design solutions for electronics and communication engineering problems with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

**PO04. CONDUCTION OF INVESTIGATION OF COMPLEX PROBLEMS:** Design and conduct experiments, analyse and interpret data, and synthesize information to provide valid conclusions.

**PO05. MODERN TOOL USAGE:** Apply appropriate techniques, resources, and modern hardware and software engineering tools to solve electronics and communication engineering problems.

**PO06. THE ENGINEERING AND SOCIETY:** Apply reasoning to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

**PO07. ENVIRONMENT & SUSTAINABILITY:** Demonstrate the understanding of the impact of the professional engineering solutions in societal and environmental contexts, and need for sustainable development.

**PO08. ETHICS:** Demonstrate the knowledge of professional and ethical responsibilities..

**PO09. INDIVIDUAL AND TEAM WORK:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

**PO10. COMMUNICATION:** Comprehend and communicate confidently and effectively in both verbal and written form.

**PO11. PROJECT MANAGEMENT & FINANCE:** Apply the engineering and management principles for efficient project management.

**PO12. LIFE-LONG LEARNING:** Recognize the need and acquire confidence for independent and life-long learning.

**COURSE OUTCOMES (COs) OF THE SUBJECT**

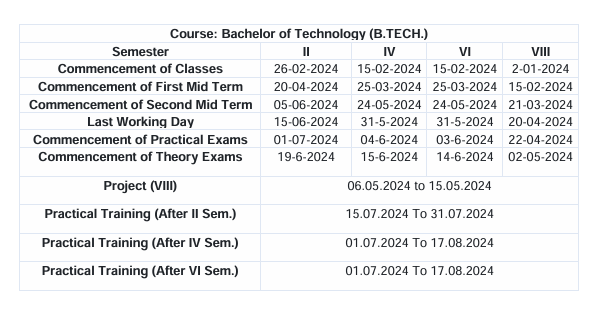
|  |  |  |
| --- | --- | --- |
| CO No. | Mapping | Statement |
| CO36404.1 | **Understand** | Define various performance parameters of antenna. |
| CO36404.2 | **Analysis** | Illustrate techniques for antenna parameter measurements. |
| CO36404.3 | **Application** | Students will apply concepts of antenna on transmitting message with high signal to noise ratio. |
| CO36404.4 | **Synthesis** | Synthesize the various applications of antennas |
| CO36404.5 | **Evaluation** | Evaluate the output of the MIMO systems. |

**COS MAPPING WITH POs AND PSOs**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course Outcome** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** | 2 | 1 | 1 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 1 |
| **CO2** | 2 | 2 | 1 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| **CO3** | 2 | 2 | 1 | 2 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 2 |
| **CO4** | 2 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| **CO5** | 2 | 2 | 2 | 2 | 1 | 0 | 0 | 2 | 0 | 0 | 0 | 1 | 2 | 1 | 0 |

**UNIVERSITY ACADEMIC CALENDAR**

Academic Calendar for Even Semester for Session



**Evaluation Scheme**

FACULTY DETAILS:

Name of the Faculty : Ms. Akansha Suthar

Designation : Assistant Professor

Department : Electronics and Communication Engineering

1. TARGET

a) Percentage Pass : 95%

b) Percentage I class : 60 %

2. METHOD OF EVALUATION

2.1. Continuous Assessment Examinations (Mid-Term 1, Mid-Term 2)

2.2. Assignments / Seminars

2.3. Mini Projects

2.4. Quiz

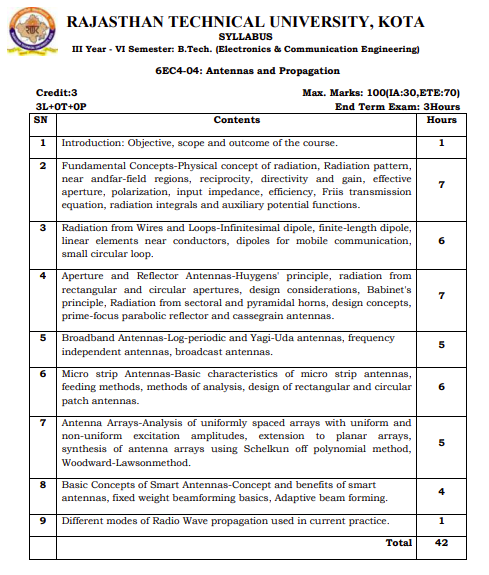
2.5. Semester Examination Others\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

3. List out any new topic(s) or any innovation you would like to introduce in teaching the subject in this Semester.

1. Take the help of creative tools to stimulate creativity. Include slide presentations, demonstration or forms of visual exercises that will excite the young minds and capture their interest.

Signature of Faculty: **Signature of HOD**

**UNIVERSITY SYLLABUS**

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**PRESCRIBED BOOKS**

1. Antennas and wave propagation: K.D. Prasad, Satya Prakashan, Tech India Publications, New Delhi,
2. Antenna Theory - C.A. Balanis, John Wiley & Sons, 3rd Ed., 2005

**WEEKLY TIME TABLE OF THE TEACHER**

First Time Table: with effect from (Date): 20-02-2024

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Day** | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| Monday |  |  | AWP |  |  |  |  |
| Tuesday |  | AWP |  |  |  |  |  |
| Wednesday |  |  |  |  |  |  |  |
| Thursday |  |  |  |  |  |  |  |
| Friday | AWP |  |  |  |  |  |  |
| Saturday |  |  | AWP |  |  |  |  |

Revision: 1 with effect from (Date): 29-04-2024

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Day** | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| Monday | AWP |  |  |  |  |  |  |
| Tuesday |  |  |  | AWP |  |  |  |
| Wednesday |  | AWP |  |  |  |  |  |
| Thursday |  |  |  |  |  |  |  |
| Friday |  |  |  |  |  |  |  |
| Saturday |  |  | AWP |  |  |  |  |

**COURSE-PLAN**

|  |  |  |  |
| --- | --- | --- | --- |
| UNIT | Lect.  No. | TOPICS | **Teaching Methods/ Teaching Aids** |
| **1** | **1** | **INTRODUCTION: Objective, scope and outcome of the course** | White Board, PPT |
| 2 | 2 | **FUNDAMENTAL CONCEPTS OF ANTENNA:**  Physical concept of radiation | White Board, PPT |
| 2 | 3 | Radiation pattern, near and far-field regions | White Board, PPT |
| 2 | 4 | Reciprocity | White Board |
| 2 | 5 | Directivity and gain | White Board, PPT |
| 2 | 6 | Effective aperture, polarization | White Board, PPT |
| 2 | 7 | Input impedance, efficiency | White Board, PPT |
| 2 | 8 | Friis transmission equation | White Board, PPT |
| 2 | 9 | Radiation integrals and auxiliary potential functions | White Board, PPT |
| 3 | 10 | **RADIATION FROM WIRES AND LOOPS** | White Board, PPT |
| 3 | **11** | Infinitesimal dipole | White Board, PPT |
| 3 | 12 | Half-wave and monopole dipole | White Board |
| 3 | 13 | Small circular loop | White Board |
| 3 | 14 | linear elements near conductors | White Board |
| 3 | 15 | Dipoles for mobile communication | White Board, PPT |
| 4 | 16 | **APERTURE AND REFLECTOR ANTENNAS:**  Huygens' principle | White Board, PPT |
| 4 | 17 | Radiation and design considerations of rectangular apertures | White Board, PPT |
| 4 | 18 | Radiation and design considerations of circular apertures | White Board, PPT |
| 4 | **19** | Babinet's principle | White Board |
| 4 | 20 | Radiation from sectoral and pyramidal horns | White Board, PPT |
| 4 | 21 | design concepts of prime-focus parabolic reflector antenna | White Board, PPT |
| 4 | 22 | design concepts of cassegrain antennas | White Board, PPT |
| 5 | 23 | **BROADBAND ANTENNAS:** | White Board, PPT |
| 5 | 24 | Log-periodic antenna | White Board, PPT |
| 5 | 25 | Yagi-Uda antenna | White Board, PPT |
| 5 | 26 | Frequency independent antennas | White Board, PPT |
| 5 | **27** | Broadcast antennas | White Board, PPT |
| 6 | 28 | **MICRO STRIP ANTENNAS** | White Board, PPT |
| 6 | 29 | Basic characteristics of micro strip antennas, feeding methods | White Board, PPT |
| 6 | 30 | Different methods of analysis | White Board, PPT |
| 6 | 31 | Design of rectangular patch antennas | White Board |
| 6 | 32 | Design of circular patch antennas | White Board |
| 7 | 33 | **ANTENNA ARRAYS-**  Analysis of uniformly spaced arrays with uniform amplitude excitation | White Board, PPT |
| 7 | 34 | Analysis of uniformly spaced arrays with non-uniform amplitude excitation | White Board, PPT |
| 7 | **35** | Extension to planar arrays | White Board, PPT |
| 7 | 36 | Synthesis of antenna arrays using Schelkun off polynomial method | White Board, PPT |
| 7 | 37 | Synthesis using Woodward-Lawson method | White Board, PPT |
| 8 | 38 | **BASIC CONCEPTS OF SMART ANTENNAS** | White Board, PPT |
| 8 | 39 | Benefits of smart antennas, Fixed weight and adaptive beamforming | White Board, PPT |
| 9 | 40 | **DIFFERENT MODES OF RADIO WAVE PROPAGATION USED IN CURRENT PRACTICE** | White Board, PPT |

**Signature of Faculty: Signature of HOD**

**Assignment – 1**

1. Derive the relation between directivity and beam solid angle. (CO1)
2. Define reciprocity theorem and prove it in case of antenna system. (CO1)
3. With reference to paraboloids, explain the following: (CO2)

i) f/D ratio

ii) Spill over and aperture efficiency i

ii) Front to back ratio

iv) Types of feeds.

1. What are the advantages and limitations of Microstrip antennas? (CO2)
2. Write short notes on: (CO3)
3. Collinear arrays
4. Binomial arrays and
5. Scanning arrays.
6. Explain the principle of formation of images in an active corner reflector antenna. Hence sketch the image formation for a 90o corner reflector. Obtain array factor for 90o corner reflector. (CO3)

**Assignment – 2**

1. Explain the effects of uniform and non-uniform amplitude distributions in array? (CO4)
2. Derive the expression for the far field pattern of an array of 2 – isotropic point sources of
3. Equal amplitude and phase
4. Equal amplitude and opposite phase
5. Unequal amplitude and any phase. (CO4)
6. In a uniform linear array, four isotropic radiating elements are spaced λ/2 apart. What is the required progressive phase shift between the elements for forming the main beam at 600 off the end-fire? (CO4)
7. How do raindrops affect radio waves? (CO5)
8. Discuss experimental determination of virtual heights and critical frequencies. (CO5)
9. Describe any two types of fading normally encountered in radio wave propagation. How are the problems of fading overcome? (CO5)

**SAMPLE QUIZ QUESTIONS**

1. The ratio of radiation intensity in a given direction from antenna to the radiation intensity over all directions is called as \_\_\_\_\_\_\_\_  
   a) Directivity  
   b) Radiation power density  
   c) Gain of antenna  
   d) Array Factor
2. The equivalent area when multiplied by the instant power density which leads to free radiation of power at antenna is called as \_\_\_\_\_\_\_  
   a) Loss area  
   b) Scattering area  
   c) Captured area  
   d) Effective area
3. Radiation resistance of a Hertzian dipole of length λ/8 is \_\_\_\_\_\_\_\_  
   a) 12.33Ω  
   b) 8.54Ω  
   c) 10.56Ω  
   d) 13.22Ω
4. The axis of back lobe makes an angle of 180° with respect to the beam of an antenna.  
   a) True  
   b) False
5. Which of the following statement is not correct?  
   a) Folded dipole antenna has less impedance than half dipole  
   b) Folded dipole is a balanced antenna  
   c) Folded dipole antenna is a dipole antenna with its end folded back forming a loop  
   d) Balun is used at the feeder when unbalanced feed is used in the folded dipole
6. What is the input impedance of a half wave folded dipole?  
   a) 73Ω  
   b) 292Ω  
   c) 146Ω  
   d) 36.5Ω
7. The directivity of Yagi-Uda antenna is increased by adding \_\_\_\_\_\_  
   a) reflectors  
   b) driven element  
   c) directors  
   d) boom
8. In which of the following bands Yagi-Uda antenna operates?  
   a) HF-UFH  
   b) VLF-MF  
   c) LF-HF  
   d) UHF-EHF
9. Larger the size of the aperture, the narrower is the Beam-widths.  
   a) True  
   b) False
10. In Horn antennas impedance matching is provided by \_\_\_\_\_\_\_  
    a) flaring  
    b) increasing Power  
    c) decreasing axial length  
    d) Balun
11. The small the flare angle, \_\_\_ is the directivity and \_\_\_\_ is the beam width.  
    a) high, low  
    b) low, high  
    c) low, low  
    d) high, high
12. For a horn antenna, in which flaring is done only in one direction is \_\_\_\_\_\_\_\_  
    a) Conical antenna  
    b) Sectoral antenna  
    c) Pyramidal horn antenna  
    d) Exponential horn antenna
13. If the walls of the circular waveguide are flared out, then it is called \_\_\_\_\_  
    a) Pyramidal horn  
    b) E-plane horn  
    c) H-plane horn  
    d) Conical horn
14. Which of the following feed line contains two different substrates separated by a ground plane?  
    a) Microstrip line feed  
    b) Coaxial feed  
    c) Aperture coupling  
    d) Proximity Coupling
15. The array factor of 4- isotropic elements of broadside array separated by a λ/4 is given by \_\_\_\_\_\_\_\_\_\_\_\_  
    a) sinc(cosθ)  
    b) cos(sinθ)  
    c) sin(sinθ)  
    d) sin(cosθ)
16. A 4-isotropic element end-fire array separated by a λ/4 distance has first null occurring at \_\_\_\_\_\_\_\_\_\_\_\_  
    a) 60  
    b) 30  
    c) 90  
    d) 150
17. What is the pitch angle if the separation of turns is at 2 cm and the circumference is of 4 cm?  
    a) 26.56  
    b) 62.65  
    c) 30  
    d) 25.34
18. What is the total axial length of the helical antenna with 5 turns and circumference per wavelength is 1.2 and separation between turns is 2 cm?  
    a) 10cm  
    b) 20cm  
    c) 6cm  
    d) 12cm
19. Up to which frequency the ground wave propagation is used?  
    a) 2MHz  
    b) 2GHz  
    c) 30MHz  
    d) 30GHz
20. Sky wave propagation reflects the frequencies \_\_\_\_\_\_\_\_\_\_\_  
    a) 2MHz  
    b) 2 MHz to 30MHz  
    c) 2 GHz to 30 GHz  
    d) 30 GHz to 50GHz

**QUIZ ANSWER KEY**

**Q1**. a **Q2.** b **Q3.** a **Q4.** a **Q5.** a **Q6.** b **Q7.** a **Q8.** a **Q9.** a **Q10.** a

**Q11.** a **Q12.** b **Q13.** d **Q14.**c **Q15.**a **Q16.**c **Q17.**a **Q18.**a **Q19.**a **Q20.**b

**Mid Term Paper-I**

**TECHNO INDIA NJR INSTITUTE OF TECHNOLOGY, UDAIPUR**

**B. TECH 3rd – YEAR (VI SEM.) – MT-I**

Antenna and Propagation (6EC4-04)

**Time:** 2 Hr **Max. Marks:** 70

**Note:**

1. The paper is divided into 2 parts: Part-A and, Part-B.
2. Part-A contains 10 questions and carries 2 mark each.
3. Part-B contains 5 questions. Each question is having two options and carries 10 marks each.

Part- A (20 Marks)

|  |  |  |
| --- | --- | --- |
|  | Describe the difference between directivity and gain. | CO1 |
|  | What are the advantages of array antenna. | CO1 |
|  | How antenna works and what are the main parameters of antenna? | CO1 |
|  | What is fringing effect? | CO1 |
|  | Define microstrip patch antenna. | CO2 |
|  | Define antenna impedance. | CO2 |
|  | What are the advantages and disadvantages of microstrip patch antenna? | CO2 |
|  | Explain isotropic radiator. | CO3 |
|  | Write the applications of microstrip patch antenna. | CO3 |
|  | What are the different types of antenna used at high frequencies? | CO3 |

Part- B (50 Marks)

|  |  |
| --- | --- |
| 1. Define polarization and its types. | CO1 |
| Or |  |
| 1. Explain the following terms:  (a) HPBW  (b) Antenna efficiency  (c) Radiation intensity | CO1 |

|  |  |
| --- | --- |
| 1. Define and prove the reciprocity theorem. | CO1 |
| Or |  |
| 2. Define radiation pattern and explain its types. | CO1 |

|  |  |
| --- | --- |
| 1. Explain effective aperture of antenna. Derive relationship between maximum effective aperture and directivity of an antenna. | CO2 |
| Or |  |
| 3. Derive Friis transmission equation. | CO2 |

|  |  |
| --- | --- |
| 1. What is array antenna? Explain the array of two isotropic sources of same amplitude and phase. | CO2 |
| Or |  |
| 4. Design a rectangular microstrip antenna using a substrate ( RT/duroid 5880) with dielectric constant of 2.2, h=0.1588 cm so as to resonate at 10 GHz. | CO2 |

|  |  |
| --- | --- |
| 5. Briefly explain microstrip patch antenna and describe the design procedure of rectangular patch antenna with a diagram. | CO3 |
| Or |  |
| 5. Explain the various feeding techniques of microstrip patch antenna. | CO3 |

**Marks and Gap Analysis of Mid-Term 1**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Sr. No.** | **Roll Number** | **Student Name** | **Mid-Term 1**  **MM-70** | **Remark**  **( Remedial Class need or not – Y/N )** |
| 1 | 21ETCEC001 | Abbas Hakimuddim Fakhruddin | 56 | Y |
| 2 | 21ETCEC002 | Abhishek Kalal | 61 | N |
| 3 | 21ETCEC003 | Abhishek Rajwaniya | 65 | N |
| 4 | 21ETCEC004 | Alfez Umar Sheikh | 56 | Y |
| 5 | 21ETCEC005 | Dhawal Purohit | 61 | N |
| 6 | 21ETCEC006 | Ms Himanshi Soni | 68 | N |
| 7 | 21ETCEC007 | Jalal Dashora | 58 | N |
| 8 | 21ETCEC008 | Jatin Tailor | 65 | N |
| 9 | 21ETCEC009 | Manav Kumawat | 70 | N |
| 10 | 21ETCEC010 | Mohit Gour | 68 | N |
| 11 | 21ETCEC013 | Rachit Dutt | 56 | Y |
| 12 | 21ETCEC014 | Sanidhya Sharma | 58 | N |
| 13 | 21ETCEC016 | Shoaib Khan Pathan | 58 | N |
| 14 | 21ETCEC017 | Snehil Sharma | 63 | N |
| 15 | 21ETCEC018 | Sumit Israni | 68 | N |
| 16 | 21ETCEC019 | Yuvraj Nagda | 65 | N |
| 14 | 21ETCEC300 | Sahil Bhoi | 56 | Y |
| 18 | 22ETCEC200 | Khushwant Singh | 58 | Y |

**\***(Y, if obtained marks are <=70%)

**Signature of Faculty: Signature of HOD**

**Remedial Action Taken to Remove the Gaps (After Mid- Term 1)**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| S.no. | University Roll no. | Name of Student | Topics to be discussed in Remedial Class | Schedule Date of Remedial Class | Outcome  Achieved |
|  | 21ETCEC001 | Abbas Hakimuddim Fakhruddin | Physical concept of radiation, Radiation pattern, -Infinitesimal dipole, Radiation from sectoral and pyramidal horns, -Log-periodic | 10/04/2024 | CO1,CO2,CO3 |
|  | 21ETCEC004 | Alfez Umar Sheikh |
|  | 21ETCEC013 | Rachit Dutt |
|  | 21ETCEC300 | Sahil Bhoi |
|  | 22ETCEC200 | Khushwant Singh |

**Signature of Faculty: Signature of HOD**

**TECHNO INDIA NJR INSTITUTE OF TECHNOLOGY, UDAIPUR**

**B. TECH 3rd – YEAR (VI SEM.) – MT-II**

Antenna and Propagation (6EC4-04)

**Time:** 3 Hr **Max. Marks:** 70

**Note:**

1. The paper is divided into 2 parts: Part-A and, Part-B.
2. Part-A contains 10 questions and carries 2 mark each.
3. Part-B contains 5 questions. Each question is having two options and carries 10 marks each.

**Part- A (20 Marks)**

|  |  |  |
| --- | --- | --- |
|  | Define the types of polarization. | CO1 |
|  | What are the roles of an antenna in wireless technology? | CO1 |
|  | What do you understand by frequency independent antenna? | CO2 |
|  | Define the types of horn antenna. | CO2 |
|  | What are the advantages of array antenna? | CO3 |
|  | Explain phased array antenna. | CO3 |
|  | What do you understand by beamforming technology? | CO4 |
|  | What are the applications of log periodic antenna? | CO4 |
|  | Give the classification of various propagation modes. | CO5 |
|  | Explain the mechanism of radio wave propagation. | CO5 |

**Part- B (20 Marks)**

|  |  |
| --- | --- |
| 1. An antenna has normalized radiation intensity U(θ,φ)= 10 sin θ sin φ;W/sr for 0<θ<πand 0<φ<2πand zero elsewhere. Find the radiated power and directivity. | CO1 |
| Or |  |
| 1. Define the following terms: 2. Effective aperture 3. Antenna temperature 4. Directivity | CO1 |

|  |  |
| --- | --- |
| 1. Derive an expression of Radiated power of a Hertzian Dipole (Infinitesimal dipole) | CO2 |
| Or |  |
| 2. Write short note on Yagi-uda antenna and log periodic antenna. | CO2 |

|  |  |
| --- | --- |
| 1. Distinguish between endfire and broadside arrays. Derive the expression of two point sources with equal amplitude and equal phase. | CO3 |
| Or |  |
| 3 Define the principle of pattern multiplication. | CO3 |

|  |  |
| --- | --- |
| 1. Define reflector antenna and microstrip patch antenna. | CO4 |
| Or |  |
| 1. Calculate the design data of rhombic antenna to operate at 50MHz, if the angle of elevation is 30. | CO4 |

|  |  |
| --- | --- |
| 5. What do you understand by duct propagation? Under what conditions are duct formed? | CO5 |
| Or |  |
| 5. What is meant by fading? Also define skip distance and virtual height. | CO5 |

**Mid Term Exam – II**

**Marks and Gap Analysis of Mid-Term II**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Sr. No.** | **Roll Number** | **Student Name** | **Mid-Term 1**  **MM-70** | **Remark**  **( Remedial Class need or not – Y/N )** |
| 1 | 21ETCEC001 | ABBAS HAKIMUDDIM FAKHRUDDIN | 56 | Y |
| 2 | 21ETCEC002 | ABHISHEK KALAL | 61 | Y |
| 3 | 21ETCEC003 | ABHISHEK RAJWANIYA | 68 | N |
| 4 | 21ETCEC004 | ALFEZ UMAR SHEIKH | 63 | N |
| 5 | 21ETCEC005 | DHAWAL PUROHIT | 63 | N |
| 6 | 21ETCEC006 | MS HIMANSHI SONI | 63 | N |
| 7 | 21ETCEC007 | JALAJ DASHORA | 63 | N |
| 8 | 21ETCEC008 | JATIN TAILOR | 63 | N |
| 9 | 21ETCEC009 | MANAV KUMAWAT | 70 | N |
| 10 | 21ETCEC010 | MOHIT GOUR | 61 | N |
| 11 | 21ETCEC011 | RACHIT DUTT | 58 | Y |
| 12 | 21ETCEC014 | SANIDHYA SHARMA | 61 | N |
| 13 | 21ETCEC016 | SHOAIB KHAN PATHAN | 61 | N |
| 14 | 21ETCEC017 | SNEHIL SHARMA | 58 | Y |
| 15 | 21ETCEC018 | SUMIT ISRANI | 56 | Y |
| 16 | 21ETCEC019 | Yuvraj Nagda | 65 | N |
| 17 | 21ETCEC300 | Sahil Bohi | 68 | N |
| 18 | 22ETCEC200 | Kushwanth | 61 | N |

**\***(Y, if obtained marks are <=70%)

**Signature of Faculty: Signature of HOD**

**Remedial Action Taken to Remove the Gaps (After Mid- Term 1I)**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| S.no. | University Roll no. | Name of Student | Topics to be discussed in Remedial Class | Schedule Date of Remedial Class | Outcome  Achieved |
|  | 21ETCEC001 | ABBAS HAKIMUDDIM FAKHRUDDIN | Analysis of uniformly spaced arrays with uniform and non-uniform excitation amplitudes, fixed weight beamforming basics, Adaptive beam forming. | 13/06/2024 | CO3,CO4,CO5 |
|  | 21ETCEC002 | ABHISHEK KALAL |
|  | 21ETCEC011 | RACHIT DUTT |
|  | 21ETCEC017 | SNEHIL SHARMA |
|  | 21ETCEC018 | SUMIT ISRANI |

**Signature of Faculty: Signature of HOD**

**Model Question Paper**

**TECHNO INDIA NJR INSTITUTE OF TECHNOLOGY, UDAIPUR**

**B. TECH 3rd – YEAR (VI SEM)**

Antenna and Propagation (6EC4-04)

**Time:** 2 Hr **Max. Marks:** 70

**Note:**

1. The paper is divided into 2 parts: Part-A, Part-B and Part-C.
2. Part-A contains 10 questions and carries 2 mark each.
3. Part-B contains 7 questions. Each question carries 4 marks each. Attempt any 5 Questions
4. Part-C contains 5 questions. Each question carries 10 marks each. Attempt any 3 Questions

Part- A (20 Marks)

|  |  |  |
| --- | --- | --- |
|  | What is the difference between directive gain and gain of antenna? | CO1 |
|  | What is the effect of antenna’s sidelobes and backlobes on its gain? | CO1 |
|  | What are the far field conditions for an antenna? | CO2 |
|  | Name the parasitic elements used in Yagi uda array. Explain their significance in array | CO2 |
|  | What is the radiation resistance of half wave dipole antenna? | CO3 |
|  | What are the differences between transmission line and dipole antenna? | CO3 |
|  | Explain the salient features of Microstrip Antennas | CO4 |
|  | What is the difference between broad-side array and end-fire array? | CO4 |
|  | In which frequency band Tropospheric scattering is used. | CO5 |
|  | In which frequency range ground wave propagation is effective. Why? | CO5 |

Part- B (20 Marks)

|  |  |
| --- | --- |
| 1. Define the terms:   i) Effective length  ii) Effective aperture area | CO1 |
| 1. Calculate effective length and effective aperture area of antenna whose radiation resistance is 73 ohms. | CO1 |

|  |  |
| --- | --- |
| 3. Derive the expression for power radiated and find the radiation resistance of a half wave dipole? | CO2 |
| 4. What are the advantages of Rhombic antenna over a single wire antenna? List out the design equations associated with a Rhombic antenna. | CO3 |

|  |  |
| --- | --- |
| 5. Write a short notes on:  i) MUF  ii) Virtual Height  iii) Wave tilt  iv) Multihop Transmission. | CO4 |
| 1. Derive the relationship between MUF and critical frequency. | CO4 |

|  |  |
| --- | --- |
| 1. Compare the characteristics of Hertzian dipole and Hertzian Loop antenna | CO5 |

**Part C** (30 Marks)

|  |  |
| --- | --- |
| 1.With the help of neat diagrams explain the principle of radiation mechanism in antennas. | CO1 |
| 1. 2. An infinitesimal electric dipole is centered at the origin and lies along z-axis. Find the far–zone electric and magnetic fields radiated. | CO2 |
| 3.Draw the radiation pattern of 8 – isotropic elements fed in phase, spaced λ/2 apart with the principle of pattern multiplication. | CO3 |
| 4.What is the density of free electrons in the ionospheric layer at critical frequency of 1.3 MHz? | CO4 |
| 5.Describe any two types of fading normally encountered in radio wave propagation. How are the problems of fading overcome? | CO5 |

**STUDENT PERFORMANCE REPORT**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **ROLL NO.** | **NAME** | **I-MID** | **II-MID** | **AVG** | **ASSIGNMENT** | **OUT OF MARKS 50** |
| 21ETCEC001 | ABBAS HAKIMUDDIM FAKHRUDDIN | 24 | 24 | 24 | 15 | 39 |
| 21ETCEC002 | ABHISHEK KALAL | 26 | 26 | 26 | 17 | 43 |
| 21ETCEC003 | ABHISHEK RAJWANIYA | 28 | 29 | 29 | 18 | 47 |
| 21ETCEC004 | ALFEZ UMAR SHEIKH | 24 | 27 | 26 | 16 | 42 |
| 21ETCEC005 | DHAWAL PUROHIT | 26 | 27 | 27 | 19 | 46 |
| 21ETCEC006 | MS HIMANSHI SONI | 29 | 27 | 28 | 20 | 48 |
| 21ETCEC007 | JALAJ DASHORA | 25 | 27 | 26 | 20 | 46 |
| 21ETCEC008 | JATIN TAILOR | 28 | 27 | 28 | 18 | 46 |
| 21ETCEC009 | MANAV KUMAWAT | 30 | 30 | 30 | 20 | 50 |
| 21ETCEC010 | MOHIT GOUR | 29 | 26 | 28 | 18 | 46 |
| 21ETCEC013 | RACHIT DUTT | 24 | 25 | 25 | 19 | 44 |
| 21ETCEC014 | SANIDHYA SHARMA | 25 | 26 | 26 | 20 | 46 |
| 21ETCEC016 | SHOAIB KHAN PATHAN | 25 | 26 | 26 | 19 | 45 |
| 21ETCEC017 | SNEHIL SHARMA | 27 | 25 | 26 | 18 | 44 |
| 21ETCEC018 | SUMIT ISRANI | 29 | 24 | 27 | 18 | 45 |
| 21ETCEC019 | Yuvraj Nagda | 28 | 28 | 28 | 20 | 48 |
| 21ETCEC300 | Sahil Bohi | 24 | 29 | 27 | 20 | 47 |
| 22ETCEC200 | Kushwanth | 25 | 26 | 26 | 18 | 44 |

**Signature of Faculty: Signature of HOD**

**RESULT ANALYSIS**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **S.NO.** | **RTU ROLL NUMBER** | **NAME OF STUDENT** | **END TERM MARKS** | **SESSIONAL MARKS** | **TOTAL** |
|  |  |  | **70** | **30** | **100** |
|  |  | **Set Target Level** | **60%** | **75%** |  |
| **1** | 21ETCEC001 | ABBAS HAKIMUDDIM FAKHRUDDIN | A | 24 | 24 |
| **2** | 21ETCEC002 | ABHISHEK KALAL | 18 | 26 | 44 |
| **3** | 21ETCEC003 | ABHISHEK RAJWANIYA | 23 | 29 | 52 |
| **4** | 21ETCEC004 | ALFEZ UMAR SHEIKH | 31 | 26 | 57 |
| **5** | 21ETCEC005 | DHAWAL PUROHIT | 37 | 27 | 60 |
| **6** | 21ETCEC006 | MS HIMANSHI SONI | 45 | 28 | 73 |
| **7** | 21ETCEC007 | JALAJ DASHORA | 25 | 26 | 51 |
| **8** | 21ETCEC008 | JATIN TAILOR | 38 | 28 | 66 |
| **9** | 21ETCEC009 | MANAV KUMAWAT | 38 | 30 | 68 |
| **10** | 21ETCEC010 | MOHIT GOUR | 24 | 28 | 52 |
| **11** | 21ETCEC013 | RACHIT DUTT | 37 | 25 | 62 |
| **12** | 21ETCEC014 | SANIDHYA SHARMA | 31 | 26 | 57 |
| **13** | 21ETCEC016 | SHOAIB KHAN PATHAN | 35 | 26 | 61 |
| **14** | 21ETCEC017 | SNEHIL SHARMA | 21 | 26 | 47 |
| **15** | 21ETCEC018 | SUMIT ISRANI | 30 | 27 | 57 |
| **16** | 21ETCEC019 | Yuvraj Nagda | 31 | 28 | 59 |
| **17** | 21ETCEC300 | Sahil Bohi | 50 | 27 | 77 |
| **18** | 22ETCEC200 | Kushwanth | 45 | 26 | 71 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| TOTAL | PASS | FAIL | ABSENT | PASS % |
| 18 | 17 | 1 | 1 | 94.4 |

**Indirect Assessment:**

**Overall Teacher Self Assessment (at the completion of course) in terms of course objective and outcomes**

**Course Objectives:**

Student will study the fundamental concepts and application of antennas and its radiation parameter. Also, they will study designing, different measurement and calculations related to various antenna. Other than this, they will also learn about radio wave propagation and smart antennas used in recent technologies.

**Course Outcomes**:

Define various performance parameters of antenna.

Illustrate techniques for antenna parameter measurements.

Students will apply concepts of antenna on transmitting message with high signal to noise ratio.

Synthesize the various applications of antennas.

Evaluate the output of the MIMO systems.

**Methodology to identify bright student**

Considered a range of criteria, including academic performance, creativity, critical thinking, problem-solving skills, and enthusiasm for learning. Bright students often excel in multiple areas. Observed how students perform in the classroom. In terms of active participation, engagement in discussions, leadership, and the ability to grasp complex concepts.

**Efforts to keep students engaged**

1. Active Learning:
   * Incorporate active learning strategies, such as group discussions, problem-solving activities, and hands-on projects. Active participation keeps students engaged and encourages critical thinking.
2. Varied Teaching Methods:
   * Use a variety of teaching methods, including lectures, group work, multimedia presentations, and interactive activities to cater to different learning preferences.
3. Technology Integration:
   * Leverage technology, such as online platforms, educational apps, and interactive software, to make lessons more engaging and interactive.

Some extra learning for bright students

1. - <https://nptel.ac.in/courses/108/101/108101092/>
2. <https://www.syedengg.ac.in/pdf/TechnicalBooklet/ECE/ANTENNAS/AWP%20QUES1.pdf>
3. <https://archive.org/details/Antenna.Theory.Analysis.and.Design3rd.Edition>

**Methodology to identify weakstudent**

Considered a range of criteria, including classroom observation, formative assessment, summative assessment, assignment review e.t.c. Weak students are struggling students with sensitivity and a desire to support their learning. Some measures, such as additional tutoring, personalized assignments, or alternative assessment methods, to help students succeed.

**Targeted inventions for weak student**

**1. Additional Resources**

Offer supplementary learning materials, such as textbooks, online resources, or multimedia content, to provide alternative explanations and reinforce key concepts.

**2. Remedial classes**

Establish a tutoring program where students can receive extra help from teachers.

**3. Flipped classroom**

Students are assigned pre-class learning materials, often in the form of videos, readings, or online modules, to cover the foundational concepts before coming to class.

Some additional resources or links for student to improve their understanding for topic

1. <https://www.sanfoundry.com/1000-antennas-questions-answers/>
2. <https://archive.nptel.ac.in/courses/117/107/117107035>