UNIT-2

Topic 1: power flow & poynting vector ( For theory and Derivation )

* 1. nptel video lecture -- Transmission Lines and E.M. Waves Prof R.K. Shevgaonkar, IIT Bombay (Lecture 27)

<https://freevideolectures.com/course/2326/transmission-lines-and-em-waves/27>

1.2. The pdf of lecture 27-

<https://www.btechguru.com/showpdf/Electronics/117101056-Transmission_Lines_and_EM_Waves/PDFs/lec27.pdf#page=10>

Topic 2: Wave Polarization

2.1. nptel video lecture -- Transmission Lines and E.M. Waves Prof R.K. Shevgaonkar, IIT Bombay (Lecture 23)

<https://freevideolectures.com/course/2326/transmission-lines-and-em-waves/23>

2.2 The pdf of lecture 23 – <https://www.btechguru.com/showpdf/Electronics/117101056-Transmission_Lines_and_EM_Waves/PDFs/lec23.pdf#page=10>

Additional Reading material is given in the --- UNIT 2\_Lecture14-Polarization

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This set of Electromagnetic Theory Multiple Choice Questions & Answers (MCQs) focuses on “Power and Poynting Vector”.

1. The total power of a wave with average power 15 units in a surface density of 0.5 units is

a) 15

b) 30

c) 7.5

d) 0.75

Answer: c

Explanation: The total power is given by the surface integral of the average power. Thus ∫Pavg ds is the total power. On substituting for Pavg = 15 and ∫ds = 0.5, we get total power as 7.5 units.

2. The power of a wave with electric field intensity of 3 units in air is

a) 0.01

b) 0.03

c) 0.05

d) 0.07

Answer: a

Explanation: The Poynting vector gives the power of a wave. It is given as P = E2/2η. On substituting for E = 3 and η = 377 in air, the power is P = 32/(2×377) = 0.01 units.

3. Find the power of an EM wave, given that the cross product of the E and H component is 2 + 3j.

a) 2

b) 1

c) 4

d) 8

Answer: b

Explanation: The Poynting power vector for complex quantity of E x H is P = 0.5 x Re(E x H). In the given data, Re(E x H) = 2, thus we get P = 0.5 x 2 = 1 unit.

4. The power in a electromagnetic wave with electric field and magnetic field intensities 12 and 8 respectively is

a) 96

b) 12

c) 8

d) 48

Answer: d

Explanation: The Poynting vector is given by P = 0.5 EH. Given that E = 12 and H = 8, we get P = 0.5 x 12 x 8 = 48 units.

The power in a wave given that H component is 0.82 units in air.

a) 126.74

b) 621.47

c) 216.47

d) 745.62

Answer: a

Explanation: The power of a wave is given by P = ηH2/2. In air medium, η = 377 and given that H = 0.82. We get power P = 377 x 0.822/2 = 126.74 units.

6. Find the power of a wave given that the RMS value of E and H are 6 and 4.5 respectively.

a) 24

b) 27

c) 29

d) 32

Answer: b

Explanation: The power is the product of the RMS electric field and the RMS magnetic field. Thus P = Erms X Hrms. On substituting Erms = 6 and Hrms = 4.5, the power is P = 6 x 4.5 = 27 units.

7. The electric and magnetic fields vary with time in which of the following fields?

a) DC

b) AC

c) Static

d) It does not vary with time

Answer: b

Explanation: The electric and magnetic fields vary with time in oscillating fields. It is certain that such fields are AC fields.

8. The power per unit velocity of a wave with electric field as 8 units and density 10 units is

a) 40

b) 20

c) 80

d) 160

Answer: c

Explanation: The power per unit velocity P/v is given by the product of electric field and the density. Thus P/v = E.d = 8 x 10 = 80 units.

9. The power of a wave in a cylindrical waveguide of radius 2m with electric field 12 units is

a) 2.39

b) 3.92

c) 9.23

d) 9.32

Answer: a

Explanation: The power of a wave is given by ∫P ds, where P = E2/2η and ∫ds = πr2. On substituting for E = 12, η = 377 in air and r = 2, we get P = 2.39 units.

10. The work done in the power transmission with E and H given by 50 and 65 respectively. The velocity of propagation is 20m/s.

a) 162.5

b) 621.5

c) 562.1

d) 261.5

Answer: a

Explanation: The work done is given by W = EH/v, where E = 50, H = 65 and v = 20. On substituting, we get W = 50 x 65/20 = 162.5 units.

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Some additional numerical examples on plane waves from Hayt and Buck (8th edition)- e-copy is available (Some problems are solved in the class before 14th March)

11.2,11.3,11.5,11.6,11.7,11.28,

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Plane Waves and Polarization – GATE Problems (Part – I),

<https://www.gatestudy.com/wp-content/uploads/2016/07/Plane-Waves-Part-I.pdf>

Some more Practice examples and Practice Questions on Unit -2

UNIT 2\_Practice\_questions.doc

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Contact hours for UNIT -2

Chapter 3 - **Uniform Plane Wave Propagation** - 8 hours

04- hour content was already covered by in-house teaching upto March 12th.

Remaining 04-hour content is covered by the above study material.

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Chapter 4 - **Plane waves at media interface** - 7 hours

This chapter is covered by the following

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| nptel video lecture -- Transmission Lines and E.M. Waves Prof R.K. Shevgaonkar, IIT Bombay  https://freevideolectures.com/course/2326/transmission-lines-and-em-waves/ |
| Lecture 29 - Plane Wave in Arbitrary Direction |
| Lecture 30 - Plane Wave at Dielectric Interface |
| Lecture 31 - Reflection and Refraction at Media Interface |
| Lecture 32 - Total Internal Reflection |
| Lecture 33 - Polarization at Media Interface |
| Lecture 34 - Reflection from a Conducting Boundary |

The PPTs for this part is also given – UNIT 2\_Notes\_Plane waves at media interface.pdf

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UNIT-3

**Chapter No. 5. Radio Wave Propagation**

Notes prepared by in-house faculties- Wave\_Propagn\_UNIT3.doc (Unit\_3 folder)

Some practice questions are also prepared and shared with the students (Through What’s app))

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