Name: Enrolment No:	UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, December 2018

Programme Name: B.Tech ASEA **Semester :** V
Course Name : EM Waves & Antennas **Time :** 03 hrs
Course Code : ELEG391 **Max. Marks :** 100
Nos. of page(s) : 01
Instructions: Attempt all questions. All Questions are compulsory.

SECTION A

S. No.		Marks	CO
1.	An antenna has a radiation resistance of 72Ω, a loss resistance 8Ω, and a power gain of 16. What efficiency and directivity does it have?.	5	CO2
2.	Define skip distance, and show how it is related to the maximum usable frequency.	5	CO4
3.	Write the expression for magnetic vector potential in case of a (i) line current (ii) sheet current (iii) volume current.	5	CO2
4.	Calculate the maximum effective aperture of a microwave antenna (f=1GHz) which has a directivity of 900.	5	CO2

SECTION B

5.	What is a parabola? With sketches, show why its geometry makes it a suitable basis for antenna reflectors. Explain why an antenna using paraboloid reflector is likely to be highly directive receiving antenna. Describe fully the Cassegrain method of feeding a paraboloid reflector, including a sketch of the geometry of this feeding arrangement.	10	CO3
6.	Write down Maxwell's equations for time varying electromagnetic fields. Explain Maxwell's fourth equation of modified Ampere's circuital law. What is displacement current?	10	CO1
7.	Define and explain LOS propagation with a diagram. If the height of transmitting and receiving antenna in a LOS system are 49 meter and a 9 meter respectively then find the distance up to which communication may be possible.	10	CO4
8.	For a in-phase six-element linear array with spacing d and binomial current distribution 1:5:10:10:5:1, use the principle of pattern multiplication to prove that the array factor F (θ) is $F(\theta)=\left[\cos\left(\frac{1}{2}\alpha d\cos\theta\right)\right]^5$	10	CO3

SECTION-C

9.	It is desired to design an antenna system, which utilizes a vertical infinitesimal dipole of length G placed a height h above a flat, perfect electric conductor of infinite extent. The design specifications require that the pattern of the array factor of the source and its image has only one maximum, and that maximum is pointed at an angle of 60◦ from the vertical. Determine (in wavelengths) the height of the source to achieve this desired design specification .	20	CO3
10.	Designa uniform broadside linear array of N elements placed along the z-axis with a uniform spacing d = λ/10 between the elements. Determine the closest integer number of elements so that in the elevation plane the (a) Half-power beamwidth of the array factor is approximately 60◦. (b) First-null beamwidth of the array factor is 60◦.	20	CO3

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SECTION A

S. No.		Marks	CO
1.	What is the principle of pattern multiplication?	5	CO2
2.	What are parasitic elements and where are they used?	5	CO3
3.	Find the skip distance for waves of frequency 4.6×10^6 Hz at a time when maximum ionization in the E region has a value of 1×10^{12} e/m^3 at a height of 110 km.	5	CO4
4.	Define Polarization in context to an Antenna? Explain the different types of polarization in detail.	5	CO1
	SECTION B		
5.	Explain the factors that influence the propagation of radio waves.	10	CO4
6.	Describe ground-wave propagation. What is the angle of tilt? How does it affect field strength at a distance from transmitter?	10	CO4
7.	Draw a 3 element Yagi – Uda antenna and explain its construction and principle of operation.	10	CO3
8.	A circular loop, of loop radius $\lambda/30$ and wire radius $\lambda/1000$, is used as a transmitting/ receiving antenna in a back-pack radio communication system at 10 MHz. The wire of the loop is made of copper with a conductivity of 5.7×10^7 S/m. Assuming the antenna is radiating in free space, determine the (a) radiation resistance of the loop (b) loss resistance of the loop (c) input resistance (d) radiation efficiency.	10	CO3
	SECTION-C		
9.	Design pyramidal horn antennas that will maximize the aperture efficiency or produce maximum power transmission to the feed, for paraboloidal reflectors with f/d ratios of (a) 0.50 (b) 0.75 (c) 1.00	20	CO3
10.	Two astronauts equipped with handheld radios land on different parts of a large asteroid. The radios are identical and transmit 5 W average power at 300 MHz. Assume the asteroid is a smooth sphere with physical radius of 1,000 km, has no atmosphere, and consists of a lossless dielectric material with relative permittivity $\varepsilon_r = 9$. Assume that the radios' antennas can be modeled as vertical infinitesimal electric dipoles. Determine the signal power (in microwatts) received by each radio from the other, if the astronauts are separated by a range (distance along the asteroid's surface) of 2 km, and hold their radios vertically at heights of 1.5 m above the asteroid's surface. ***Additional Information Required to Answer this Question:*** Prior to landing on the asteroid the astronauts calibrated their radios. Separating themselves in outer space by 10 km, the astronauts found the received signal power at each radio from the other was 10 microwatts, when both antennas were oriented in the same direction.	20	CO3