**INTRODUCTION TO FIELD, WAVES AND ANTENNAS**

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**Q1 (1) What is Electromagnetism? Explain in brief along with Gravitational force analogue**

# Define electromagnetism…

Electromagnetism force is one of the four fundamental forces in nature .nuclear weak interaction and gravitational .Gravitational is the weakest at 0¯41 that of the nuclear force EM force exists between charged particles it is the dominate force in microscopic system that of the nuclear forces.

# Gravitational force analogue..

Force acts at a distance concept of field

Each mass m1 induces a gravitational field around it so that if another mass m2 introduced to some point, it will experience force equal to eq: 1

The field does not physically eminate from the object but its influences exists ar every point in space the field is defined as:

= - (N/kg)

Where R is a unit vectors that point radially away from m1 (-R point towards m1)

**Q1 (2) Explain in brief the branches of Electromagnetism along with the table?**

|  |  |  |
| --- | --- | --- |
| Branches | Condation | Field Quantities(units) |
| Electrostatics | Stationary charges  (ₐq/ₐt=0) | Elec. Field intensity E(V/m)  Elec. Flux density D (C/m)  D=e |
| Magnetostatics | Steady currents  (ₐI/ₐt=0) | Magnetic flux density B(T)  Mag . field intensity H(A/m)  B=ᶣH |
| Dynamics | Time varying current  (ₐI/ₐTǂ0) | E,D,B and H  E,D couple to (B,H) |

**Q1 (3) Explain in detail the sinusoidal wave in lossless medium with mathematical expressions**

|  |  |  |
| --- | --- | --- |
| Branches | Condition | Field Quantites(units) |
| Electrostatics | Stationary charges  (ₐq/ₐt=0) | Elec . field intensity E(V/M)  Elec . flux density D(c/m2)  D=E |
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**Q1 (4) Proof the Euler’s Formula? Where does it come from?**

# Euler formula

e=cosᴓ+jsinᴓ

Where does this come from ?

On way to see this is using Taylor series even if u don’t prove it u can convince your self that these series hold. Take the taylor series representation for sin and cos :

Sin

What does the exponential function?

What about if we take z to be j?

cos

j sin

so we have : ej=cos+j sin

**Q1 (5) Explain in detail the sinusoidal wave in a lossy medium with mathematical expressions**

# Sinusoidal wave in lossy medium…

So far wave amplitude did not change with distance lossless case

If it changes (decreases )loss case (loss medium).

**Attenuation constant** characterizes how lossy the medium is

is measuredin Np/m

Fall –off given by an exponential function exp (\_ax)so that full wave is given by

Example of such function given

**Q2) a: An airline is a transmission line in which air separates the two conductors, which renders In addition, assume that the conductors are made of a material with high conductivity so that For an air line with a characteristic impedance of 50 and a phase constant of 20 rad/m at 700 MHz Find the line inductance and the capacitance . Following quantities are given as: (**5 marks)

An air line is a transmission line in which air separates the two conditions which riders G=0 because in assume that the conductors are made that of a material characteristic impendence of 50 and a phase constant of 20 rad/m at 700 MHz fine the line inductors L’ and the line capacitance C’

The following quantities are given

Z=50 =20 rad/m

F=700MHz =710HZ

With R =G=0

=Jm

=jm (jw=

Z0==

# The ratio of to z0 is

=wC’

Or

C’=

=9.0910-11(F/M)=90.9(Pf/m)

**Q2 b: A 50 microstrip line uses a 0.5mm – thick sapphire substrate with What is the width of its copper strip?**

A 50 micro strip line uses a 0.5mm thick sapphire substrate with =9 What is the width of its copper strip?

Since z0= 50> 44-18 =32 we should use

P= +((0.2+)

=+ ()(0.23+)

=2.06

X=

=

=

=1.056

# Hence

W=sh

=1.0560.5mm

=0.53mm

To cheak our calculations we will use s=1.056 tocalculate Z0 to verify that the value we obtained is indeed equal or close to 50 with =9

X=0.55

Y=0.99

Z0=49.93ans

**Q3) a) Transform the vector (x + z)ay to cylindrical**. (5 marks)

 

=

Ap =0\*cos+(x+z) sin+0

Ap = (x+z) sin

Ap= (pcos+z)cos

A =0\* (-sin)+(x+z)cos+0

A =(pcosp+z)cos

Az=0

**b)** Explain the difference between the two points with the help of figures and transform A to spherical and find the value of A at points (3, -4,0) given below. (2+3 marks)

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# Ans…

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Ax | Ay | Az | Ap | A | Az | Ar | A | A |
| Ax | 1 | 0 | 0 | Cos | -sin | 0 | sin | Coscos | -sin |
| Ay | 0 | 1 | 0 | Sin | cos | 0 | sin | Cossin | cos |
| Ax | cos | 0 | 1 | 0 | 0 | 1 | Cos | Cos | 0 |
| Ap | -sin | sin | 0 | 1 | 0 | 0 | Sin | Sin | 0 |
| A | 0 | cos | 0 | 0 | 1 | 0 | 0 | o | 1 |
| Ax | sincos | 0 | 1 | 0 | 0 | 1 | Cos | Cos | 0 |
| Ar | cos | Sincos | cos | sin | 0 | cos | 1 | 1 | 0 |

**Ar= p cossin+pz2 sin az**

=(rsin)cossin+(rsin)(r cos)2 cos

=r sin cos+r3sincossin

A=rsin cos-r sin2

A

A=A,a+A,a+

(x,y,z,)=(3,-4,0)(r,)=(5,