MUTHAYAMMAL ENGINEERING COLLEGE

(An Autonomous Institution)

(Approved by AICTE, New Delhi, Accredited by NAAC & Affiliated to Anna University)

Rasipuram - 637 408, Namakkal Dist., Tamil Nadu.

Estd. 2000

IQAC

MUST KNOW CONCEPTS

MKC

EEE

2021-22

Course Code & Course Name : 19EEC01& Electromagnetic Fields

Year/Sem/Sec : II / III / A

S.No.	Term	Notation (Symbol)	Concept / Definition / Meaning / Units / Equation / Expression	Units
Unit-I : Introduction				
1.	Cartesian system	-	Three-dimensional space, it has three (the x-axis, y-axis, and z-axis).	NIL
2.	Volume of a parallelepiped in Cartesian	-	dV = dx dy dz	NIL
3.	Scalar field	-	A scalar is an entity which only has a magnitude	NIL
4.	Examples of scalar quantities	-	Mass, electric charge, temperature, distance, etc.	NIL
5.	Vector field	-	A vector, on the other hand, is an entity that is characterized by a magnitude and a direction.	NIL
6.	Vector quantities	-	Displacement, velocity, position, force, and torque	NIL
7.	Source of electric field	-	The electric field is produced by stationary charges	NIL
8.	Source of magnetic field	-	The magnetic field is produced by moving charges (currents)	NIL
9.	electric field	E	Electric field is defined as the electric force per unit charge	NIL
10.	Electric flux	Q	Total number of electric lines of force emanating from a charged body	NIL
11.	Electric flux density	D	The amount of flux passes through unit surface area	NIL
12.	Permittivity	ε (epsilon),	Measure of the electric polarizability of a dielectric	NIL
13.	Relation between Electric Flux Density (D) Electric Field (E)	-	D= EE	NIL
14.	Coordinate system	-	A system that uses one or more numbers	NIL

15.	Cartesian coordinate system	-	It has three mutually perpendicular vectors. These vectors define the three coordinate axes: the x, y, and z−axis.	NIL
16.	Electric field	E	Electric field is defined as the electric force per unit charge	NIL
17.	Cylindrical coordinates Systems	-	It Consists of three coordinates (ρ, φ, z) , where ρ is the radial coordinate, φ the azimuth, and z the height	NIL
18.	Spherical co-ordinate system	-	Spherical co-ordinate system (r, θ, ϕ). gives the radial distance, azimuthal angle, and polar angle	NIL
19.	Another name of cylindrical coordinate system		Circular system	NIL
20.	Volume of a parallelepiped in Cartesian		dV = dx dy dz	NIL
21.	Gradient	-	The Gradient (also called Slope) of a straight line	NIL
22.	Divergence		Divergence is a vector operator that operates on a vector field, producing a scalar field	NIL
23.	Curl	-	Curl is a vector operator that describes the infinitesimal rotation of a vector field in three-dimensional Euclidean space	NIL
24.	Curl of gradient of a vector		Null vector	NIL
25.	Curl of curl of a vector		Grad(Div V) – (Del)2V	NIL
Unit-II : Electrostatics				
26.	Electric dipole		An electric dipole is defined as a couple of opposite charges q and –q separated by a distance d.	NIL
27.	Electric dipole moment		The dipole moment of an electric field is a vector whose magnitude is charge times the separation between two opposite charges.	NIL
28.	Point charge		A point charge means that electric charge which is separated on a surface or space whose geometrical dimensions are very very small compared to other dimensions	C
29.	One coulomb		One coulomb of charge is defined as the charge possessed by $(1/1.602\text{x}10^{-9})$ i.e $6\text{x}10^{18}$ number of electrons.	C
30.	equipotential surface	-	It is an imaginary surface in an electric field of a given charge distribution, in which all points on the surface are at the same electric potential.	-

31.	Potential difference		The work done per unit charge in moving unit charge from B to A in the field E r is called potential difference between the points B to A.	V
32.	Absolute potential		The work done in moving a unit charge from infinity to the point under the consideration against E	V
33.	Relationship between V and E		E = - gradV	NIL
34.	Potential Gradient		The rate of change of potential with respect to the distance is called potential gradient	NIL
35.	Current density	-	Current passing through the unit surface area, when the surface is held normal to the direction of the current. The current density is measured in A/m2 .	NIL
36.	Polarization	-	The applied field E r shifts the charges inside the dielectric to induce the electric dipoles	NIL
37.	Point form of Ohm's law	-	J = σE Where σ - conductivity of material.	NIL
38.	Boundary conditions	-	The conditions existing at the boundary of the two media when field passes from one medium to other	NIL
39.	Rotational field		If curl of a vector field exists then the field is called rotational.	NIL
40.	Irrotational vector field	-	The curl vanishes i.e. curl is zero..	NIL
41.	Biot Savart law in magnetic field is analogous to which law in electric field	-	Coulomb's law	NIL
42.	Application of Biot Savart law		It is used to compute a) Magnetic field intensity b) Magnetic flux density	NIL
43.	Gauss divergence theorem Conversion		Gauss divergence theorem converts surface to volume integral	NIL
44.	Stoke's and Green's theorem Conversion		Convert line integral to surface integral	NIL
45.	Divergence theorem conversion		Convert Surface to volume integral	NIL
46.	Divergence theorem	-	The volume integral of the divergence of vector field is equal to the net outward flux of the vector through the closed surface that bounds the volume	NIL
47.	Stoke's theorem	-	The surface integral of the curl of a function	NIL

			over a surface bounded by a closed surface is equal to the line integral of the particular vector function around that surface	
48.	Coulomb's law	-	The force of attraction or repulsion between two electrically charged objects is directly proportional to the magnitude of their charge and inversely proportional to the square of the distance between them	NIL
49.	Gauss's law	-	Gauss's law states that the net flux of an electric field in a closed surface is directly proportional to the enclosed electric charge.	NIL
50.	Applications of Gaus s' Law.	-	Gauss' law is a powerful tool for the calculation of electric fields and electric flux density	NIL
Unit-III : Magnetostatics				
51.	Magnetostatics		The study of steady magnetic field, existing in a given space, produced due to the flow of direct current through a conductor	NIL
52.	Fringing effect		If there is an air gap in between the path of the magnetic flux, it spreads and bulges out. This effect is called fringing effect	NIL
53.	Relation between Magnetic flux and flux density		It is obtained through the property of medium and permeability μ . This is given by, $B = \mu H$.	NIL
54.	Conservation of Magnetic Flux		It states that, the integral B ds over a closed surface is always zero. $\int B.ds = 0$	NIL
55.	Scalar magnetic potential		The scalar magnetic potential Vm can be defined for source free region where current density is zero.	NIL
56.	Lorentz force equation	-	It is given as the total force on a moving charge in the presence of both electric and magnetic fields.	NIL
57.	Potential Gradient		The rate of change of potential with respect to the distance is called potential gradient	NIL
58.	Current density	-	Current passing through the unit surface area, when the surface is held normal to the direction of the current. The current density is measured in A/m2 .	NIL
59.	Polarization	-	The applied field E r shifts the charges inside the dielectric to induce the electric dipoles	NIL
60.	Point form of Ohm's law	-	$J = \sigma E$ Where σ - conductivity of material.	NIL
61.	Boundary conditions	-	The conditions existing at the boundary of the two media when field passes from one medium to other	

62.	Rotational field		If curl of a vector field exists then the field is called rotational.	
63.	Irrotational vector field	-	The curl vanishes i.e. curl is zero..	
64.	Biot Savart law in magnetic field is analogous to which law in electric field	-	Coulomb's law	-
65.	Application of Biot Savart law		It is used to compute a) Magnetic field intensity b) Magnetic flux density	
66.	Point form of Ampere law	-	Curl(H) = J	-
67.	Basis of Ampere law	-	Stoke's theorem	-
68.	Ampere law	-	The magnetic field created by an electric current is proportional to the size of that electric current with a constant of proportionality equal to the permeability of free space."	-
69.	Magnetic flux density	B	It is the number of lines of force passing through a unit area of material	Wb/m^2 or Tesla (T).
70.	Magnetic field intensity	H	Magnetic field strength refers to the ratio of the MMF which is required to create a certain Flux Density within a certain material per unit length of that material	A/m
71.	Divergence of magnetic field intensity H	-	Zero	-
72.	Value of $\int H.dL$		I	-
73.	Laplacian of the magnetic vector potential	-	$-\mu J$	-
74.	Relation between flux density and vector potential		B = Curl(A)	
75.	Perfect dielectric		For perfect dielectric, the conductivity is zero and hence the loss of the system is also zero.	-
Unit-IV : Electrodynamic Fields				
76.	Basis of The first Maxwell law		Faraday and Lenz law	NIL
77.	Benefit of Maxwell		The Maxwell equation relates the parameters	NIL

	equation		E, D, H, B. When one parameter is known the other parameters can be easily calculated.	
78.	Maxwell second equation		The second Maxwell equation is based on Ampere law. It states that the field intensity of a system is same as the current enclosed by it, i.e, Curl(H) = J.	NIL
79.	Continuity equation of conductors		The continuity equation indicates the current density in conductors. This is the product of the conductivity of the conductor and the electric field subjected to it. Thus $J = \sigma E$ is the implication of the continuity equation for conductor	NIL
80.	Charge density of a electrostatic field		From the Gauss law for electric field, the volume charge density is the divergence of the electric flux density of the field. Thus Div(D) = ρv.	NIL
81.	Dipole formation in a magnet		Interaction between the north and south poles together	NIL
82.	Dielectric condition		$\sigma/\omega\varepsilon < 1$	NIL
83.	lossless dielectric medium attenuation		Zero	NIL
84.	Intrinsic impedance		Ratio of square root Permeability to permittivity	NIL
85.	Phase shift between the electric field and magnetic field of perfect conductors,		45	NIL
86.	Permeability of a dielectric material in air medium		Absolute permeability	NIL
87.	Reason for Standing waves occurs		Impedance mismatch	NIL
88.	Standing wave ratio		Ratio of voltage maxima to voltage minima	NIL
89.	range of the standing wave rati		$1 < S < \infty$	NIL
90.	matched line standing wave ratio		1	NIL
91.	Standing wave ratio of short circuited and open circuited lines		∞	NIL
92.	Force that exists in an electromagnetic wave		Lorentz force	NIL

93.	Magnetic moment and torque Relation		T = BM	NIL
94.	Poisson equation in free space		Laplace equation	NIL
95.	Expression for the inductance in terms of turns, flux and current		L = N dφ/di	NIL
96.	Magnetization		The magnetization is defined by the ratio of Magnetic moment to Volume	NIL
97.	Faraday's law of Maxwell equation		Curl(E) = -dB/dt	NIL
98.	Ampere law of Maxwell law		Curl(H) = J	NIL
99.	Normal Incidence		When a uniform plane wave incidences obliquely to the boundary between the media, then it is known as normal incidence.	NIL
100.	Intrinsic impedance		The ratio of amplitudes of E and H of the waves in either direction is called intrinsic impedance of the material in which wave is travelling.	NIL
Unit-V : Electromagnetic Waves				
101.	Ratio of conduction to displacement current density		Loss tangent	NIL
102.	Phase angle between good conductors, the electric and magnetic field		45 out of phase	Nil
103.	Uniform plane waves		Electromagnetic waves which consist of electric and magnetic fields that are perpendicular to each other and to the direction of propagation and are uniform in plane perpendicular to the direction of propagation are known as uniform plane waves.	Nil
104.	Power density		The power density is defined as the ratio of power to unit area. Power density=power/unit area.	Farad
105.	Wave velocity	$v = \frac{1}{\sqrt{\mu\varepsilon}}$.	The velocity of propagation is called as wave velocity.	Nil
106.	Dielectric medium is lossless dielectric.		For perfect dielectric medium, both the fields E and are in phase. Hence there is no attenuation .Hence there is no loss.	Nil

107.	Lossy dielectric		The presence of attenuation indicates there is a loss in the medium.	NIL
108.	Standing wave ratio		The standing wave ratio is defined as the ratio of maximum to minimum amplitudes of voltage.	NIL
109.	Perfect dielectric		For perfect dielectric, the conductivity is zero and hence the loss of the system is also zero.	
110.	Skin effect		For the frequencies in the microwave range, the skin depth or depth of penetration is very small for good conductors and all the fields and currents may be considered as confined to a thin layer near the surface of the conductor. This thin layer is nothing but the skin of the conductor and hence it is called skin effect.	
111.	Lorentz force equation		It is given as the total force on a moving charge in the presence of both electric and magnetic fields.	
112.	Skin depth		It is defined as that depth in which the wave has been attenuated to 1/e or approximately 37% of its original value	
113.	Poynting vector.		The pointing vector is defined as rate of flow of energy of a wave as it propagates. P =E X H	
114.	Poyntings Theorem		The net power flowing out of a given volume is equal to the time rate of decrease of the the energy stored within the volume- conduction losses.	
115.	Maxwell's fourth equation		The net magnetic flux emerging through any closed surface is zero	
116.	Maxwell's Third equation		The total electric displacement through the surface enclosing a volume is equal to the total charge within the volume	
117.	loss tangent		It is the ratio of the magnitude of conduction current density to displacement current density of the medium.	
118.	Transmission coefficients.		Transmission coefficient is defined as the ratio of the magnitude of the transmitted field to that of incident field.	
119.	Relation between Magnetic flux and flux density		he is obtained through the property of medium and permeability μ . This is given by, B = μ H.	
120.	conservation of Magnetic Flux		It states that, the integral B ds over a closed surface is always zero. ∫ B.ds= 0	
121.	Scalar magnetic potential		The scalar magnetic potential Vm can be defined for source free region where current	

			density is zero.	
122.	Scalar quantity	-	The scalar is a quantity whose value may be represented by a single real number which may be positive or negative.e.g, temperature, mass, volume, density	
123.	Vector quantity	-	A quantity which has both a magnitude and a specified direction in space is called a vector. e.g. force, velocity, displacement, acceleration	
124.	Unit vector	-	A unit vector has a function to indicate the direction. Its magnitude is always unity	
125.	Point in a Cartesian system	-	A point in rectangular coordinate system is located by three coordinates namely x, y and z coordinates. The point can be reached by moving from origin, the distance x in x direction then the distance y in y direction and finally z in z direction.	
Placement Questions				
126.	Physical significance of divergence		Divergence of current density gives net outflow of current per unit volume. Divergence of flux density gives net outflow per unit volume. In general, divergence of any field density gives net outflow of that field per unit volume	
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131.	Differential length in Cartesian system		$\overline{dl} = dx\bar{a}_x + dy\bar{a}_y + dz\bar{a}_z$	
132.	Differential length in cylindrical system		dr-differential length in r direction $rd\theta$-differential length in θ direction dz-differential length in z direction $\overline{dl} = dr\bar{a}_r + rd\phi\bar{a}_\phi + dz\bar{a}_z$	
133.	Differential Volume in cylindrical system		$dv = rdrd\phi dz$	

134.	Relation between Cartesian and cylindrical coordinate system	$x = r\cos\phi$ $y = r\sin\phi$ $z = z$
135.	Point charge	A point charge means that electric charge which is separated on a surface or space whose geometrical dimensions are very very small compared to other dimensions
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147.	Stoke's theorem	The surface integral of the curl of a function over a surface bounded by a closed surface is equal to the line integral of the particular vector function around that surface
148.	Coulomb's law	The force of attraction or repulsion between two electrically charged objects is directly proportional to the magnitude of their charge and inversely proportional to the square of the distance between them
149.	Gauss's law	Gauss's law states that the net flux of an electric field in a closed surface is directly proportional to the enclosed electric charge.

150.	Applications of Gauss' Law.	Gauss' law is a powerful tool for the calculation of electric fields and electric flux density

Faculty Team Prepared **Signatures**

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HoD