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PRESIDENCY UNIVERSITY BENGALURU

SCHOOL OF ENGINEERING

MAKE UP EXAMINATION – JULY 2024

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| **Semester :III** | **Date :04-JULY-2024** |
| **Course Code :EEE2003** | **Time :1:30PM-4:30PM** |
| **Course Name :Electromagnetic Fields** | **Max Marks :100** |
| **Program :B.Tech EEE** | **Weightage :50%** |

**Instructions:**

1. *Read all questions carefully and answer accordingly.*
2. *Question paper consists of 3 parts.*
3. *Scientific and non-programmable calculator are permitted.*
4. *Do not write any information on the question paper other than Roll Number.*

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| **PART A** | | | |
| **ANSWER ANY 4 QUESTIONS 4Q X 5M=20M** | | | |
| 1 | Lorentz force plays a crucial role in various applications ranging from electronic devices and motors, sensors, imaging to biomedical applications. Describe the Lorentz force equation. | (CO 3) | [Knowledge] |
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| 2 | A vector field is uniquely characterized by its divergence and curl. Neither the divergence nor curl of a vector field is sufficient to completely describe the field. Given the vector field G = (16xy-z) ax + (8x^2) ay - (x) az. State whether the given field is irrotational or not. | (CO 1) | [Knowledge] |
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| 3 | An electrostatic field is produced by a static charge distribution. Define the following terms:  a. Electric Field     b. Energy density     c. Electric Flux | (CO 1) | [Knowledge] |
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| 4 | Describe the self-inductance and mutual inductance of a circuit with necessary sketches and equations. | (CO 3) | [Knowledge] |
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| 5 | Electromagnetic theory based on Maxwell's equations establishes the basic principle of electrical and electronic circuits over the entire frequency spectrum from dc to optics. List the EM waves applications and its characteristics. | (CO 4) | [Knowledge] |
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| 6 | Define the following:  a. Divergence of a vector      b. curl of a vector  c. Divergence theorem        d. Stokes theorem | (CO 2) | [Knowledge] |
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| **PART B** | | | |
| **ANSWER ANY 5 QUESTIONS 5Q X 10M=50M** | | | |
| 7 | An experimental set up requires a rectangular electromagnet with iron core.  The core carries two coupled coils of N1=360 and N2=480 turns respectively. The self-inductance of coil 1&2 is 0.6H and 1.3H and mutual inductance between the coils is 0.3mH.   1. The coupling coefficient 2. The total inductance if the mms of both coils are in the same direction and also in the opposite direction. | (CO 3) | [Comprehension] |
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| 8 | A General law of magneto statics states that the magnetic field intensity dH produced at a point P in space by a differential current clement is proportional to the product differential current element and the sine of the angle a between the element and the line joining P to the element and is inversely proportional to the square of the distance between P and the element. A thin ring of radius 5 cm is placed on plane z = 2 cm so that its center is at (0, 0, 2 cm). If the ring carries 100 mA along aø, find H at (a) (0, 0, - l c m) (b) (0, 0, 10 cm). | (CO 3) | [Comprehension] |
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| 9 | Coaxial cable has an inner and outer core that share a geometric axis. This prevents electromagnetic interference and enables more reliable data transmission over longer distances. An underground coaxial cable is used for transmitting electrical power from one place to another. The inner radius is 6 cm and outer radius is 15 cm. If the cable is impressed with the voltage of 5.2 kV and the relative permittivity of the cable is 2, then a) Identify the unknown quantities that could be computed from the given data b) Compute the unknown Quantities. | (CO 2) | [Comprehension] |
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| 10 | Laplace's equation is of primary importance in solving electrostatic problems involving a set of conductors maintained at different potentials. Examples of such problems include capacitors and vacuum tube diodes. Laplace's and Poisson's equations are not only useful in solving electrostatic field problem; they are used in various other field problems. Among the following potentials for which potential equation the Laplace's equation can’t be applied.   1. V = X^2 + Y^2-2Z^2 + 20 2. V = (z cosø) / ρ 3. V = r cosø | (CO 2) | [Comprehension] |
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| 11 | A parallel-plate capacitor with plate area of 5 cm^2 and plate separation of 3 mm has a voltage 50 sin 10^3 t V applied to its plates. Calculate the displacement current assuming € = 2€o. | (CO 4) | [Comprehension] |
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| 12 | The conducting triangular loop in figure carries a current of 10A. Find H at (0, 0, 5) due to side 1 of the loop. | (CO 2) | [Comprehension] |
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| 13 | According to Faraday's experiments, a static magnetic field produces no current flow, but a time-varying field produces an induced voltage (called electromotive force or simply emf) in a closed circuit, which causes a flow of current. Faraday discovered that the induced emf (in volts), in any closed circuit is equal to the time rate of change of the magnetic flux linkage by the circuit.  Explain the three different methods by which variation in flux is realized with necessary equations. | (CO 4) | [Comprehension] |
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| **PART C** | | | |
| **ANSWER ANY 2 QUESTIONS 2Q X 15M=30M** | | | |
| 14 | Sea water plays a vital role in the study of submarine communications. Assuming that for sea water, conductivity ( σ )  = 4 S/m, εr = 70, µr = 1, and f = 50 MHz.  (a) List the quantities which are associated with EM waves can be found out by using the above data.  (b) Compute the listed quantities. | (CO 4) | [Application] |
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| 15 | The xy-plane serves as the interface between two different media. Medium 1 (z < 0) is filled with a material whose µr = 6, and medium 2 (z > 0) is filled with a material whose µr = 4. If the interface carries current (1/µo) ay mA/m, and B2 = 5ax, + 8az mWb/m2.  i. List the quantities that are associated with magnetic fields can be found with the given data.  ii. Compute the listed quantities. | (CO 3) | [Application] |
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| 16 | In a certain conducting region,    (a) Determine Current density J at (5, 2 , - 3 )  (b) Find the current passing through *x = —1,0 < y<2, 0<z < 2*  (c) Show that divergence of magnetic flux density is zero | (CO 3) | [Application] |
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