

HS 102

Science, Technology and Society

Mid Semester Exam

Total Marks-30

Answer the following Questions-

1. Explain the Proletariat and the Bourgeoisie class with examples. (3)
2. While Erin Brockovich defies the expectations of a struggling single mother who speaks and presents herself as she desires, she occasionally caricatures those around her based only on their exteriors and transgresses limits in the workplace. Do you concur with this statement? (3)
3. In *Erin Brockovich*, what was happening to the people in the town? In your opinion, what should be done to prevent the type of problem described in *Erin Brockovich* from happening again? (3)
4. What do you understand by Inductive and Deductive reasoning? Explain the four types of Inductive reasoning. Based on the topic of your term paper, explain the process of reasoning you are planning to apply? (3)
5. Explain the data analysis process of your term paper. (3)
6. What is deductive reasoning in story telling? (3)
7. What is Modus Ponens? (3)
8. What is technological determinism and technological voluntarism? (3)
9. Explain the difference between Applied science and Applications of science. (3)
10. State and explain the four types of alienation by Marx in a workplace? (3)

INDIAN INSTITUTE OF INFORMATION TECHNOLOGY VADODARA
Mid Semester Examination (AY 2022-23, Winter Semester)
Course: EE100 Basic Electrical Engineering

Full Marks: 50

Date: 01/06/2023

Time: 10:00 AM - 12:00 Noon

Instructions:

1. The exam is a closed book/resource.
2. Attempt **ALL** the questions.
3. Each question carries 10 marks.
4. Answer each question sequentially beginning on a new page.
5. Only a scientific calculator is permitted to use.

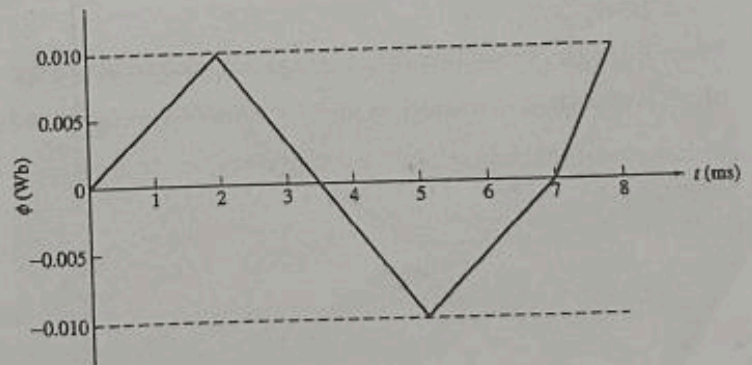
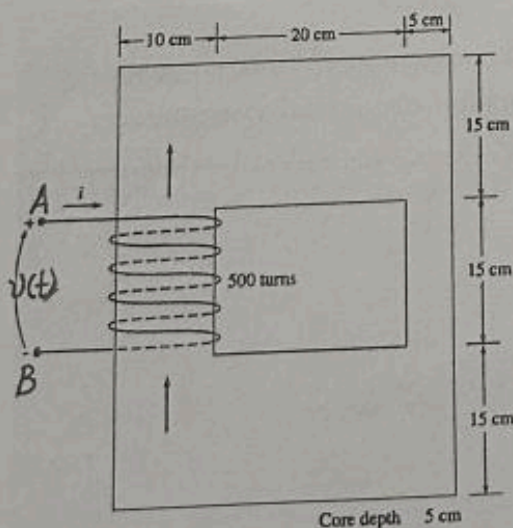
Ques. 1: In a single phase power system, the total current of $15 \angle 0^\circ \text{ A}$ is supplied to the impedances $Z_1 = 10 + j15 \Omega$ and $Z_2 = 6 - j8 \Omega$ connected in parallel. Calculate the following:

- a) Real power supplied to each branch of the impedances.
- b) Power factor of each branch of the impedances.
- c) Total power factor.

Ques. 2: In a three-phase power system, a star-connected generator with line voltage 230 V is supplying power to delta-connected balanced load. The impedance of the load branch is $8 + j6 \Omega$ per phase. Determine the following:

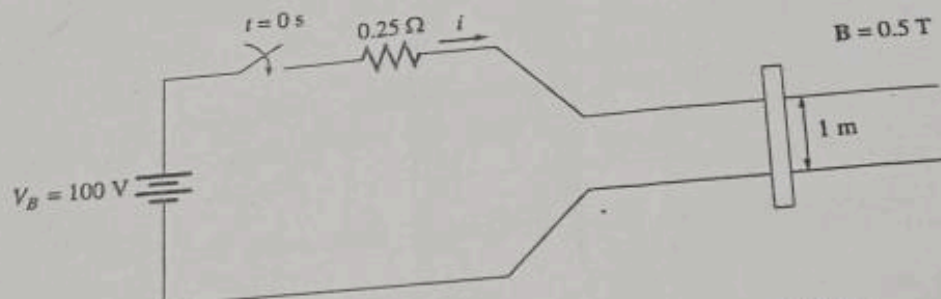
- a) Magnitude of current flowing in a phase of the load.
- b) Total power consumed by the load.
- c) Power factor of the load
- d) Reactive power of the load.

Ques. 3: The ferromagnetic core shown below has the magnetic flux $\phi(t)$ shown beside. Sketch the voltage $v(t)$ present across the terminals A and B of the coil.



$v = IR$
1.5
3/2

Ques. 4: A linear dc machine shown below has a magnetic flux density of 0.5 T directed into the page, a resistance of 0.25Ω , a bar length $l = 1.0 \text{ m}$, and a battery voltage $V_B = 100 \text{ V}$.



- What is the initial force on the bar at starting? What is the initial current flow?
- What is the no-load steady-state speed of the bar?
- If the bar is loaded with a force of 25 N opposite to the direction of motion, what is the new steady state speed? What is the efficiency of the machine under these circumstances?

Ques. 5: A 1000-VA 230/115-V transformer has been tested to determine its equivalent circuit. The results of the tests are tabulated below:

Open-Circuit Test	Short-Circuit Test
$V_{oc} = 230 \text{ V}$	$V_{sc} = 19.1 \text{ V}$
$I_{oc} = 0.45 \text{ A}$	$I_{sc} = 8.7 \text{ A}$
$P_{oc} = 30 \text{ W}$	$P_{sc} = 42.3 \text{ W}$

- Find the equivalent circuit of this transformer referred to the low-voltage side of the transformer.
- Find the transformer's voltage regulation at rated conditions and $p.f. = 0.8$ (lagging).
- Determine the transformer's efficiency at rated conditions and $p.f. = 0.8$ (lagging).

5. Are the following set of vectors linearly independent? If A is a matrix formed using following vectors, i.e., $A = [v_2 | v_3 | v_1]$ then for which values of $b \in \mathbb{R}^3$, $AX = b$ is consistent? Is there a vector b such that $AX = b$ is inconsistent? Give justification. **6 Marks**

$$v_1 = \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix}, v_2 = \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix}, v_3 = \begin{bmatrix} -1 \\ 1 \\ 1 \end{bmatrix}$$

6. Let $\mathbb{R}_n[X]$ denote the set of all polynomials in one variable, X , of degree less than or equal to n with coefficients from \mathbb{R} , for each $n \in \mathbb{N}$. Consider $T(f) = \int f(X) dX$. **6 Marks**
- a) Is $T : \mathbb{R}_3[X] \rightarrow \mathbb{R}_4[X]$ linear, one-to-one and onto?
 - b) Give dimensions and basis of $\mathbb{R}_3[X], \mathbb{R}_4[X]$.
 - c) If T is linear then represent T using these basis.
 - d) Find $T(1 + X^3)$ using matrix representation of T .

Indian Institute of Information Technology Vadodara
Mid Semester Exam '23 PH110 Electrodynamics

(This is a closed book exam. Access to internet is not allowed. No mobile phones or calculators are allowed to be used. Backside contains some useful formulae.)

- 1) Write the expression for the Coulomb force felt by a point charge q at location \vec{r} due to another point charge Q at location \vec{R} . Using this expression also find the electric field $\vec{E}(\vec{r})$ at point \vec{r} due to the charge Q . Calculate the divergence of \vec{E} and show that it is proportional to $\delta^3(\vec{r} - \vec{R})$.
[5 marks]
- 2) Suppose you are given an infinitely long straight wire which has charge density λ . Find the value of the electric potential $V(\vec{r})$ at some point which is L distance away from the wire. Also give the expression for the electric field at that point.
[3 marks]
- 3) Consider that you are given a parallel plate capacitor consisting of two metallic plates of area A held a distance d apart from one another. Let Q be placed on one of them while $-Q$ be placed on the other. What is the electric field in the region between the plates? What is the potential difference between the plates? Suppose we want that the two plates be moved by an infinitesimal distance ϵ away from one another, then what is the work needed to be done?
[3 marks]
- 4) Define what is a conservative vector field. Give some examples and clearly show their conservative nature. What is divergence theorem? Write the statement and show its working using an example.
[4 marks]
- 5) Suppose one has a metallic spherical shell of radius R , and one brings Q charge from infinity on it. What is the work done in this process? What is the potential and electric field inside the shell, on the shell, and outside it? Provide the expressions and derivation.
[5 marks]
- 6) Suppose one has a infinitely long straight wire placed on top of a planar metallic sheet such that it is parallel to sheet while being at a distance d . If one places charges on the wire, such that the line charge density is σ , then what would be the potential in the region above the plate? You can assume that the sheet is grounded.
[5 marks]

Indian Institute of Information Technology Vadodara
Mid-semester Examination
MA 102 (Mathematics II: Linear Algebra and Matrices)

Max. Marks: 30

Instructions:

1. Calculators are not allowed to use.
2. Write down answers neatly in sequence.
1. Find all solutions of following linear system using elementary row operations/Gaussian elimination: 4 Marks

$$\begin{aligned} 4x_1 - 6x_2 - 14x_3 + 10x_4 + 4x_5 &= -4 \\ -x_1 + 2x_2 + 4x_3 - 3x_4 - x_5 &= 2 \\ 2x_1 - 4x_3 + 2x_4 + x_5 &= 3 \\ x_1 - 5x_2 - 7x_3 + 6x_4 + 2x_5 &= -7 \end{aligned}$$

2. Are A and B similar, i.e., $A = PBP^{-1}$ for some P ? Find elementary matrices E_i such that $E_k E_{k-1} \cdots E_2 E_1 A = B$, where

$$A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}, B = \begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix}$$

Can you generalize above example for a certain set of matrices for A, B ? 4 Marks

3. Let T be a function of \mathbb{R}^2 which first rotates a point clockwise by 45° and then shift horizontally to its right by distance 1. 5 Marks

a) Find $T\left(\begin{bmatrix} 1 \\ 1 \end{bmatrix}\right)$.

b) Write down a formula for T .

c) Is T a linear transformation? Give justification.

d) If T is a linear transformation then give its standard matrix representation.

4. Let $T\left(\begin{bmatrix} x \\ y \\ z \end{bmatrix}\right) = \begin{bmatrix} 3x + 2y + 2z \\ 2x + 3y + 2z \\ 2x + 2y + 3z \end{bmatrix}$ be a function from \mathbb{R}^3 to \mathbb{R}^3 . 5 Marks

a) Verify that T is a linear transformation.

b) What is the standard basis of \mathbb{R}^3 ? Represent T by a matrix using the standard basis of \mathbb{R}^3 .

c) Does there exists a basis $\{v_1, v_2, v_3\}$ of \mathbb{R}^3 such that $T(v_i)$ is a scalar multiple of v_i for each i ? If yes then find them and represent T using this new basis.