

INDIAN INSTITUTE OF INFORMATION TECHNOLOGY VADODARA

Mid Semester Examination (AY 2021-22, Winter Semester)

Course: EE100 Basic Electrical Engineering

Full Marks: 50

Date: 16/06/2022

Time: 10:50AM-12:10PM

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: You are provided with a regulated dc power supply 0-30 V, a variable resistor 0-47 Ω , connecting wires, switch, conducting bar, a pair of frictionless conducting rails separated by 50cm, and a magnet of 0.5 T. Propose a design of a dc machine operating as a motor. Subsequently, answer the following:

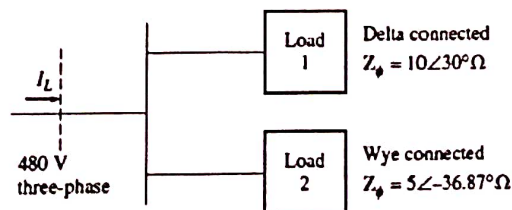
- a) What is this machine's starting current? What is its steady-state velocity at no load (force)?
- b) Suppose you apply a load (force) pointing opposite to the motion of the conducting bar. Determine and plot the speed of the conducting bar as a function of the load (force).
- c) What do you conclude from the speed-load (force) characteristics?

Ques. 2: A single phase power system consists of a 440-V 50Hz generator supplying to a load $Z_{load} = 40 + j50 \Omega$ through a transmission line whose impedance per km of distance is $Z_{line} = 0.02 + j0.03 \Omega$. If the load is remotely located at a distance of 50 km,

- a) What will be the transmission line loss?
- b) Propose a technique to reduce the transmission loss. You will be provided with suitable electrical machines as per your proposal.
- c) Estimate the percentage power saving in your proposal.

Ques. 3: A three-phase power system is shown below. The generator supplies a constant line voltage of 480 V and the power is distributed between two balanced loads as shown in the figure. The phase impedance of each load is provided in the figure. Assume that the impedance of the distribution line is negligible,

- a) Find the overall power factor of the distribution system.
- b) Find the total line current supplied to the distribution system.



Ques. 4: A ring shaped magnetic core has a circular cross-section of 3 cm in diameter and a mean circumference of 80 cm. A 1 mm air-gap is cut out in the core and it is wound with a coil of 600 turns. Estimate the current required to establish a flux of 0.75 mWb in the air-gap. Neglect fringing and leakage. The magnetization data of the given core is:

H (AT/m)	200	400	600	800	1000	1200	1400	1600	1800	2020
B (T)	0.10	0.32	0.60	0.90	1.08	1.18	1.27	1.32	1.36	1.40

Ques. 5: A 15-kVA 8000/230-V distribution transformer has an impedance referred to the primary of $80 + j300 \Omega$. The components of the excitation branch referred to the primary side are $R_C = 350 \text{ k}\Omega$ and $X_M = 70 \text{ k}\Omega$. If the primary voltage is 7967 V and the load impedance is $Z_L = 3.2 + j1.5 \Omega$,

- Calculate the secondary voltage of the transformer.
 - Calculate the voltage regulation of the transformer.
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