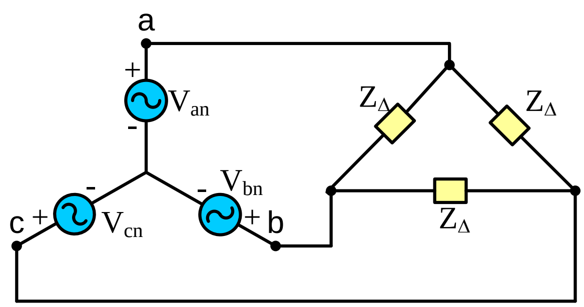
**King Fahd University of Petroleum & Minerals**
**Electrical Engineering Department**
**EE306: Electrical Energy Engineering**

**Problem Session 1** **141**

**Problem 1:**

A Δ-connected load consists of three identical impedances of $Z_\Delta = 20\ \angle\text{-}30^o\ \Omega$ each and is supplied from a three-phase, 208-V source. (use **Van** = $120\angle 0^o$ )Calculate:

(1) magnitudes and angles of each phase voltage and current on the load side.
(2) magnitude and angles of each line voltage and current.
(3) the load power factor
(4) the real, reactive and apparent power taken by the load.




**Problem 2:**

A balanced 3-phase supply with a line voltage of 480 V supplies two balanced 3-phase loads as follows. Load 1 is a Δ-connected load with a phase impedance of $10\angle 30°\ \Omega$, and load 2 is a Y-connected with a phase impedance of $5\angle\text{-}36.87°\ \Omega$. Find:

**(a)** the overall power factor. **(b)** the total current supplied.
**(c)** the total real, reactive, and apparent powers.

**Problem 3:**

A balanced 3-phase Y-connected load with phase impedance of $20+j15\ \Omega$ is connected to a 400-V, 3-phase, 50-Hz supply. Calculate:

**(a)** the line current. **(b)** the real and reactive power supplied.

If a 3-phase Δ-connected capacitor bank is connected parallel to the above load, calculate the capacitance per phase to obtain a resultant power factor of 0.95 lagging.

**Problem 4:**

A 600-turn coil is wrapped uniformly around a steel ring with a circular cross-sectional area. The inner and outer diameters of the ring are 19 cm and 31 cm respectively. Calculate

**(a)** the current required to produce a flux of 1.7 mWb in the ring.
**(b)** the current to produce this flux when an air-gap of 2 mm is made in the ring.

Neglect leakage and fringing. The magnetization characteristic of the steel is

| | | | | | |
|---|---|---|---|---|---|
| B (Wb/m$^2$) | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 |
| H (At/m) | 550 | 600 | 650 | 730 | 850 |

**Problem 5:**

A flux of $3.6\times10^{-4}$ Wb is to be established in the center leg of the sheet steel core as shown in Fig. 1. Dimensions are given in cm. Find the necessary current in the 300-turn coil. The magnetization curve of the silicon sheet steel is shown in Fig. 2.

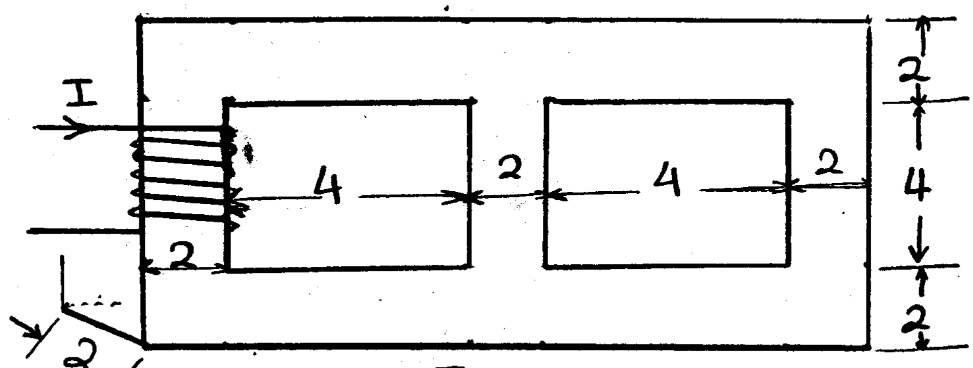



Fig. 1.

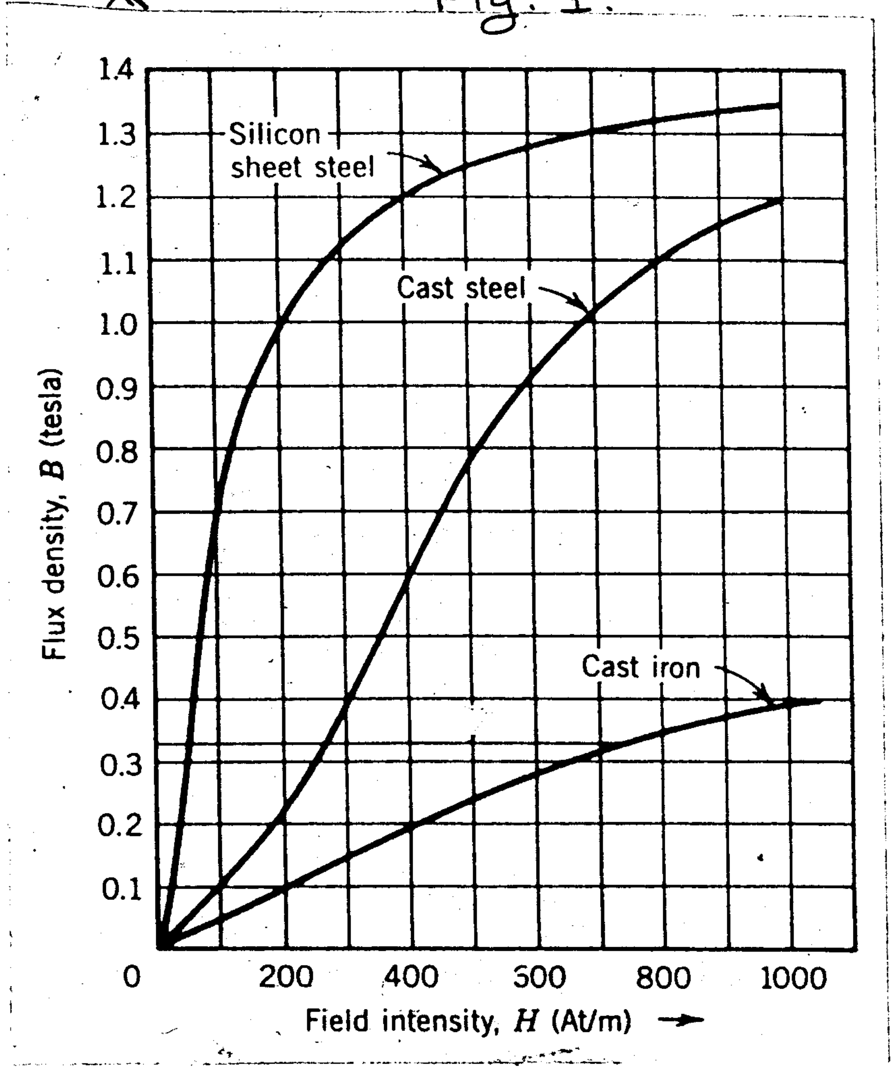



Fig. 2

**Problem 6:**

A ferromagnetic circuit has a magnetic core with infinitely high relative permeability. It has three legs, and air gaps of 2 mm and 1 mm are cut from section A and C as shown in Fig.3. A coil is wound on the center leg B, and it has 200 turns and a resistance of 2.5Ω. The magnetic core has a 5x5 cm uniform cross-sectional area. A DC voltage is applied to the coil.

(a) Determine the voltage that will produce a flux density of 0.75 T in the right leg C, which contains the 1-mm air gap.
(b) Find the magnetic flux in the other two legs of the core.

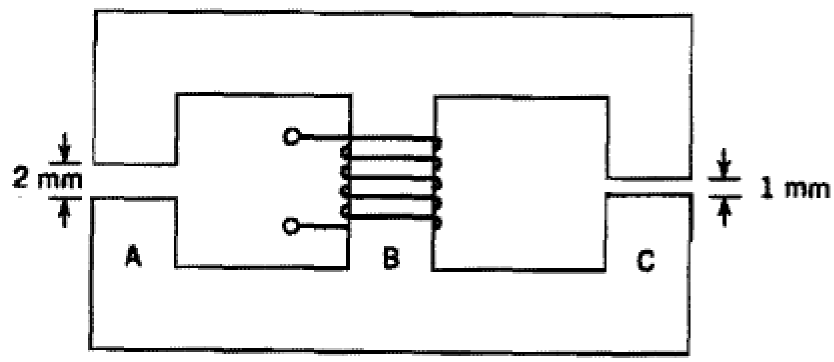



Fig. 3 Magnetic circuit