Ollscoil na hÉireann, Gaillimh

National University of Ireland, Galway

SEMESTER II EXAMINATIONS, 1999/2000

THIRD YEAR ELECTRONIC ENGINEERING
THIRD YEAR MECHANICAL ENGINEERING

ELECTRICAL POWER AND MACHINES

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Duration of examination: *One* Hour *Thirty* Minutes

Instructions: Answer *three* questions

$\mu_o = 4\pi \times 10^{-7}$ H/m 1 hp=746 W

Q1. Derive an expression for the power in a three-phase balanced load in terms of line voltages and line currents.

The input power to a 3-phase induction motor is measured by the two-watt meter method. The readings were 6.7 kW and -1.8kW and the line voltage was 400 V. Calculate:

(a) the total active power
(b) the power factor
(c) the line current

Q2. Explain why the third or triplen harmonics do not cancel in the neutral of a balanced three-phase system.

The load in Fig.1 is a rectifier with a capacitor filter. The load is balanced, the output current is 50A and the output ripple is 10% giving an input power factor of 0.42.

(a) Calculate the line current I_a
(b) Calculate the neutral current I_n

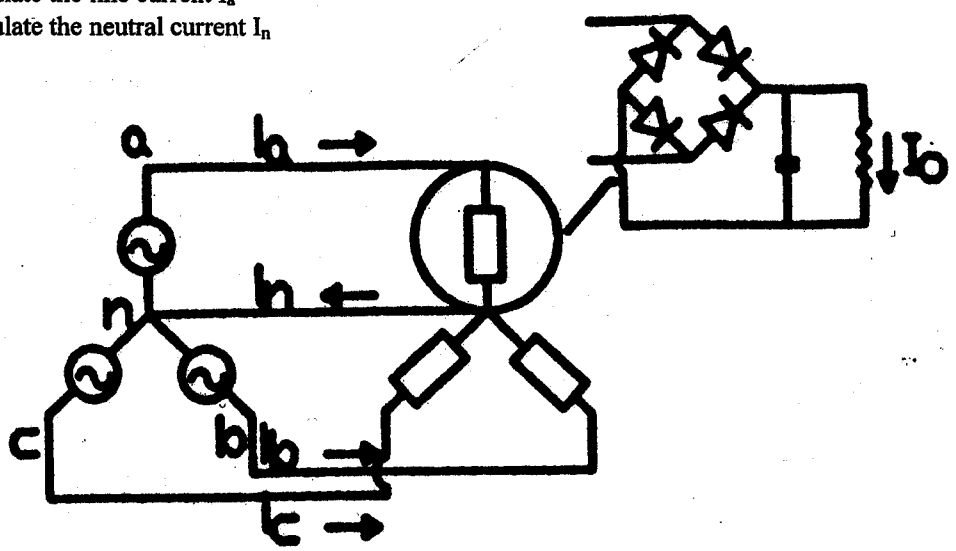

Fig. 1 Three-phase rectifier

Q3. Explain how a rotating flux wave is produced in a 3-phase induction motor.

A three-phase, 240v, 50Hz, six-pole induction motor has the following equivalent circuit parameters:

$R_1 = 0.075\ \Omega$, $R_2 = 0.11\ \Omega$, $L_1 = L_2 = 0.25\text{mH}$, $L_m = 15\text{mH}$

(a) Draw the equivalent circuit and show component values.

(b) The motor drives a fan. The torque required for the fan varies as the square of the speed and is given by:

$T_{fan} = 12.7 \times 10^{-3}\ \omega_m^2$ Nm

Determine the speed of the fan when the motor is connected to a three-phase, 240 V, 50 Hz supply.

Q4. Describe one of the following motors under the headings:

- Principle of Operation
- Motor Characteristics
- Applications

(a) Reluctance Motor
(b) Universal Motor