UNIVERSITY OF MINES AND TECHNOLOGY, TARKWA

FIRST SEMESTER EXAMINATIONS, NOV/DEC 2018

COURSE NO: EL 275
COURSE NAME: Transformers
CLASS EL II **TIME**: 3 hours

Name**:** _____ Index Number: _____

Instruction: Attempt all questions.

Question 1

A single-phase transformer has 500 turns on the primary and 40 turns on the secondary winding. The mean length of the magnetic path in the core is 150 cm and the joints are equivalent to an air-gap of 0.1 mm. When a potential difference of 3000 V is applied to the primary, maximum flux density is 1.2 T. Calculate:

a. The cross-sectional area of the core; [2 *marks*]
b. No-load secondary voltage; [2 *marks*]
c. The no-load current drawn by the primary; and [10 *marks*]
d. The power factor on no-load. [2 *marks*]

Given that AT/cm for a flux density of 1.2 T in the iron to be 5, the corresponding iron loss to be 2 W/kg at 50 Hz and density of iron as 7.8 g/cm^3.

Question 2

a. A 25 kVA, 2200/220 V, single-phase, 50 Hz transformer has a primary resistance of 2.5 Ω and reactance of 4.8 Ω. The secondary resistance and reactance are 0.01 Ω and 0.018 Ω respectively. Find

   i. the equivalent resistance referred to primary [2 *marks*]
   ii. the equivalent impedance referred to the primary [2 *marks*]
   iii. the equivalent reactance referred to secondary [2 *marks*]
   iv. the total copper loss of the transformer. [2 *marks*]

b. A 25 kVA, 2200/220 V, 50 Hz distribution transformer is tested for efficiency and regulation as follows:

   - Open-circuit test (low voltage side): 220 V, 4 A, 150 W
   - Short-circuit test (high voltage side): 90 V, 10 A, 350 W

   Determine:

   i. the core loss [2 *marks*]
   ii. the equivalent resistance referred to secondary [2 *marks*]
   iii. the regulation of transformer at 0.8 power factor lagging current [2 *marks*]
   iv. the efficiency at half-load at 0.8 power factor lagging current [2 *marks*]

c. For a single-phase, 200-kVA, distribution transformer has full-load copper losses of 3.02 kW and iron losses of 1.6 kW. It has following load distribution over a 24-hour day:

- 80 kW at unity power factor, for 6 hours.
- 160 kW at 0.8 power factor (lagging), for 8 hours.
- No load, for the remaining 10 hours.

Determine its all-day efficiency. [8 *marks*]

Question 3

a. State any five (5) disadvantages associated with operating transformers in parallel. [5 *marks*]

b. Two 3-phase transformers of capacity 800 kVA operate in parallel to supply a load of 1000 kVA at a power factor of 0.866 lagging. Transformation ratio is same: 6600/400 V, delta/star. If the equivalent impedances referred to secondary are $(0.005 + j0.015)$ ohm and $(0.012 + j0.030)$ ohm per phase, respectively, calculate the load and power factor of each transformer. [15 *marks*]