UNIVERSITI
TEKNOLOGI
PETRONAS

FINAL EXAMINATION
JANUARY 2025 SEMESTER

COURSE	:	**EFB2083 - ELECTRICAL MACHINES**
DATE	:	**8 APRIL 2025 (TUESDAY)**
TIME	:	**2.30 PM - 5.30 PM (3 HOURS)**

INSTRUCTIONS TO CANDIDATES

1. Answer **ALL** questions in the Answer Booklet.
2. Begin **EACH** answer on a new page in the Answer Booklet.
3. Indicate clearly answers that are cancelled, if any.
4. Where applicable, show clearly steps taken in arriving at the solutions and indicate **ALL** assumptions, if any.
5. **DO NOT** open this Question Booklet until instructed.

Note :

i. There are **SIX (6)** pages in this Question Booklet including the cover page .

ii. **DOUBLE-SIDED** Question Booklet.

1. a. Discuss the process of conducting short circuit test and open circuit test in transformer and analyze on how to obtain power factor from the tests.

[10 marks]

b. The test results of a 4 KVA, 200/400 V and 50 Hz single phase transformer as follows:

Open Circuit Test	**Short Circuit Test**
- $V_{oc} = 200\ V$	- $V_{sc} = 15\ V$
- $I_{oc} = 0.7\ A$	- $I_{sc} = 10\ A$
- $P_{oc} = 70\ W$	- $P_{sc} = 85\ W$

Determine the primary resistance, primary reactance, equivalent resistance referred to primary and equivalent reactance referred to primary.

[15 marks]

2. a. Analyse the equation of speed for separately excited DC motor and convert the equivalent electrical diagram to mechanical diagram for the motor.

[7 marks]

b. A 25-kW, 230-V, DC shunt machine has an armature resistance of 0.05 Ω and field resistance of 150 Ω. Determine:

i. The total armature power developed when working as motor taking 25 kW input.

[10 marks]

ii. The total armature power developed when working as generator while delivering output of 25 kW.

[8 marks]

3. a. Three phase voltages are applied to the three windings of an electrical machine as shown in **FIGURE Q3a**. Determine the resultant magnetomotive force (mmf)at t_1 and t_2, by sketching the mmf where its amplitude remains unaltered. Show clearly step taken.

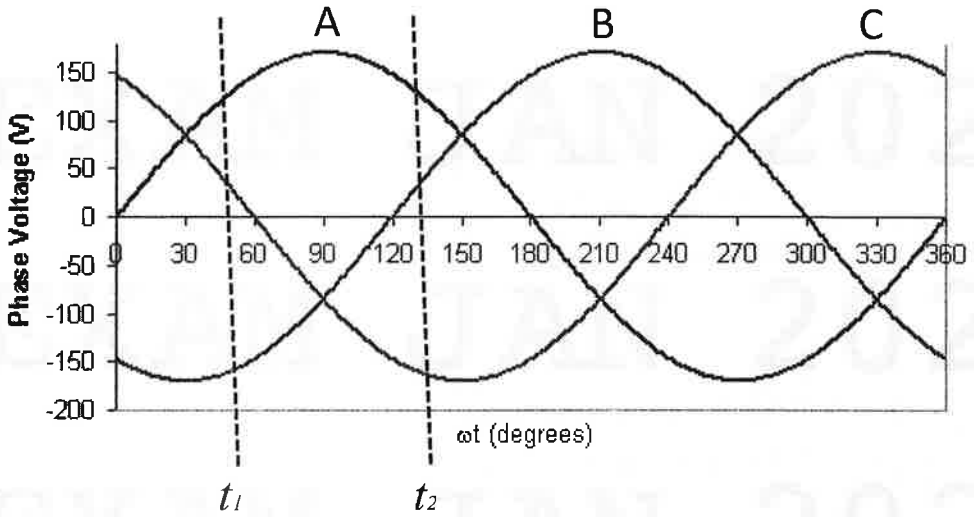

FIGURE Q3a

[10 marks]

b. A 480-V 200-kVA 0.8-power-factor-lagging 60-Hz two-pole Y-connected synchronous generator has a synchronous reactance of 0.25 Ω and an armature resistance of 0.03 Ω. At 60 Hz, its friction and windage losses are 6 kW, and its core losses are 4 kW. The field circuit has a dc voltage of 200 V, and the maximum I_F is 10 A. The resistance of the field circuit is adjustable over the range from 20 to 200 Ω. The OCC of this generator is shown in **FIGURE Q3b**.

i. When the generator is running at no load, determine the field current is required to generate voltage terminal, V_T equal to 480 V.

[5 marks]

ii. Determine the armature voltage, E_A of this machine at rated conditions.

[10 marks]

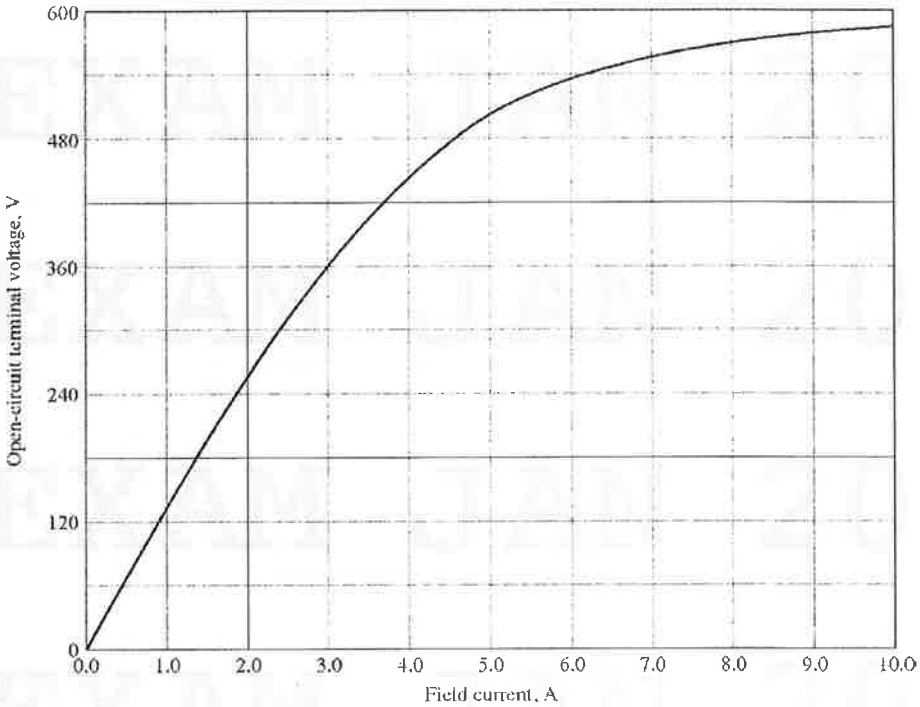

FIGURE Q3b

4. a. Analyse the power flow diagram of 3-phase induction motor. Suggest how to improve the performance of the motor. Justify your answer.

[10 marks]

b. A 408-V, 60-Hz, 50-hp, 3-phase induction machines is drawing 60 A at 0.85 pf lagging. The stator copper losses are 2 kW and the rotor copper losses are 700 W. The friction and windage losses are 600 W. The core losses are 1800 W and the stray losses are negligible. Determine power converted from electrical to mechanical and efficiency of the motor.

[15 marks]

-END OF PAPER-