5. (a) Briefly explain an **'Isolating Transformer'** and give at least two applications. **(5 marks)**

(b) A 400 kVA transformer has a primary winding resistance of 0.525 ohm and a secondary winding resistance of 0.0012 ohm. The iron loss is 2.45 kW and the primary and secondary voltages are 5.5 kV and 325 V, respectively. If the power factor of the load is 0.795, determine the efficiency of the transformer

(i) on full load and **(9 marks)**

(ii) on half load. **(6 marks)**

6. After allowing for diversity, a factory load consists of three main sections:

- a motor load of 250 KVA, 0.8 pf. lagging;
- 100 KW heating and lighting load, pf unity;
- inductive load of 300 KVA, 0.5 pf. lagging.

If the supply voltage is three phase four wire 415 Volts,

a. Calculate the current absorbed by the factory load. **(8 marks)**

b. If the heating load is increased by 150 KW show how this can be achieved without exceeding the existing KVA maximum demand. **(8 marks)**

c. Draw a phasor diagram. **(4 marks)**

END OF PAPER

EXAMINATION: AUTHORISATION B

Paper I (Theory) Time Allowed - 3Hrs

February 2016

WRITE ALL YOUR WORK ON THE ANSWER BOOK PROVIDED. EVERY ANSWER SHOULD INCLUDE ALL WORKINGS, NECESSARY DIAGRAMS AND FORMULAE.

ANSWER FIVE QUESTIONS

START EACH ANSWER ON A FRESH PAGE.

1. (a) A circuit is made up of two branches in parallel. Branch "A" consists of a coil having resistance of 15Ω and an inductance of 0.05H. Branch "B" consists of a resistor of 8Ω in series with a capacitor of 80μF. The circuit is supplied from 230V 50Hz a.c. supply.

   Calculate:

   i) the reactance of the coil and of the capacitor; **(2 marks)**

   ii) the current in the two branches; **(2 marks)**

   iii) the phase angles of the current in each of the two branches with respect to the supply voltage; **(2 marks)**

   iv) the total current taken by the circuit from the supply; **(3 marks)**

   v) the total power in the circuit; **(3 marks)**

   vi) the total reactive power in the circuit. **(3 marks)**

   (b) Sketch a phasor diagram (not to scale) showing the supply voltage, the two branch currents and the total current taken by the circuit from the supply. **(5 marks)**

2. A 220 volt shunt motor takes 105 amperes. The armature resistance is 0.08 ohm and the field resistance is 44 ohms. The motor runs at 950 r.p.m.
   If the iron and friction losses are equal to 2 KW, find:

   (a) (i) the B.H.P; **(6 marks)**
   (ii) the total torque; **(6 marks)**
   (iii) the shaft torque. **(6 marks)**

   (b) Draw a neat diagram showing the arrangement. **(2 marks)**

3. (a) Prove that for both Star and Delta connected loads the total active power is given by $\sqrt{3}\, V_L\, I_L \cos\phi$, where V_L and I_L are the line voltage and line current respectively and ϕ is the angle between the phase values of the voltage and current. **(5 marks)**

   (b) In a three-phase four wire system the line voltage is 400V and the following single phase loads are connected as follows:

   - a resistive load of 25 kW between L1 and Neutral;
   - a resistive load of 17 kW between L2 and Neutral;
   - a resistive load of 10 kW between L3 and Neutral.

   Calculate:

   i. the current in each line; **(3 marks)**
   ii. the current in the Neutral conductor. **(5 marks)**

   (c) Sketch a phasor diagram to show all the currents. **(2 marks)**

   (d) The main neutral conductor supplying these loads was accidently broken when the 17 kW load was being disconnected from the supply. When the supply was switched ON again to supply the 25kW and 10 kW loads, the main neutral conductor was missing (broken). Calculate the voltage across the 25 kW load and the 10 kW load. **(5 marks)**

4. (a) Explain briefly the following:

   (i) stator losses; **(2 marks)**
   (ii) rotor losses; **(2 marks)**
   (iii) friction & winding losses; **(2 marks)**
   (iv) slip speed. **(2 marks)**

   (b) The power supplied to a three-phase induction motor is 50 kW and the stator losses are 2 kW. If the slip is 4%, determine:

   (i) the rotor copper loss; **(4 marks)**
   (ii) the mechanical power developed by the rotor; **(4 marks)**
   (iii) the output power of the motor if the friction and windage losses are 1 kW and **(2 marks)**
   (iv) the efficiency of the motor, neglecting rotor iron losses. **(2 marks)**