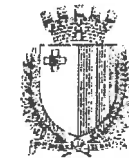


6. (a) List the main advantages of an a.c. transmission and distribution system. **(5 marks)**
- (b) State the disadvantages of an a.c. transmission system. **(3 marks)**
- (c) Describe the losses which occur in a transformer on load. **(4 marks)**
- (d) A 250 kVA, 11 000 V/400V, 50 Hz single-phase transformer has 80 turns on the secondary. Calculate:
- i. the approximate values of the primary and secondary currents. **(4 marks)**
- ii. the approximate number of primary turns. **(4 marks)**

Total: 100 marks

END OF EXAMINATION PAPER



GOVERNMENT OF MALTA
MINISTRY FOR EDUCATION
AND SPORT
DEPARTMENT OF EXAMINATIONS

EXAMINATION FOR AUTHORISATION B

Paper 1: Theory

Date: 2 February 2022

Time: 16:00 – 19:00 (Three hours)

This examination paper contains six questions. Candidates are requested to answer any FIVE (5) questions. Candidates are also requested to include all their work in the booklet provided. Every answer should include all workings, any necessary diagrams and formulae. Use a fresh page for each different question. Each question carries 20 marks.

1. (a) Sketch the **Torque / Speed** curve for a three-phase induction motor, indicating the starting torque and the operational area. **(5 marks)**
 - (b) Explain what is meant by the term **Slip** when related to an induction motor. **(3 marks)**
 - (c) A three-phase, 50 Hz, six pole induction motor has a slip 0.04 per unit when the output power is 20kW. The frictional loss is 250W. Calculate:
 - i) the rotor speed **(6 marks)**
 - ii) the rotor copper losses (I^2R). **(6 marks)**
2. (a) What is meant by the term **back emf** when related to DC motors. **(3 marks)**
 - (b) Draw the **Torque / armature current** and **speed / armature current** relationship for a series motor and a shunt motor. **(4 marks)**
 - (c) On full load a 300V series motor takes 90A and runs at 15 rev/s. The armature resistance is 0.1Ω and the series winding resistance is $50 \text{ m}\Omega$. Determine the speed when developing full load torque but with a 0.2Ω diverter in parallel with the field winding. (Assume that the flux is proportional to the field current). **(13 marks)**
3. A load in a factory consists of the following:
 - i. 9 kW of lighting at unity power factor (p.f.)
 - ii. a 12 kVA motor at 0.75 p.f. lagging.
 - iii. a number of small motors taking 15 kW at 0.6 p.f. lagging.

The loads are balanced over the three phases of a 415V supply system. Determine:

- (a) the total kW **(3 marks)**
- (b) the total kVAr **(3 marks)**
- (c) the overall kVA **(3 marks)**
- (d) the overall power factor **(4 marks)**
- (e) the line current. **(4 marks)**
- (f) Draw the final power triangle of the combined load. **(3 marks)**

4. The following loads are connected to a 415V three-phase four-wire system:
 - between red line and neutral, a non-inductive resistor of 24Ω .
 - between yellow line and neutral, an 886W load at 0.555 power factor (p.f.) lagging.
 - between blue line and neutral, a capacitor of resistance 30Ω in series with a resistor of 40Ω .

The phase sequence is red, yellow, blue.

- (a) Draw the circuit and voltage vector diagrams. **(3 marks)**
 - (b) Calculate the current in each line. **(4 marks)**
 - (c) Calculate the total power. **(5 marks)**
 - (d) Calculate the current in the neutral. **(8 marks)**
5. A coil of inductance 159.2 mH and resistance 40Ω is connected in parallel with a $30 \mu\text{F}$ capacitor and connected across a 240 V, 50 Hz supply.

Sketch the RLC circuit. **(2 marks)**

Calculate:

 - (a) the current in the coil **(4 marks)**
 - (b) the current in the capacitor **(3 marks)**
 - (c) the supply current and its phase angle **(6 marks)**
 - (d) the circuit impedance **(2 marks)**
 - (e) the power consumed. **(3 marks)**