FACULTY OF SCIENCE & TECHNOLOGY

#### MIDLANDS STATE UNIVERSITY



**Mining and Mineral Processing Engineering Department**

**PRINCIPLES OF ELECTRICAL ENGINEERING**

**CODE: HMIE 221**

### SESSIONAL EXAMINATIONS

**DECEMBER 2016**

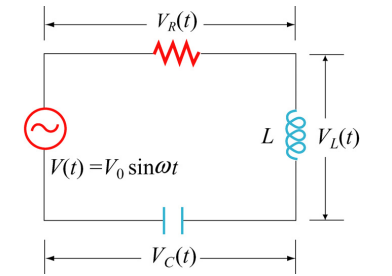
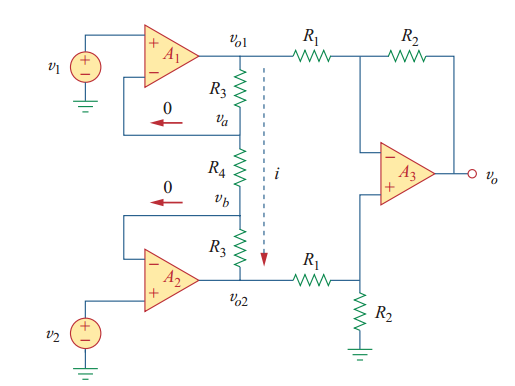
**DURATION: 3 HOURS**

**EXAMINER: MR E CHIPFUPI**

## INSTRUCTIONS

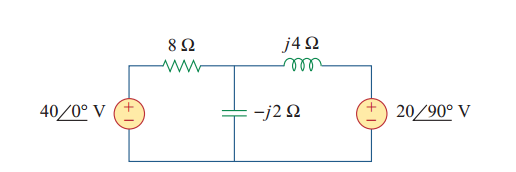
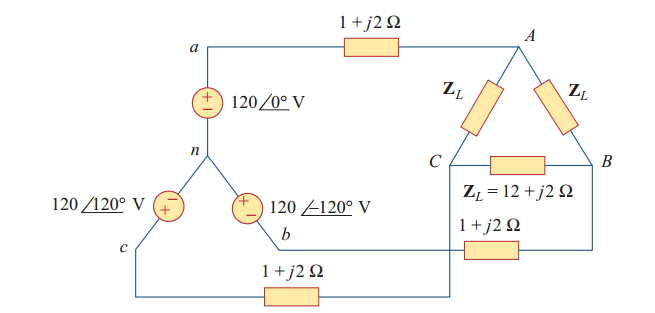
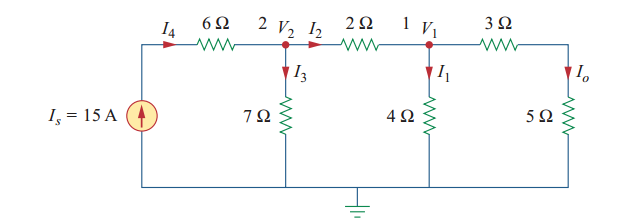
1. *Answer* ***All*** *Questions*
2. *All questions carry equal marks*
3. *Total marks:100*

**QUESTION 1**

1. Define the following terms
2. Root mean square current
3. Root mean square voltage
4. Impedance
5. Reactance
6. Resonant frequency **[5]**
7. For the RLC circuit shown in Figure 1, show that  
    **[10]** **Figure 1**
   * + 1. An *instrumentation amplifier* shown in Figure 2 is an amplifier of low-   
          level signals used in process control or measurement applications and  
          commercially available in single-package units. Show that  
           **[10]**  
          

**Figure 2**

**QUESTION 2**

1. Calculate the average power absorbed by each of the five elements in the circuit of Figure 3. **[10]**   
    **Figure 3**
2. Obtain the line currents in the three-phase circuit of the circuit shown in Figure 4. **[10]**  
   **Figure 4**
3. Assume and use linearity to find the actual value of in the  
   circuit of Figure 5. **[5]**  
     
   **Figure 5**

**QUESTION 3**

1. A 50 hp, 250 V, 1200 rpm DC shunt motor with compensating windings has  
   an armature resistance (including the brushes, compensating windings, and  
   interpoles) of 0.06 Ω. Its field circuit has a total resistance Radj + RF of 50 Ω, which produces a no-load speed of 1200 rpm. The shunt field winding has 1200 turns per pole.  
     
   (i) Find the motor speed when its input current is 100 A. **[5]**  
   (ii) Find the motor speed when its input current is 200 A. **[5]**  
   (iii) Find the motor speed when its input current is 300 A. **[5]**  
   (iv) Plot the motor torque-speed characteristic. **[5]**
2. What are the Advantages of three-phase systems over single-phase supplies?

**[5]**

**QUESTION 4**

1. A 5 kVA single-phase transformer has a turns ratio of 10:1 and is fed from a 2.5 kV supply. Neglecting losses, determine
2. the full-load secondary current,
3. the minimum load resistance which can be connected across the secondary winding to give full load kVA,
4. the primary current at full load kVA.

**[10]**

1. A 50-kVA 13800/208V **∆-Y** distribution transformer has a resistance of 1% and a reactance of 7% per unit.
   1. What is the transformer’s phase impedance referred to the high voltage side? **[4]**  
      ii. Calculate this transformer’s voltage regulation at full load and 0.8pf lagging, using the calculated high side impedance. **[5]**  
      iii. Calculate this transformer’s voltage regulation under the same conditions, using the per-unit system **[6]**

**END OF PAPER**