EAST AFRICAN SCHOOL OF AVIATION EXAMINATION

DIPLOMA IN AERONAUTICAL ENGINEERING AVIONICS

SUBJECT: ELECTRICAL CIRCUIT ANALYSIS

STREAM: Y2 Avionics **Duration:3.00 HRS**

DAY/DATE: WEDNESDAY:05/04/1017 **TIME: 2:00—5:00PM**

INSTRUCTION TO CANDIDATES

1. *This paper consists of **FOUR (4)** pages*
2. *You should have the following for this examination:*
   Answer booklet;
   Mathematical tables/ Electronic calculator.
3. *Answer FIVE questions*

1. (a) Describe how phase voltage and line voltage are measured in a star connected 3-phase system. **(4 marks**

(b) Calculate the line voltage of a 3 phase star connected system whose phase voltage is 240 volts. **(4 marks)**

(c) Explain how the magnitude of the line current is achieved in a delta connected system. (**6 marks)**

(d) Write down the formula of calculating the line voltage of a star connected 3 phase system and state how line voltage, phase, voltage, line current and phase current are related in a balanced delta connected system. **(6 marks)**

2 (a) State the laws of Kirchhoff's and calculate the current to a point(node) in an electrical circuit having three branches of +20 amperes,+2 amperes and -18 amperes. **(6 marks)**

(b) Define the meaning of the following in electrical circuits:

(i) Passive network
(ii) Bilateral circuit
(iii) Electric network
(iv) Non linear circuit **(8 marks)**

(c) Calculate the impedance of a series circuit consisting of a capacitor with a reactance of 7 ohms, an inductor with a reactance of 10 ohms and a resistor with a resistance of 4 ohms. **(6 marks)**

3 Calculate the impedance, the current flow and the voltage drop in a series circuit with a capacitor of 200µf which is connected in series with a lamp of 10 ohms and a power supply of 110V AC 60cycles.Take π as 3.14 **(20 marks)**

4 (a) Explain how low pass filters are operating with well labeled diagrams of inverted L,T and π type. (**9 marks)**

(b) Describe how the output taken across the Capacitor will be if the inductive reactance (X_l) is small and the capacitive reactance (X_c) is large. (**2 marks**

(c) State the purpose of High Pass filter and support the answer with three different types of inverted L,T and π diagrams. (**9 marks)**

5 (a) Name four types of LC Filters and explain what a filter is. (**5 marks)**

(b) Explain the reason why the filter networks are reactive. (**3 marks)**

(c) Define the meaning of the word "cut-off frequency(f_c)" (**2 marks)**

(d) With well labeled graphs of ideal characteristics of low pass filter and high pass filter show attenuation, frequency , frequency cut off, pass band and stop band. (**10 marks)**

6 (a) Describe how the lines and phases of delta and star are connected, and show the formulae of calculating the voltages, and currents in the circuits. (**6 marks)**

(b) State the difference between a three phase star three wire connected system and a three phase star four wire connected system . (**4 marks)**

(c) Calculate the value of the impedance and total current flow in a circuit connected to a generator of 110V AC 60cycles and a load of 2µf capacitance and a 10,000 ohms resistance in parallel. Take π as 3.14. (**10 marks)**

7. (a) State the function of each of the following parts of a DC machine

(i) Field system

(ii) Armature winding

(iii) Commutator **(6 marks)**

(b) Describe armature reaction and with a well labeled diagram, show how interpoles are used to correct the reaction. (**14 marks)**

8 (a) Explain why transformers are rated in Volt-Amperes (VA) instead of watts(W) (**3 marks)**

(b) Draw a circuit of a delta –star connection of three phase transformer and explain two advantages of this transformer connection. (**9 marks)**

(c) The iron loss and full load copper loss in a 50 KVA transformer is 500 W and 800W respectively. If the power factor is 0.8 lagging, determine the efficiency at;

(i) half load

(ii) full load (**8 marks)**

(b) (i) Explain two (2) groups of capacitors and from each group write two kinds of capacitors. (**6 marks)**

(ii) Clearly write down the formulae used for capacitors in series and parallel and calculate the total capacitance of three capacitors of values of 10µf,5µf and 8µf which are connected in series. (**6 marks)**

9. A lamp of 6 ohms and an inductor of 0.021henrys are connected in series to a power supply of 110V AC 60cycles. Calculate:

(a) The current flow (**8 marks)**

(b) The voltage drop across the resistance and across the inductance. (**4 marks)**

(c) Prove that the voltage drops is equal to the power supply. (**8 marks)**

10 (a) Describe True Power and Apparent Power and calculate the apparent power and the power factor where a 220 VAC motor takes 50 Amperes from the line ,but the wattmeter in the line shows that only 9350 watts are taken by the motor. (**14 marks**

(b) With a well labeled diagram, show the power relations in AC circuits. (**6 marks)**

11. (a) (i) Define armature reaction and explain how this reaction can be counteracted. (**4 marks)**

(ii) Name two types of armatures which are currently inexistence. **(2 marks)**

(ii) Explain how generators are rated and state where this information of generator rating can be found on a generator. **(2 marks)**

(b) Show the generator characteristics of series connection, shunt connection, differential compounding and cumulative compounding in a well labeled diagram taking X axis from o-100% current output and Y axis from 0-100% voltage output. **(12 marks)**

12 (a)(i) Explain the principle of operation of an AC single phase motor when used as a capacitor start and state why the centrifugal switch is connected in series with the capacitor in the starting winding. (**6 marks)**

(ii) Describe how motor speeds are controlled. (**4 marks)**

(b) In a well labeled diagram of a load characteristic of a DC motor show series connection, cumulative compounding, shunt connection and differential compounding taking X axis output power or load from o-100% and Y axis as speed of rotation from 0 -100%. (**10 marks)**

13. (a) Explain the four(4) major parts of a DC machine. (**6 marks)**

(b) State where split phase and capacitor start motors can be used. (**4 marks)**

(c) Describe the purpose of an equipment rating or face plate. (**2 marks**

(d) Explain how DC machines are classified. (**8 marks**

14. (a) Calculate the line voltage of a 3 phase star connection system which has a phase voltage of 240v and explain how phase voltage and line voltage are measured. (**10 marks)**

(b) Describe which line is always used as the return in a Delta connection 3 phase distributor and explain how line voltage and phase voltage are the same and line current is 3 times the phase current. (**10 marks)**

15. (a) (i) Name and describe three major parts of a transformer.

(ii) Explain how power is coupled to secondary winding from primary winding. (**2marks)**

(iii) In transformer, explain turns ratio. (**2 marks)**

(b) (i) Define transformer efficiency and give its units. (**3 marks)**

(ii) Name all the losses of transformer and explain how they can be reduced **(4 marks)**

(iii) Explain how transformers are rated. (**3 marks)**