Document No : UniKL MFI_SD_AC41
Revision No: 02
Effective Date: 01 December 2008

CONFIDENTIAL

SET A

UNIVERSITI KUALA LUMPUR
Malaysia France Institute

FINAL EXAMINATION

JANUARY 2014 SESSION

SUBJECT CODE	:	**FED 20203**
SUBJECT TITLE	:	**INDUSTRIAL MOTOR CONTROL**
LEVEL	:	**DIPLOMA**
TIME / DURATION	:	**2.5 HOURS**
DATE	:	

INSTRUCTIONS TO CANDIDATES

1. **Please read the instructions given in the question paper CAREFULLY.**
2. **This question paper is printed on both sides of the paper.**
3. **Please write your answers on the answer booklet provided.**
4. **Answer should be written in blue or black ink except for sketching, graphic and illustration.**
5. **This question paper consists of TWO (2) sections. Section A and B. Answer all questions in Section A. For Section B, answer three (3) question only.**
6. **Answer all questions in English.**
7. **Do not open the question paper until instructed to do so.**

THERE ARE 11 PAGES OF QUESTIONS, EXCLUDING THIS PAGE AND APPENDIX.

SECTION A (Total: 25 marks)

INSTRUCTION: Answer ALL questions.
Please use the answer booklet provided.

Remarks : For all the following questions, the candidate is requested to tick the correct answer in the box provided.

1. When supplying a motor , a contactor should never be cut off

   True ☐ False ☐

2. An ' ON DELAY' contact is a N/O contact which is delayed to the opening

   True ☐ False ☐

3. The overload relay is used to protect the motor against

   Short circuit problems ☐
   Overcurrent due to high frequency ☐
   High current due to heavy mechanical loads ☐
   Overvoltage due to overloads ☐

4. A fuse shold not be installed in the neutral wire

   True ☐ False ☐

5. The Earth Leakage Circuit Breaker is to protect the motor against

   Short circuit problems ☐
   Overcurrent due to high frequency ☐
   High current due to heavy mechanical loads ☐
   Earth leakage to the body of the motor ☐

6. In an automatic installation:

The control circuit executes the order given by the operator ☐
The power circuit performs the order given by the control circuit ☐
The control circuit performs the order given by the power circuit ☐
The control circuit and the power circuit are independent ☐

7. Because of its advantages, the following motor is the most commonly used in the industry

Direct Current Motor ☐
Squirrel Cage Induction Motor ☐
Slip Ring Induction Motor ☐
Stepper Motor ☐

8. When the mechanical load on the shaft of an asynchronous motor increases, the slip will:

Increase ☐
Decrease ☐
Remain constant ☐
Affect the current ☐

9. The mechanical power available on the shaft of an asynchronous motor depends on:

The mechanical torque and the speed ☐
The voltage ☐
The current ☐
The frequency ☐

10. The stator windings of a slip ring motor and a squirrel cage motor are identical

True ☐ False ☐

11.The main parameter used to control the speed of an asynchronous motor is :

- The slip ☐
- The frequency of the supply voltage ☐
- The rotor resistances ☐
- The mechanical load on the motor ☐

12.The Direct On Line starting is used to :

- Control the speed of a motor ☐
- Start up small horse power motors ☐
- Reduce the starting current ☐
- Reduce the starting torque ☐

13.The star-delta starting is used to reduce the starting current

True ☐ False ☐

14.The principle operation of a Dahlander motor is based on :

- The variation of the frequency ☐
- The changing of the number of poles ☐
- The replacement of a winding by another ☐
- The RMS voltage of the supply ☐

15.To reverse the direction of rotation of a Dahlander motor, we should reverse any two (2) phases of the supply :

True ☐ False ☐

16.The pole changing motor is operating, in all cases, at constant torque and a variable power :

True ☐ False ☐

17.The ALTISTART is used to :

Control the speed of an induction motor ☐
Obtain a smooth starting of a motor ☐
Achieve a soft starting and a soft stopping of an induction motor ☐
Obtain a reduced torque during starting ☐

18.The 'BOOST' function in an ALTISTART is used in case of heavy mechanical loads :

True ☐ False ☐

19. If, during starting, the speed of the motor is linear, the acceleration is considered as constant :

True ☐ False ☐

20. The microprocessor used in the ALTISTART permits, particularly to calculate the necessary firing angle for best stopping :

True ☐ False ☐

21.The ALTIVAR is mainly used to :

Control the speed of an induction motor ☐
Control the frequency in the rotor ☐
Maintain the firing angle constant ☐
Maintain V/F constant ☐

22.The PWM (Pulse With Modulation) technique is employed in order to :

Maintain V/F constant ☐
Reduce the starting current ☐
Increse the efficiency of the motor ☐
Reduce the harmonics ☐

23.The rectifier employed in the ALTIVAR is used to convert Direct Current to Alternating Current :

True ☐ False ☐

24. In an ALTIVAR, the ratio V/F is maintained constant to have :

A constant voltage ☐
A constant current ☐
A constant torque ☐
A constant speed ☐

25. In the ALTIVAR, the fast braking is achieved by :

Injection of a DC current to the stator ☐
Cutting off the supply from the stator ☐
Reversing two phases of the stator supply ☐
Sending back the energy to the power supply ☐

SECTION B (Total: 75 marks)

INSTRUCTION: Answer only THREE (3) questions.
Please use the answer booklet provided.

Question 1

Figure 1 and **Figure 2** shows two types of 240V/415V induction motor connection

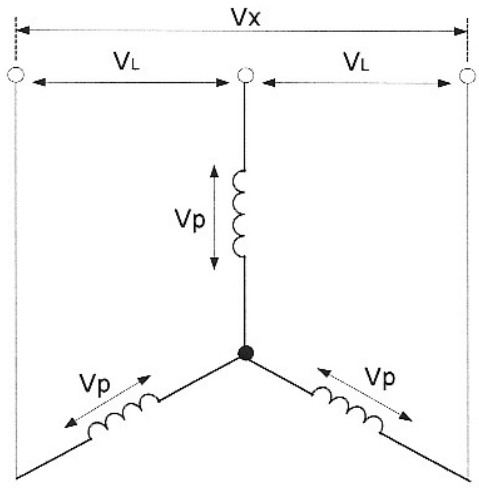

Figure 1

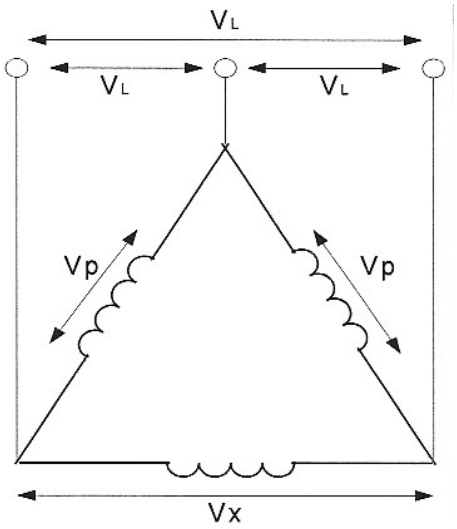

Figure 2

(a) Answer the following questions

i. What type of connection shown in **figure 1** ?

ii. Determine VL, VP and VX for **figure 1.**

iii. What type of connection shown in **figure 2** ?

iv. Determine VL, VP and VX for **figure 2.**

(10 marks)

(b) A 3-phase 240 / 415 V motor is connected in STAR. **Figure 3** shows name plate of that motor. The power supply available is 3-phase 240 V and 3-phase 415 V.

Determine;

i. The suitable power supply, V_S; Line voltage, V_L and phase voltage, V_P.

ii. The input power drawn from the supply.

iii. The efficiency of the motor.

iv. The torque produced by the motor.

(15 marks)

3-phase Induction Motor Name Plate					
V	Hz	min^{-1}	kW	cos φ	A
Δ 220/230	**50**	**2770**	**0.12**	**0.7**	**0.75**
Δ 240	**50**	**2810**	**0.12**	**0.65**	**0.75**
Y 380/400	**50**	**2770**	**0.12**	**0.7**	**0.45**
Y 415	**50**	**2810**	**0.12**	**0.65**	**0.45**

Figure 3

Question 2

Figure 4 shows a Power circuit to control a Dahlander Motor. The motor had a single winding which can be devided into two parts to give a two to one pole-pair ratio depending on their connection.

i. what is the name of the connection ?

ii. What is the speed ratio of the motor ?

iii. How to connect the motor in low speed ?

iv. How to connect the motor in high speed ?

v. How to Inverse the rotation of the motor ?

vi. Explain the operation of the power circuit

vii. Design a control circuit that would match the power circuit in part (vi).

(25 marks)

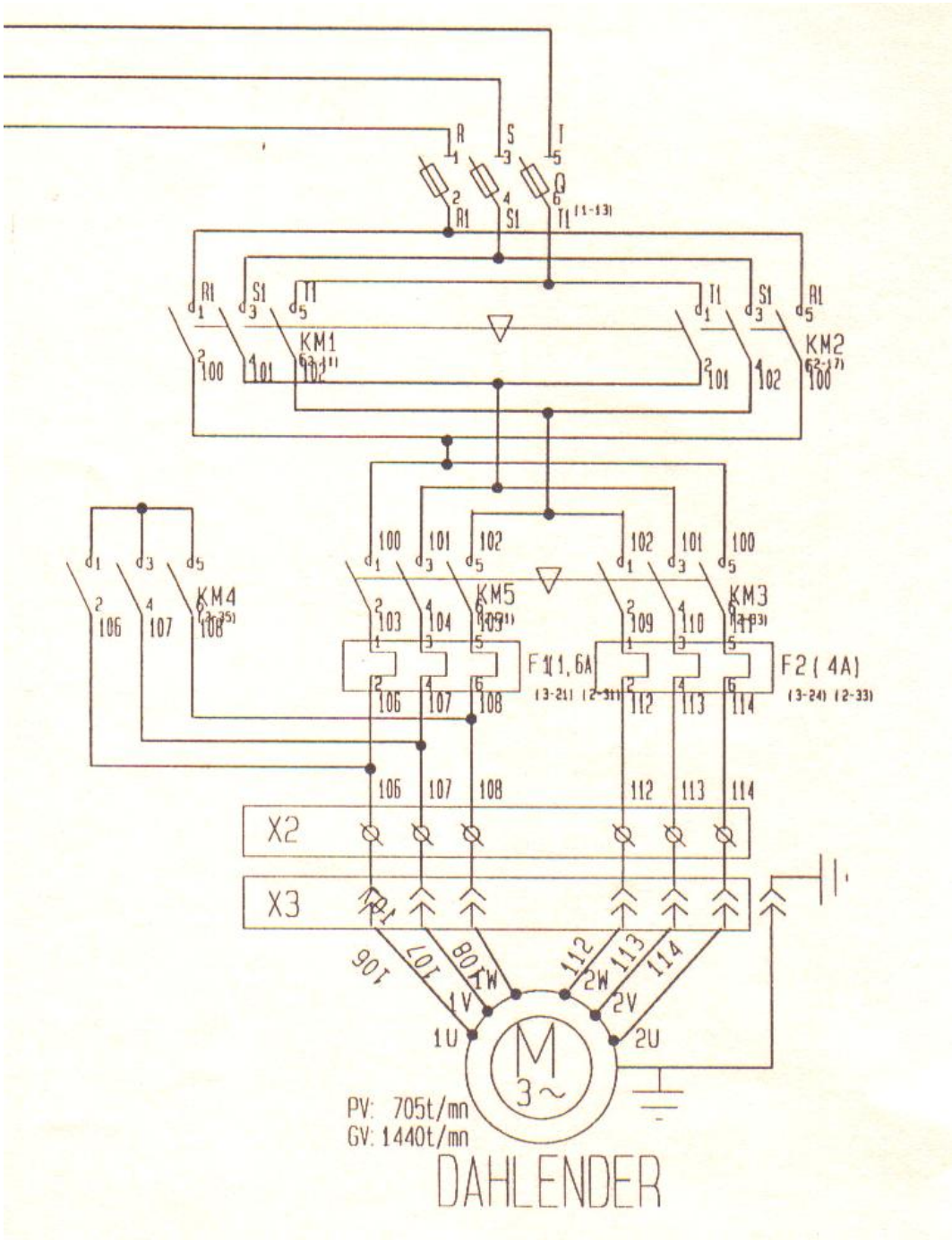
R
S
T
KM1
KM2
KM4
KM5
KM3
F1(1,6A)
F2(4A)
X2
X3
1U
1V
1W
2U
2V
2W
M
3~
PV: 705t/mn
GV: 1440t/mn
DAHLENDER

Figure 4

Question 3

In one application, a 3-phase induction motor is used with Rotor Resistance Starter. The power circuit of this system is shown in **Figure 5**

i. Name the type of induction motor and give the power rating (output power) that normally used with Stator Resistance starter.

ii. Explain the principle operation of Stator Resistance Starter.

iii. Draw the control circuit.

iv. Plot the graph: Starting current/speed characteristic for Stator Resistance starter.

(25 marks)

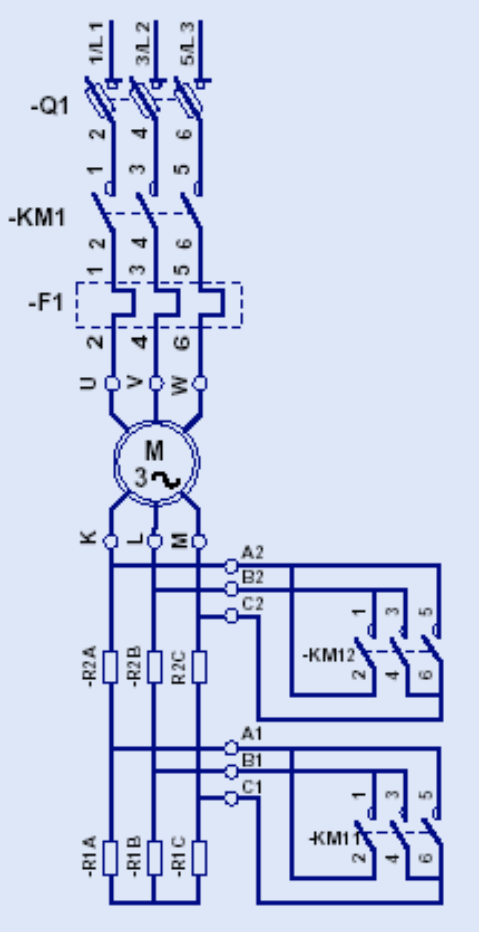

Figure 5: Power Diagram of Rotor Resistance Starter

Question 4

(a) Design a control circuit of a Forward –Reverse Star-Delta Starter that will operate as follows:-

i. Actuate pushbutton S 1 , the control circuit will receive supply of 48VAC. Indicator light H1 will lights on.

ii. Actuate pushbutton S 2, the motor will rotate in forward direction.

iii. Actuate pushbutton S 3, the motor will rotate in reverse direction.

iv. Actuate Pushbutton S4, the motor will stop.

v. Incase of emergency, there should have two emergency stop pushbuttons in the circuit.

vi. Incase of motor over loaded, the TOR will trip and indicator light H2 will lights on.

(15 marks)

(b) Draw a power circuit of a Forward –Reverse Star-Delta Starter for the motor.

(10 marks)

END OF QUESTION PAPER

APPENDIX

Useful formula:

1. Electrical Power:
   $P_e = V_L I_L \sqrt{3} \cos \varphi$

2. Mechanical Power:
   $P_m = T\Omega$

3. Rotor Speed (Motor Speed)
$$N_r = \frac{120(1-s)f}{p}$$

4. Direct On Line Starting Method:
$$\frac{T_{st}}{T_f} = \left(\frac{I_{sc}}{I_f}\right)^2 .s_f$$

5. Star-Delta Starting Method
$$\frac{T_{st}}{T_f} = \frac{1}{3}\left(\frac{I_{sc}}{I_f}\right)^2 .s_f$$

6. Auto-Transformer Starting Method
$$\frac{T_{st}}{T_f} = K^2\left(\frac{I_{sc}}{I_f}\right)^2 .s_f$$