INTERNATIONAL UNIVERSITY OF EAST AFRICA

'Learning to Succeed'

FACULTY OF ENGINEERING

END OF SEMESTER EXAMINATIONS - APRIL 2025

PROGRAMME: BACHELOR OF ELECTRICAL AND CONTROL ENGINEERING

YEAR/SEM: YEAR 3/SEMESTER 2

COURSE CODE: ELE3224

NAME: ELECTRICAL DRIVES I

DATE: 2025-04-15

TIME: 2:00-5:00PM

INSTRUCTIONS TO CANDIDATES:

1. Read the instructions very carefully
2. The time allowed for this examination is STRICTLY three hours
3. Read each question carefully before you attempt and allocate your time equally between all the Sections
4. Write clearly and legibly. Illegible handwriting cannot be marked
5. Number the questions you have attempted
6. Use of appropriate workplace examples to illustrate your answers will earn you bonus marks
7. Any examination malpractice detected will lead to automatic disqualification.

DO NOT WRITE ANYTHING ON THE QUESTION PAPER

Section A Choose any two questions from this section. All questions carry equal marks (20MKS)

Question 1:

Choose the correct answer. @2mks
Q1. Which one of the following device is uncontrolled?
A. SCR
B. MOSFET
C. Diode
D. TRIAC

Q2. When armature current becomes discontinuous?
A. Small firing angles
B. Large firing angles
C. Infinite firing angle
D. Does not depend on firing angle
Q3. Closed-loop control of an induction motor is used for:
A. Speed regulation
B. Torque control
C. Reducing energy losses
D. All of the above

Q4. A chopper in a DC motor drive is used for:
A. AC to DC conversion
B. DC to DC conversion
C. DC to AC conversion
D. None of the above
Q5. The main advantage of closed-loop control in DC drives is:
A. Better speed regulation
B. Reduced power consumption
C. Elimination of speed sensors
D. Simplicity of control
Q6. A full-converter DC drive consists of:
A. Four diodes and two thyristors
B. Four thyristors
C. Two diodes and two thyristors
D. Six thyristors
Q7. A self-excited DC motor differs from a separately excited DC motor because:
A. It has no field winding
B. The field winding is connected to the armature supply
C. It has no armature winding
D. It has an external field excitation source
Q8.For the same triggering angle and ratings

A. a semi-converter operates at lower output voltage than a full converter
B. a semi-converter operates at higher output voltage than a full converter
C. a semi-converter has lower values of input p.f as compared to a full converter
D. a semi-converter has more THD as compared to a full converter

Q9. Which of the following ii not a starting method for induction motors

A. Star-delta starter

B. Reactor starter
C. Auto transformer starter.
D. None of the above.

Q10. Which of the following power electronics components is used in the single phase separately excited DC motor drive
A. Triac
B. Thyristor
C. IGBT
D. None of the above.

Question 2:

Choose the correct answer. @ 2mks
Q**1.** The consideration involved in the selection of the type of electric drive for a particular application depends upon
A. Speed control range and its nature
B. Starting Nature
C. Environmental condition
D. All of the above
Q2. Synchronous motors are commonly used in applications requiring:
A. Constant speed operation
B. Variable speed operation
C. High slip
D. Low torque
Q7. Half wave converters are used for controlling DC motor of _
A. Below400W
B. 400Wâ??4000W
C. Morethan4000W
D. Anywhere

Q8. How many thyristors do we need in half wave converter?
A. 1
B. 2
C. 3
D. Many
Q3. Half wave converters are used for controlling DC motor of _
A. Below400W
B. 400Wâ??4000W
C. Morethan4000W
D. Anywhere

Q4. How many thyristors do we need in half wave converter?
A. 1
B. 2
C. 3
D. Many
Q5.In a closed-loop system, the primary feedback signal is:
A. Voltage
B. Current
C. Speed or position
D. Temperature
Q6. The main advantage of a chopper-based DC drive over a phase-controlled rectifier drive is:
A. Lower harmonic distortion

B. Better speed control
C. Higher efficiency
D. All of the above

Q7. Which functional mode of operation of the dual converter will have circulating current betwee n the converter?
A. Non-circulating current mode.
B. Circulating current mode
C. Both A and B
D. None of the above

Q8. A single-phase semi-converter is connected to a 230 V source and is feeding a load R = 10 ohms in series with a large inductance that makes the load current ripple free. Find the average out put current for a firing angle alpha = 45Â°.
A. 14 A
B. 17 A
B. 10 A
D. 0 A

Q9. A single-phase asymmetrical semi-converter employs
A. one SCR and one diode in each leg
B. two SCRs in one leg and two diodes in the other
C. two SCRs in both the legs
D. two diodes in both the legs

Q10. On what factors the speed of dc motor depends?
A. Applied voltage.
B. Field flux.
C. Armature current I_a.
D. All of these.

Question 3:

Choose the correct answer. @ 2mks

Q1. Which of the motor is used to drive the constant speed line shafting, lathes, blowers and fans
A.D.C. shunt motor.
B. D.C. series motor.
C. Cumulative compound motor.
D. None of the above.

Q2. Which type of drive can be used for Hoisting Machinery?
A. AC slip Ring Motor
B. Ward Leonard Method
C. Cumulative Compound Motor
D. All of the above

Q3. In a synchronous motor, the rotor speed is:
A. Always equal to synchronous speed
B. Less than synchronous speed
C. Greater than synchronous speed
D. Variable with load

Q4. The slip of an induction motor is given by:
A. (Ns - N) / Ns
B. (N - Ns) / Ns
C. (Ns + N) / Ns
D. (Ns * N) / Ns

Q5.A dual converter consists of:
A. Two full converters operating in opposite directions
B. Two semi-converters in parallel
C. A single full-wave rectifier
D. One semi-converter and one full converter
Q6. Which type of self-excited DC motor has the highest starting torque?
A. Series motor
B. Shunt motor
C. Cumulative compound motor
D. Differential compound motor
Q7. Which of the following is not a starting method for induction motors
A. Star delta starter
B. Reactor starter
C. Auto transformer starter
D. None of the above.
Q8. A three-phase induction motor is analogous to

A. Generator
B. Rotating transformer
C. Rotating Motor
D. Rotating converter

Q9. Which of the following is an application of a dual converter?
A. Direction and speed control of DC motors.
B. Applicable where reversible DC is required.
C. Industrial variable speed DC drives.
D. All of the above.
Q10. Which converter/s can be used for DC series motor control?
A. Semi-converters
B. Half-wave converter
C. Full-converter
D. Semi converters and full converter

Question 4:

Choose the correct answer. @2mks
Q1. The use of the starter in D.C motors is necessary because
A. They are not self-starting.
B. Initially there is no back e.m.f. and armature current is very high which is to be avoided by usi ng high resistance starter
C. To overcome back e.m.f..
D. None of the above.
Q2. How many thyristors are required for full converter?
A. 1
B. 2
C. 3
D. 4
Q3. The main advantage of a synchronous motor drive over an induction motor drive is:
A. Better efficiency and power factor
B. Lower cost
C. Simpler construction
D. Reduced torque

Q4. A variable frequency drive (VFD) is used to:

A. Change supply frequency to control speed
B. Convert DC to AC
C. Improve power factor
D. Reduce mechanical losses
Q5. The two converters in a dual converter are controlled to operate in:
A. Same quadrant
B. Opposite quadrants
C. Single quadrant
D. No specific quadrant
Q6. The main advantage of a full-converter DC drive over a semi-converter drive is:
A. Higher efficiency
B. Ability to operate in both directions
C. Lower cost
D. Simplicity of design
Q7. A semi-converter DC drive consists of:
A. Only diodes
B. Only thyristors
C. Both diodes and thyristors
D. Only transistors
Q8. In a shunt-wound DC motor, if the field winding resistance increases, the speed will:
A. Increase
B. Decrease
C. Remain constant
D. First decrease, then increase
Q9. A 3-phase delta connected squirrel cage induction motor when started with a DOL starter has a starting torque of 600 NM. Its starting torque when star delta starter is used:

A. 600 NM.
B. 200 NM
C. 300 NM
D. 1200 NM
Q10. Choose which of the following statements is true about the non-circulating current mode of t he dual converters
A. Two converters will be in the ON condition at the same time.
B. One converter will perform at a time.
C. None of the above.
D. All of the above

Section B Choose any three questions from this section. All questions carry equal marks(20MKS) each.

Question 1:

a. With aid of a basic block diagram, define a chopper drive.
b. Discuss **briefly some of the applications of DC chopper drives**
c. What are the **different advantages of** DC chopper control

d. Using circuit diagrams, discuss the different types of DC chopper drives including wave forms and equations where necessary.
e. What are the three types of braking in DC chopper fed drives

Question 2:

a. Define the term **electrical Drives**
b. Identify and explain **the main components** of a modern electric drive system.
c. Discuss at least **three practical applications** of electric drives in different industries.
d. Discuss the different **types of electric motors** presently used for speed control applications:
e. What are different **types of motor loads** applied in electrical drives?

Question 3:

a. a. Briefly **describe the construction** of a three-phase induction motor?
b. b. Explain **the working principle** of an induction motor and differentiate between squirrel cage and wound rotor types.
c. c. Derive the **expression for slip** in an induction motor and discuss its significance in motor performance.
d. d. Describe different **methods of starting** an induction motor. Compare the advantages and disadvantages of at least two methods.

Question 4:

a. Explain :

i. The **theory of operation** of separately excited DC machines and derive expression of induced EMF.

ii. The **construction features** of separately excited DC machines

b. b. With aid of diagrams, briefly discuss the **different types of DC motors**
c.
d. c. State the different **methods of speed control** of the different types of DC motors

e. d. With aid of circuit diagrams, discuss the **different types of single phase** DC motor drives.