



MURANG'A UNIVERSITY OF TECHNOLOGY

SCHOOL OF ENGINEERING TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONICS
ENGINEERING

UNIVERSITY ORDINARY EXAMINATION

2023/2024 ACADEMIC YEAR

..... YEAR **SECOND** SEMESTER EXAMINATION FOR, BACHELOR OF
SCIENCE IN

EET 619 – FACTS AND HVDC TRANSMISSION

DURATION: 2 HOURS

Instructions to candidates:

1. Answer question One and Any Other Two questions.
2. Mobile phones are not allowed in the examination room.
3. You are not allowed to write on this examination question paper.

SECTION A: ANSWER ALL QUESTIONS IN THIS SECTION

QUESTION ONE (30 MARKS)

- a) State the significance for installing the FACTS Devices in AC Transmission networks (3marks)
- b) Present any four advantages and any four disadvantages of FACTS devices (4marks)
- c) With the aid of the basic diagram of the static VAR compensator (SCV), explain its operation and state why SVC is used in HVD transmission system. (6marks)
- d) Sketch a typical arrangement of the main components of HVDC converter station and explain its operation (12marks)

SECTION B – ANSWER ANY TWO QUESTIONS IN THIS SECTION

QUESTION TWO (20 MARKS)

- a) In the context of HVDC transmission, define the term ‘Harmonics’. State and explain any four areas that can be degraded and destroyed by the presence of harmonics in the power system. (6marks)
- b) State and explain the four methods of turning ‘ON’ a thyristor. (6marks)
- c) With the aid of equal area contention, compare the transient stability margin for a simple two machine systems;
 - i) Without compensation
 - ii) With a series compensator
- d) Discuss the GTO Thyristor controlled series capacitor (GCSC) and illustrate your answer with schematic representation

QUESTION THREE (20 MARKS)

- a) State and explain the three kinds of limitation one has to overcome for the best use of the transmission and to improve the leading capability of the HVDC transmission system (12marks)
- b)
 - i. State two considerations that should be made when making choice for DC machines interconnections. (2marks)
 - ii. Having settled in (i) above, there are three possible configurations for interconnections. State them. (3marks)
- c) list and explain the three factors that are used to compare the merits of the two modes of transmission AC and DC (8marks)

QUESTION FOUR (20 MARKS)

- a) Mention the three types of HVDC lines and with the aid of their respective schematic diagrams, explain their operation. (5marks)
- b) For the rectifier shown in fig 4
- Use Fourier series to obtain expressions for output voltage and load current.
 - If $V_M = \dots$ Determine the value of series inductance L to limit ripple current to 5% of I_{de} (10marks)
- c) A three phase full-wave controlled rectifier is operated from a 3-phase Y-connected 220 VL-L 60 H₂ supply and the load is highly inductive with a resistance R = 50 in series with a battery E= 20v and the delay angle -----calculate;
- The average output voltage
 - The average and rms thyristor currents
 - The output power (10marks)

QUESTION FIVE (25MARKS)

- a) The rectifier in Fig 5(a) is operated from 460 V_{L-L}, 50H₂ supply at the secondary side and the load resistance is 200c. Determine
- Efficiency, FF, RF, TUF, PIV of each diode, crest factor of input current (10marks)
 - consider the steady state equivalent circuit of a two terminal DC link and with the aid of the schematic diagrams, deduce the expression for the steady state (10marks)
 - with the reference to Facts, explain what you understand by ' Power flow' considering a simple case of power flow in parallel paths (5marks)