(*University of Choice*)

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

MAIN CAMPUS

UNIVERSITY EXAMINATIONS 2023/2024 ACADEMIC YEAR

SECOND YEAR FIRST SEMESTER EXAMINATIONS

FOR THE DEGREE OF BACHELOR OF SCIENCE IN ELECTRICAL AND COMMUNICATION ENGINEERING

COURSE CODE: ECE 271

COURSE TITLE: FUNDAMENTALS OF POWER SYSTEMS

DATE: THURSDAY 07/12/2023 **TIME:** 12: 00 PM – 2:00 PM

INSTRUCTIONS TO CANDIDATES

ANSWER QUESTION ONE AND ANY OTHER TWO QUESTIONS.
QUESTION ONE CARRIES 30 MARKS AND ALL OTHERS 20 MARKS EACH.

TIME: 2 Hours

MMUST observes ZERO tolerance to examination cheating

QUESTION ONE

a) Highlight any four advantages of electrical energy over other forms of energy. [4 marks]

b) Derive to prove that for a balanced three phase Y-connected system with positive sequence sources, the line voltage is $\sqrt{3}$ times the phase voltage and leads it by 30°. [6 marks]

c) A generating station has a maximum demand of 35 MW and has connected load of 60 MW. The annual generation of units is 24×10^7 kWh. Calculate the load factor and the demand factor. [6 marks]

d) Generation stations (or power stations) can be classified based on several criteria, including the type of fuel used, the size of the station, the type of technology used, and the location of the station. With example from the Kenyan system, briefly explain classification categories for generation stations. [8 Marks]

e) A3-phase Y-Y system shown in Figure Q1(e)) has a generator phase voltage of 230 volts at 50 Hz. The load draws 900 VA with a power factor of 0.85 lagging. Determine the generator phase current. Also determine components to correct the power factor. [6 marks]

QUESTION TWO

a) Define tariff and discuss its objectives. [6 Marks]

b) A customer connected loads are 20 lamps of 60W each and two heaters of 3,000W each. His maximum demand is 2kW. On the average he uses 10 lamps 7 hours a day and each heater for 5 hours a day. Determine his

(i) Average load
(ii) Monthly energy consumption and
(iii) load factor [8 Marks]

c) Define Load curve and Load duration curve. What is its significance? [6 Marks]

QUESTION THREE

a) Explain any two advantages of liquid fuels over solid fuels [4 Marks]

b) Compare hydro and thermal power plants. [4Marks]

b) Enumerate and explain briefly the factors which should be considered while selecting the site for nuclear power plant. [6 Marks]

c) With an aid of sketches, explain the principle of operation of a diesel fired power plant. Cite examples of such power plants in Kenya. [6 Marks]

QUESTION FOUR

a) What is Ferranti effect? Why is reducing Ferranti effect a desirable practice for long distance power transmissions? [4 Marks]

b) Derive the expressions for the ABCD constants for the nominal-π circuit of a medium transmission line. [6 Marks]

c) Determine the voltage, current and power factor at the sending end of a three phase, 50 Hz, overhead transmission line 160 km long delivering a load of 100 MVA at 0.8 pf lagging and 132 kV to a balanced load. Resistance per km is 0.16 Ω, inductance per km is 1.2 mH and capacitance per km per kilometer is 0.0082μF. Use nominal T method in your computation. [10Marks]

QUESTION FIVE

a) Base value is an important parameter in computations in per unit levels, explain the procedure for choice of base values [6 Marks]

b) A 33 MVA, 13.8 KV, 3-phase generator has a sub transient reactance of 0.5%. The generator supplies a motor through a step- up transformer - transmission line – step-down transformer arrangement. The motor has rated input of 25 MVA at 6.6 KV with 25% sub transient reactance. Draw the equivalent per unit impedance diagram by selecting 25 MVA (3φ), 6.6 KV (LL) as base values in the motor circuit, given the transformer and transmission line data as under:

- Step up transformer bank: three single phase units, connected Δ–Y, each rated 10 MVA, 13.2/6.6 KV with 7.7 % leakage reactance and 0.5 % leakage resistance;
- Transmission line: 75 KM long with a positive sequence reactance of 0.8 ohm/ KM and a resistance of 0.2 ohm/ KM; and
- Step down transformer bank: three single phase units, connected Δ–Y, each rated 8.33 MVA, 110/3.98 KV with 8% leakage reactance and 0.8 % leakage resistance. (14 marks)