



70

KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS
2019/2020 ACADEMIC YEAR

SECOND YEAR SECOND SEMESTER
MAIN EXAMINATIONS

FOR THE DEGREE OF BSC RENEWABLE ENERGY AND BIOFUELS

COURSE CODE: REN 223

COURSE TITLE: ELECTRICAL TECHNOLOGY II

DURATION: 2 HOURS

DATE: 3/2/2021

TIME: 8-10am

INSTRUCTIONS TO CANDIDATES

- Answer **QUESTION ONE** (Compulsory) and any other two (2) Questions.
- Indicate **answered questions** on the front cover.
- Start every question on a new page and make sure question's number is written on each page.

This paper consists of 4 printed pages. Please Turn Over



KIBU observes ZERO tolerance to examination cheating

Question One.

- a) Define the following terms as applied in power supply
i) Annual load curves
ii) Load factor
iii) Demand factor (3 marks)
- b) List and briefly explain any **THREE** selection sites of a thermal power plant (3 marks)
- c) Water for a hydro-electric station is obtained from a reservoir with a head of 100 metres. Calculate the electrical energy generated per hour per cubic metre of water if the hydraulic efficiency be 0.86 and electrical efficiency 0.92. (4 marks)
- d) List and explain any **THREE** advantages of solid state relays have over electro-mechanical relays (3 marks)
- e) A series-connected DC motor has an armature resistance of 0.5Ω and field winding resistance of 1.5Ω . In driving a certain load at 1200 rpm, the current drawn by the motor is 20A from a voltage source of 200V. The rotational loss is 150W. Find the output power and efficiency. (4 marks)
- f) A plant having installed capacity of 20MW produces annual output of 7.35×10^6 KWh and remains in operation for 2090 hours in a year. Calculate the plant use factor (4 marks)
- g) A coil has an inductance of 40mH and negligible resistance. Calculate its inductive reactance and the resulting current if connected to 240 V, 50 Hz supply. (3 marks)
- h) With a suitable circuit diagram and phasor waveforms explain the principle of operation of half wave rectifier. (3 marks)
- i) Consider the following set of three unbalanced voltages, all the quantities given in per unit. Determine the positive negative and zero sequence components of the three phases
 $V_a = 1.0 \angle 0^\circ$ $V_b = 1.2 \angle -110^\circ$ $V_c = 0.9 \angle 120^\circ$ (3marks)

Question Two

- a) State any **THREE** advantages of using coal power plant over other plants (3 marks)
- b) Draw the schematic diagram of a thermal plant and explain its major functional components (8 marks)
- c) Describe any **THREE** classifications of hydroelectric power plant (3 marks)
- d) A diesel engine power plant has one 700 kW and two 500 kW generating units. The fuel consumption is 0.28 kg per kWh and the calorific value of fuel oil is 10200 kcal/kg. Estimate
i) the fuel oil required for a month of 30 days
ii) Overall efficiency. Plant capacity factor = 40%. (6 marks)

Question Three.

- a) The faulted segment of an L-L fault is shown in fig 1 below it is assumed the fault has occurred at node k of the network phases *b* and *c* got shorted through impedance Z_f , determine the following parameters
i) Fault current $I_{fa(012)}$
ii) Voltage at fault points
iii) The Thevenin equivalent of an L-L fault (8 marks)

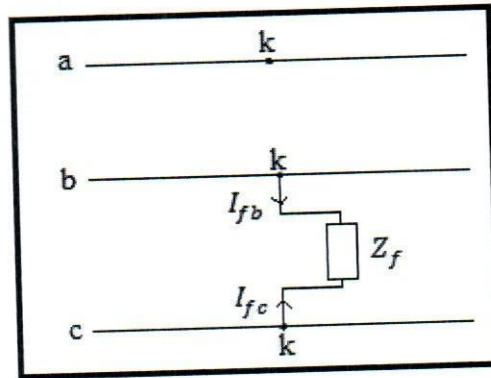


Fig 1

- b) Consider a three phase Y connected generator running unloaded with rated voltage when 1LG fault occurs at its terminals. The generator is rated 20kV, 220MVA with subsynchronous reactance of 0.2 per unit. The subtransient mutual reactance between the windings is 0.025 per unit. The neutral of the generator is grounded through a 0.05 per unit reactance, equivalent circuit is shown in fig 2. Calculate the sequence components V_{a012} and I_{a012} (6 marks)

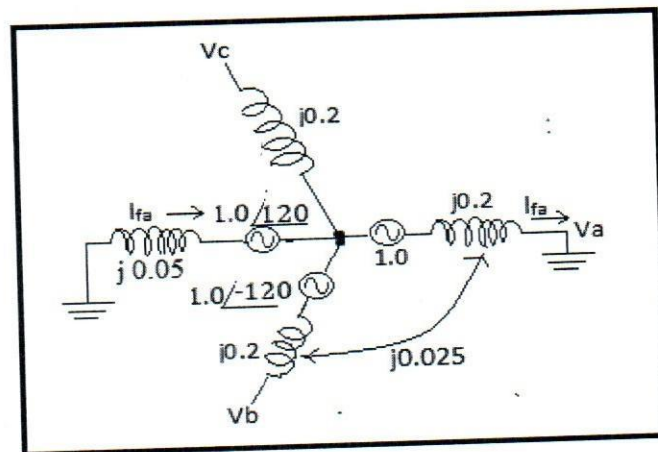


Fig 2

- c) The load duration curve for a typical heavy load being served by a combined hydro-steam system may be approximated by a straight line; maximum and minimum loads being 60,000 kW and 20,000 kW respectively. The hydro power available at the time of minimum regulated flow is just sufficient to take a peak load of 40,000 kWh per day. It is observed that it will be economical to pump water from tail race to the reservoir by utilising the steam power plant during the off-peak periods and thus running the station at 100% load factor. Determine the maximum capacity of each type of plant. Assume the efficiency of steam conversion to be 70%. The maximum demand of a power station is 100MW, if the annual load factor is 50%. Calculate the total energy generated in a year. (6 marks)

Question Four.

- a) Define the following terms as used in AC power circuits
- i) Power regulation
 - ii) Q factor

(2 marks)