JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY

SCHOOL OF ENGINEERING AND TECHNOLOGY

UNIVERSITY EXAMINATIONS FOR THE DEGREE OF SCIENCE IN RENEWABLE ENERGY TECHNOLOGY AND MANAGEMENT

FOURTH YEAR FIRST SEMESTER 2015/2016 ACADEMIC YEAR

CENTRE: MAIN CAMPUS

COURSE CODE: TET 3411

COURSE TITLE: ELECTRIC POWER SYSTEMS

EXAM VENUE: AH2 **STREAM: BSc RE TECH & MGT**

DATE: 12/10/2015 **EXAM SESSION:9.00 – 11.00 AM**

TIME: 2 HOURS

Instructions to candidates

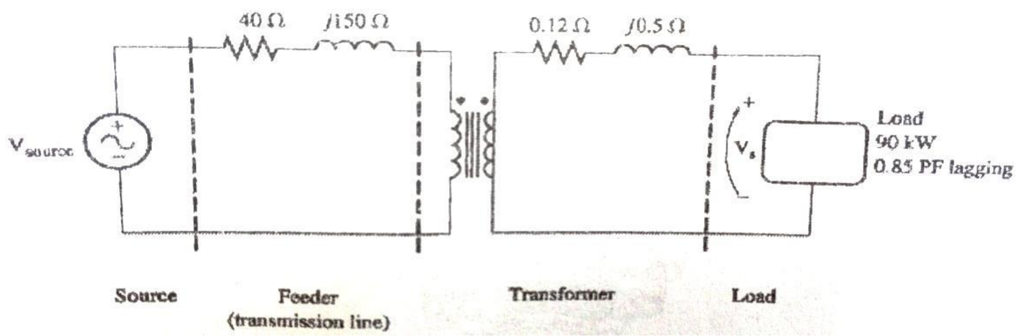
1. **The paper contains FIVE questions.**
2. **Answer question ONE and any other TWO questions**

QUESTION ONE (COMPULSARY)

a) State and briefly explain the various purposes of power system analysis. (10 Marks)

b) Explain the basic structure of a power system. (8 Marks)

c) A single-phase power system is shown in Figure 1. The power source feeds a 100 –kVA 14/2.4 –kV transformer through a feeder impedance of 40.0 + j150Ω. The transformer's equivalent series impedance referred to its low-voltage side is 0.12 + j0.5Ω. The load on the transformer is 90kW at 0.8 power factor lagging and 2300V.



i) Refer the feeder impedance to the low voltage side.

ii) What is the voltage at the power source of the system?

iii) What is the voltage regulation of the transformer?

iv) How efficient is the overall power system? (12 Marks)

QUESTION TWO

a) What is the advantage of using the per unit method in power system analysis? (2 Marks)

b) A transmission system consists of a generator, step up transformer, transmission line, step down transformer and a load all in series. The following parameters apply to each system component:

Generator: 120MVA, 11kV, j0.6pu
Step up transformer: 135MVA, 11/132kV, j0.15pu
132kV transmission line: 4 + j12 Ohms
Step down transformer: 125MVA, 132/11kV, j0.112pu

i) Represent the system in the form of a single line diagram (2 Marks)

ii) If the system is required to deliver 125MW at utility power factor and 11kV at the load, what will be the sending voltage and sending power factor? (13 Marks)

iii) Determine the efficiency of the system. (3 Marks)

Use the per unit system and a base power of 135MVA. Sketch phasor diagram

QUESTION THREE

a) With the aid of a phasor diagram, explain how a synchronous motor may be used to improve the power factor. (6 Marks)

b) A three phase 50Hz overhead transmission line supplies a balanced load of 10000Kw at 110Kv at a lagging power factor of 0.9.The line has a total resistance of 15Ω and a susceptance of $4x10^{-4}$S.Using the nominal T model, determine the:

i) Sending end current

ii) Sending end voltage

iii) Sending end power factor

iv) Transmission efficiency. Sketch the phasor diagram. (14 Marks)

QUESTION FOUR

A three phase load of 175A at 0.8 power factor lagging is supplied at a nominal voltage of 6.6Kv, 50Hz by means of a 33Kv transmission line 20 km long and a 33/6.6KV step down transformer. The resistance per kilometer of each conductor is 0.45Ohms ohms and the reactance per transformer of 0.55.The resistance and reactance of the transformer primary are 7.5ohms and 13.2Ohms respectively while the resistance and reactance of the secondary are 0.35Ohms and 0.65Ohms respectively.

a) Represent the system in the form of series impedances.
b) Find the voltage at the receiving end if the sending voltage is maintained at a line voltage of $35.7<0^0$kV.
c) Determine the sending end power factor, receiving end power, sending end power and the power lost in transmission. Use the Ohmic method. (20 Marks)

QUESTION FIVE

a) What are the advantages of the Gauss Seidel method for solving power flow problems. (4 Marks)
b) The figure below shows the online diagram of a simple three bus system with generation at buses 1 and 2.The generator at bus 2 delivers a reactive power of 315 Mvar which is its upper limit. Using Gauss-Seidel method, start with a flat start keeping $|V_2|$=1.05pu,determine the phasor values of V_2 and V_3.Perform one iteration. Use S_{base}=100MVA. (16 Marks)