FIJI NATIONAL UNIVERSITY

SCHOOL OF ELECTRICAL AND ELECTRONIC ENGINEERING

BACHELOR OF ENGINEERING (ELECTRICAL) – YEAR 4

EEE788 - ELECTRICAL POWER TRANSMISSION & DISTRIBUTION

FINAL EXAMINATION – SEMESTER 1 - 2016 DURATION: 3 HOURS

DAY/DATE: APETT TIME:APETT ROOM:APETT

INSTRUCTIONS TO STUDENTS:

1. You are allowed 10 minutes extra reading time during which you are not allowed to write.
2. Begin each **SECTION** on a fresh page and use both sides of the sheet.
3. Write your candidate number at the top of each answer sheet.
4. Insert all foolscaps, graph paper, drawing paper etc in their correct sequence and secure with string.
5. For all sheets of paper on which rough / draft work has been done, cross it through and you must attach to the answer booklet.
6. Write clearly the number(s) of the question(s) attempted on top of each sheet.
7. ~~AS/NZS 3000:2007 RULE BOOKS ARE ALLOWED~~
8. **ATTEMPT ALL QUESTIONS**

SECTION A (30 MARKS)

1. Analyse at least three different conductor materials used in overhead line work.
   (5 marks)
2. Conductor vibrations cause a lot of havoc on overhead lines. With the aid of diagrams outline any three of these vibrations.
   (4 marks)
3. Due to heavy loads experienced on transmission and distribution of electrical energy, bundle conductors are used. Outline the advantages and disadvantages of using bundle conductors.
   (6 marks)
4. Explain the following types of effects on overhead lines:
   a. Ferranti effect
   b. Corona effect.
   (5 marks)
5. Identify the different types of markings made on transformers and also specify the conditions to be met when three-phase transformers are to be connected in parallel.
   (10 marks)

SECTION B (70 MARKS)

1. Calculate the resistance and inductance per phase of 32.2 km of overhead line having copper conductors of 2.91 cm diameter and:
   (a) Spaced with 1.5 m between adjacent centres in flat regular intervals
   (b) Spaced on corners of triangle having sides of 1.5 m, 1.725 m and 1.93 m.
   (Rho for copper = 1.71 micro ohm cm and conductors are transposed). (10 marks)

2. (a). Identify and analyse any three overhead insulators. (5 marks)

   (b). Outline any three of the standard markings on power transformers.
   (3 marks)
   (c). Draw the HV connection for the Dy11 and Dy1 transformers.
   (2 marks)
3. A string of 5 insulators is used to suspend one conductor of a 33 kV three-phase line. The air capacitance between each cap/pin junction to the tower is 1/5 the capacitance of each unit. Calculate the voltage across each insulator and also the string efficiency.
   (10 marks)

4. A three-phase distribution system has the following:
   (a) Alternator – 7 MVA, Reactance is 2.5 ohm per phase and generating at 11 kV.
   (b) Transformer 1 – 3 MVA, Reactance is 0.08 pu and output voltage of 33 kV.
   (c) The transmission line is 33 kV and has a Reactance of 4 ohms per phase.
   (d) Transformer 2 – 1.5 MVA, Reactance of 0.4 pu and output voltage of 11 kV.
   Calculate the fault current if a three-phase symmetrical fault to earth occurs at the remote feeder.

   (10 marks)

5. A 11 kV, 50Hz 36.5 km single core lead sheath cable has a conductor of radius 2.5 cm and lead sheath radius of 5 cm and $\varepsilon r = 7$. Calculate the following:
   (a) Total resistance of the copper (Rho copper = 1.71μΩ - cm)
   (b) Inductance
   (c) Capacitance
   (d) Insulation Resistance (Rho insulation = 1.3 Exponential 8 MΩ - cm)
   (e) Power loss due to insulation resistance.

   (10 marks)

6 (a) With the aid of diagram explain the operation of a Buchholz relay as used for transformer protection
   (b) Deduce the precaution to be observed with CTs and what are the dangers that can be met when this precaution is not observed.

   (10 marks)

7 (a) Outline the different protections used on feeders to protect the system and with the aid of a diagram discuss how a Time gradient Protection works
   (b) Identify any four (4) circuit breakers used in power systems.

   (10 marks)