



FIJI NATIONAL UNIVERSITY

**COLLEGE OF ENGINEERING, SCIENCE AND
TECHNOLOGY**

**SCHOOL OF ELECTRICAL AND ELECTRONICS
ENGINEERING**

BACHELOR OF ENGINEERING (HONS.) - ELECTRICAL – YEAR 3

EEB713 - ELECTRICAL POWER TRANSMISSION & DISTRIBUTION

FINAL EXAMINATION – SEMESTER 2,2018 - DURATION: 3 HOURS

DAY/DATE: AS PER ETT TIME: AS PER ETT ROOM:ETT

TOTAL MARKS = 100%

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. ATTEMPT ALL QUESTIONS

SECTION A: General – 15 Marks`

- 1.1. Identify any six (6) provisions that make electrical energy a valuable form of energy.
(3 marks)
- 1.2. Identify the four (4) types of design that power lines depend on.
(2 marks)
- 1.3. Analyse at least three (3) different conductor materials used in overhead line work.
(3 marks)
- 1.4. An underground cable essentially consists of one or more conductors covered with suitable insulation and surrounded by a protecting cover. Identify at least three (3) necessary requirements that cables must fulfill.
(3 marks)
- 1.5. Explain what you understand about; (a) Ferranti effect and (b) Corona effect as they affect the overhead transmission lines.
(4 marks)

SECTION B: STRUCTURES, VIBRATIONS & BUNDLE – 25 MARKS

- 2.1. Outline any three (3) aspects upon which power line design depends on.
(3 marks)
- 2.2. With the aid of diagrams outline any three (3) line supports used for overhead lines.
(3 marks)
- 2.3. With the aid of sketches outline any three (3) conductor vibrations that occur on overhead lines.
(6 marks)
- 2.4. With the aid of sketches outline the two (2) methods by which conductor vibrations can be reduced.
(4 marks)
- 2.5. Due to heavy loads experienced on transmission and distribution of electrical energy, bundle conductors are used. Outline with the aid of sketches the advantages and disadvantages of using this phenomenon.
(9 marks)

SECTION C: R, L & C of OVERHEAD LINES – 25 MARKS

- 3.1. Find the diameter of a three – phase, four wire copper conductors of 50km route length and the resistivity of the material is $1.71 \mu\Omega\text{cm}$. The resistance of the conductor is 2.55Ω .
(3 marks)
- 3.2. A single – phase line possesses an inductive reactance of $X = 10$ ohms and is connected to a fixed sending end voltage of 1000 Volts. If it is fully compensated, calculate the following:
(a) The maximum active power that the line can deliver to a sensitive load
(b) Draw the diagram of the compensated line with the capacitive reactance carrying a current I , the phasor diagram that gives us the key to solving the value of X required to be installed on the receiver side, in (a)
(c) The capacitive reactance that must be installed on the receiver side when the active power is 40 kilowatts and the diagram of this compensated line and its phasor diagram.
(15 marks)
- 3.3. Calculate the R, L & C of a single phase lines of 15km using solid conductors of copper, 1.5cm diameter and spaced 70cm between centres. ($\rho = 1.71\mu\Omega\text{-cm}$)
(7 marks)

SECTION D: SHORT, LONG LINES, STEP & TOUCH VOLTAGES – 20 MARKS

- 4.1. A three-phase, 150kVA load at 0.707p.f. lag is supplied by a short wire line at 415V. Calculate the sending end voltage if the impedance is $(0.15 + j0.018) \Omega/\text{phase}$. Assume a balanced star connected load.
(8 marks)
- 4.2. A two-core, single-phase distribution ABC is 640m long. The distance from A to B is 274.3m and from B to C is 365.7m. The impedance of the line is $(0.2 + j 0.075) \Omega/\text{conductor per 3657m length}$. Calculate the voltage at A if at C it is 230V and the loading is as follows:
60A, at 0.8p.f. lag at B
30A at unity p.f. at C
(8 marks)

4.3. If you were driving on the road and on a bend you suddenly saw another car travelling towards you. In trying to avoid collision you swerved, hit a power pole and one of the lines dropped and landed on your car. The other driver saw what happened and stopped some distance away from your car. Explain what you must do to avoid you getting electrocuted and also the other driver who may want to assist you.

(4 marks)

SECTION E: TRANSFORMERS, CTs & PROTECTIONS – 15 MARKS

5.1. Specify the conditions to be met when three – phase transformers are to be connected in parallel.

(1.5 marks)

5.2. Draw the HV connection and phasor diagrams for the Dy1 and Dy11 transformer.

(1.5 marks)

5.3. With the aid of a diagram explain the operation of a Buchholz relay as used for transformer protection.

(5 marks)

5.4. Deduce the precaution to be observed with CTs and identify the dangers that can be met when this precaution is not observed.

(5 marks)

5.5. Identify any four (4) circuit breakers used in power systems.

(2 marks)

THE END