



FIJIANATIONAL UNIVERSITY

COLLEGE: COLLEGE OF ENGINEERING, SCIENCE & TECHNOLOGY (CEST)

SCHOOL: SCHOOL OF ELECTRICAL & ELECTRONICS ENGINEERING

PROGRAMME: TRADE DIPLOMA IN ELECTRICAL ENGINEERING - STAGE 3

UNIT CODE: EEE467

TITLE: ELECTRICAL PRINCIPLES

### FINAL EXAMINATION – TRIMESTER 3, 2016

ROOM: AS PER TIMETABLE TIME: 3 HOURS & 10 MINUTES

#### INSTRUCTIONS TO STUDENTS

1. You are allowed **10 minutes** extra **reading time** during which you are **NOT** 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 attached sheet.
4. Insert all written foolscaps, graph paper, drawing paper, etc. in their correct sequence and secure with a string.
5. For all sheets of paper on which rough/draft work has been done, cross it through and **ATTACH** these to your answer scripts.
6. Write clearly the number(s) of the question(s) attempted on the top of each sheet.
7. Use of programmable calculator(s) is prohibited.
8. **ANSWER ALL QUESTIONS**
9. Show all working where necessary.
10. **ALWAYS CHECK YOUR WORK BEFORE YOU LEAVE THE EXAM ROOM.**

**QUESTION 1****ALTERNATORS AND DC GENERATORS****[20 MARKS]**

- a) The term 'AC generator' commonly refers to alternator. An alternator is an electrical machine which converts mechanical energy into alternating electric energy. They are also known as synchronous generators. Briefly explain the principles of operation of alternators with the construction. (6 marks)
- b) Why are Alternators rated in kVA and not in kW? (2 marks)
- c) Why do cylindrical Alternators operate with steam turbines? (2 marks)
- d) What is the purpose of commutator in d.c generator? (2 marks)
- e) A conductor 0.5m long is rotating on the periphery of an armature at 30m/s. If the flux density is 0.8T, calculate the maximum voltage induced in the conductor when it is cutting the field at an angle of  $90^\circ$ . (2 marks)
- f) Write down the equation for frequency of emf induced in an alternator: (1 mark)
- g) Why is the stator core of Alternator laminated? (2 marks)
- h) List the three factors that affect the load sharing in parallel operating generators? (3 marks)

**QUESTION 2****SINGLE PHASE AC CIRCUITS****[20 MARKS]**

- a) A resistor  $30\Omega$ , inductor  $0.15\text{H}$  and capacitor  $20\mu\text{F}$  are all connected in series across a  $240\text{V}$   $50\text{Hz}$  supply. Find the voltage drop across each component and the total current. (3.5 marks)
- b) If a  $1\text{kW}$  load is connected to a  $250\text{ V a.c.}$  supply, find the current flowing at:
- i) Unity power factor ( $\theta = 0^\circ$ ) (1 mark)
  - ii) Power factor =  $0.8$  ( $\theta = 37^\circ$ ) (0.5 mark)
  - iii) Power factor =  $0.4$  ( $\theta = 66^\circ$ ) (0.5 mark)
  - iv) Draw the phasor diagram (2.5 marks)
- c) State three disadvantages of low power factor? (3 marks)
- d) Briefly explain two ways of improving power factor. (3 marks)
- e) Draw the waveform and the phasor diagram which shows the current leading the voltage by  $30^\circ$ . (3 marks)
- f) What are the effects of resistance, capacitance and inductance in AC circuits? (3 marks)

**QUESTION 3****THREE PHASE SYSTEMS****[20 MARKS]**

- a) For a balanced load, the neutral current is zero, thus the neutral wire is unnecessary and is usually omitted. Where a distribution system is subject to load changes on one phase, so putting the system out of balance, a neutral conductor becomes necessary and must be installed. What are the two requirements for the balanced load. (2 marks)
- b) When connected to a three – phase motor, two wattmeter's gave readings of 5kW and -1kW.  
Find:  
(i) the total power being consumed (2 marks)  
(ii) the power factor of the motor (2 marks)
- c) State two difference between star and delta systems. (2 marks)
- d) Briefly explain two advantages of three phase compared to single phase system: (2 marks)
- e) What is the purpose of using a neutral conductor in an unbalanced system. (2 marks)
- f) A three phase 415V, 50Hz star connected system is connected across three resistors of values 4 $\Omega$ , 8 $\Omega$  and 12 $\Omega$  respectively. Each resistor is connected across each phase.  
Find:  
(i) each of the phase current (4 marks)  
(ii) the total power consumed by the system (4 marks)

**QUESTION 4**

**CAUSES & EFFECTS OF SELF-INDUCTANCE AND MUTUAL  
INDUCTANCE**

**[15 MARKS]**

- a) Two inductors whose self-inductances are given as 75mH and 55mH respectively are positioned next to each other on a common magnetic core so that 75% of the lines of flux from the first coil are cutting the second coil. Calculate the total mutual inductance that exists between the two coils. (2 marks)
- b) When two coils having inductances of 5H and 4H respectively were wound uniformly onto a non-magnetic core, it was found that their mutual inductance was 1.5H. Calculate the coupling coefficient that exists between. (2 marks)
- c) Draw the graph of current vs time which shows the growth of current in circuit containing inductance and resistance. (2 marks)
- d) Differentiate between self-inductance and mutual inductance. (2 marks)
- e) List the three factors on which the value of induced voltage depends on? (3 marks)
- f) State the four important points which should be noted when illustrating the relative directions and values of induced voltage during 'circuit break' and 'circuit make' in self-induced voltage. (4 marks)

**QUESTION 5**

**TRANSFORMERS**

**[25 MARKS]**

- a) Explain the working principle of a transformer? (3 marks)
- b) Mention three factors on which hysteresis loss depends? (3 marks)
- c) How can eddy current loss be minimised? (1 mark)
- d) Based on the core construction, explain the two types of transformer with diagrams. (6 marks)
- e) A delta connected three phase transformer of 415V, 50Hz supply has 100 turns on primary winding and 600 turns on secondary winding. Find the output phase voltage and output phase current if the output is connected to a delta load. (6 marks)
- f) State one application of instrument transformers. (1 mark)
- g) Draw the following connection for three phase transformers:  
(i) Star – delta (2.5 marks)  
(ii) Delta – star (2.5 marks)

\*\*\*\*\*THE END\*\*\*\*\*



EOP RECEIPT CHECKLIST FORM

Particulars	Details/Comments (To be filled by Unit Lecturer)	Tick if present on EQP (To be filled by exams staff)
<b>Cover Page</b>		
Fiji National University with Logo	✓	
College	✓	
School	✓	
Program	✓	
Unit Code	✓	
Unit Name	✓	
Examination Period	✓	
Duration of Examination	✓	
Instructions	✓	
Total Number of Pages	✓	
<b>Other Pages</b>		
Footer		
Page Number	✓	
Unit Code	✓	
Examination Period	✓	
<b>Last Page</b>		
The End	✓	
<b>Overall</b>		
Proper Print	✓	
Examination Requirements (FNU/E-1)	✓	
Moderator's Report (FNU/E-3)	✓	
ERRS (Class List)	✓	
Unit Coordinator/Principal Lecturer's Name	Aman Nath Chandra	

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