



FIJI NATIONAL UNIVERSITY

COLLEGE OF ENGINEERING, SCIENCE & TECHNOLOGY (CEST)

SCHOOL OF ELECTRICAL & ELECTRONICS ENGINEERING

CERTIFICATE IV IN ELECTRONICS ENGINEERING-STAGE 3

EEE411- ELECTRICAL PRINCIPLES 3

FINAL EXAMINATION – PENSTER 4, 2015

TIME ALLOWED = 2 HOURS

INSTRUCTIONS TO STUDENTS

1. *You are allowed 10 minutes Extra reading time during which you are NOT to write.*
2. *Begin each answer 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 string*
5. *For all sheets of paper on which rough/draft work has been done, cross each one 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. **ANSWER ALL QUESTIONS.**
8. *Show all workings where necessary.*
9. *Do not use programmable calculators, especially the ones that does the conversions of number systems.*
10. **ALWAYS CHECK YOUR WORK BEFORE YOU LEAVE THE ROOM!**

Section A**Multiple Choice****[20 marks]**Write the **Alphabet** of the **best choice** in the Answer Sheet.

- 1) A _____ filter rejects all frequencies within a specified band and passes all those outside this band.
 - A) Low-pass
 - B) High-pass
 - C) Band-pass
 - D) Band-stop

- 2) In a series resonance circuit the impedance at resonance is
 - A) Infinite
 - B) Zero
 - C) Minimum
 - D) Maximum

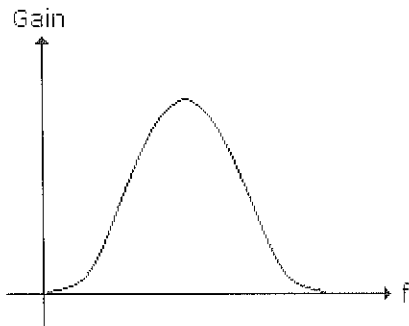
- 3) The brushes in modern motors are mainly made of
 - A) Copper
 - B) Zinc
 - C) Iron
 - D) Carbon

- 4) If the input power to a transformer is 650watts and the output power is 610watts, what is the efficiency?
 - A) 0%
 - B) 50%
 - C) 93.8%
 - D) 100%

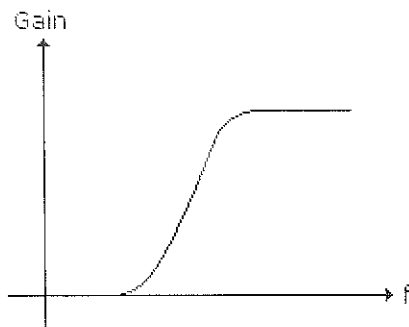
- 5) What is the wavelength of a 150MHz sine wave?
 - A) 0.5m
 - B) 1m
 - C) 1.5m
 - D) 2m

6) Identify the frequency response curve for a band-pass filter.

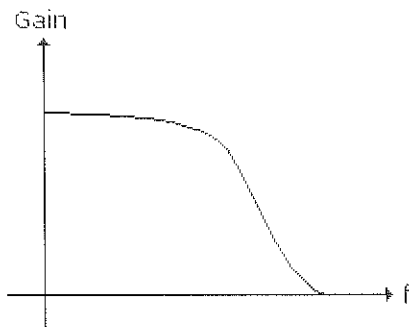
A)



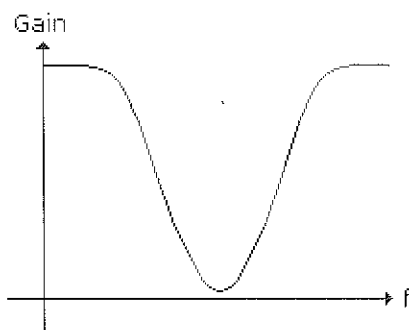
B)



C)



D)



- 7) Which of ^{these} is correct about a step down transformer:
- A) $V_p < V_s$
 - B) $N_p < N_s$
 - C) $I_p < I_s$
 - D) $I_p > I_s$
- 8) Torque in a motor is made from
- A) I_f and Φ
 - B) V_g and I_a
 - C) I_a and Φ
 - D) R_a and Φ
- 9) The unit for flux density, B is
- A) Copper
 - B) Zinc
 - C) Iron
 - D) Carbon
- 10) The total reactance at resonant frequency in a series resonance circuit is:
- A) 0Ω
 - B) X_L
 - C) X_C
 - D) 1Ω
- 11) A device that converts electrical energy into mechanical energy is called:
- A) Regulator
 - B) Motor
 - C) Engine
 - D) Generator
- 12) A filter which allows the higher frequency components of the applied voltage to develop output voltage across the load resistance, while the lower frequency components are attenuated or reduced, in the output.
- A) Low Pass Filter
 - B) High Pass Filter
 - C) Band Pass Filter
 - D) Band Stop Filter

- 13) In a parallel RLC circuit, which value may always be used as a vector reference?
- A) current
 - B) reactance
 - C) resistance
 - D) voltage
- 14) The amount of voltage induced in the transformer secondary depends on:
- A) Self-Inductance
 - B) Length of Core
 - C) Input Voltage
 - D) Mutual Inductance
- 15) What is the mathematical relationship between the power in the primary (P_p) and power in the secondary (P_s) of a transformer?
- A) $P_s = P_p + P_L$
 - B) $P_s = P_p / P_L$
 - C) $P_s = P_p \times P_L$
 - D) $P_s = P_p - P_L$
- 16) The gain in decibel at cutoff frequency is
- A) 0 dB
 - B) 1 dB
 - C) 3 dB
 - D) -3 dB
- 17) The ratio of smallest RMS voltage value to the largest is called the:
- A) VSWR
 - B) ISWR
 - C) Characteristic Impedance
 - D) Reflection Coefficient
- 18) A transformer with a turn's ratio of 1:3 has what current ratio?
- A) 3:1
 - B) 1:1
 - C) 1:3
 - D) $\sqrt{2} = 1$

19) Resonance occurs when

- A) $X_L = R$
- B) $X_L = X_C$
- C) $L = C$
- D) $F_r = f_c$

20) Resonant tuned circuits are used in

- A) Logic circuits
- B) Radio receivers
- C) Power distribution control
- D) Motor speed regulation

SECTION B

QUESTION 1

FREQUENCY RESPONSE

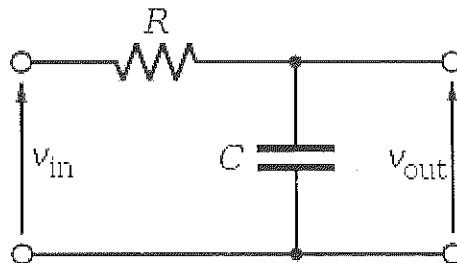
[16 MARKS]

A. Define the following terms:

- i. Low Pass Filter
- ii. Cut – off frequency

(2 marks)

B. An RC circuit is given below:



- i. Derive the expression for
 - a) Cut-off frequency, f_c
 - b) Output voltage, V_{out}
- ii. Construct the complete phasor diagram.
- iii. What is the effect of V_{out} , when the frequency is:
 - a) Increased
 - b) Decreased

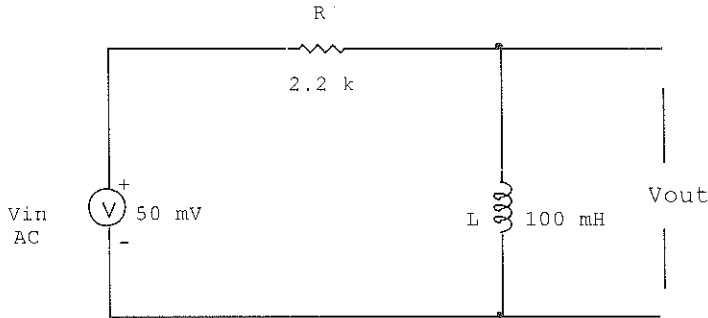
(2 marks)

(2 marks)

(2 marks)

(2 marks)

C. An RL High Pass Filter circuit is shown below:



Calculate the following:

- i. Cut-off frequency, f_c (2 marks)
- ii. V_{out} at cut-off frequency (2 marks)
- iii. Phase angle, Φ at 1KHz (2 marks)

QUESTION 2

RESONANCE

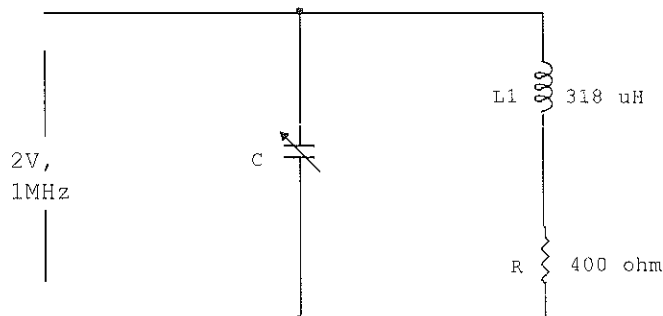
[16 MARKS]

A.

- i. Sketch the frequency of impedance for a series resonant circuit. (1.5 marks)
- ii. A coil of inductance 100mH is connected in series with a 0.2 μ F capacitor. Calculate the frequency at which resonance occurs? (1.5 marks)
- iii. A circuit having a resistance of 10 Ω , an inductance of 0.5H and a variable capacitance in series, is connected across a 100V, 50Hz supply. Calculate:
 - a) The capacitance to give resonance. (2 marks)
 - b) The voltage across the inductance and capacitance. (3 marks)
 - c) The Q factor of the circuit. (2 marks)

B.

- i. A coil of 400 Ω resistance and 318 μ H inductance in parallel with a variable capacitor across a 2V, 1MHz a.c. supply.



Calculate:

- a) The capacitance when the supply current is a minimum.

$$\text{NOTE: } f_{pr} = \frac{1}{2\pi} \sqrt{\frac{1}{LC} - \frac{R^2}{L^2}}$$

(4 marks)

- b) The effective impedance of the circuit.

(2 marks)

QUESTION 3

TRANSMISSION LINES

[16 MARKS]

A.

- i. Determine the wavelengths for electromagnetic waves in free space with the following frequencies:

- a) 5 kHz
b) 10 kHz

(3 marks)

- ii. State the primary function of transmission line.

(1 mark)

B.

- i. Define the following terms:

- a) Velocity of propagation
b) Characteristic Impedance

(1 mark)

(1 mark)

- ii. The coaxial line is a very popular transmission line.

- a) Sketch the basic construction.
b) Give *one* advantage of it.

(3 marks)

(1 mark)

C.

- i. A transmission line 50km long, gave the following results of impedance measurements at 800Hz:

$$Z_{o/c} = 300 \angle -30^\circ \Omega$$

$$Z_{s/c} = 1540 \angle -10^\circ \Omega$$

Calculate the *characteristic impedance*, Z_0 .

(2 marks)

- ii. A 75Ω transmission line is terminated in a load resistance $Z_L = 150\Omega$.

Determine the following:

- a) *Standing Wave Ratio (SWR)* resulting from this mismatch.

(2 marks)

- b) *Reflection Coefficient*, K_r

(2 marks)

QUESTION 4:

TRANSFORMERS

[16 MARKS]

A.

- i. Define a transformer. (2 mark)
- ii. State the two purposes of the core in the construction of a transformer. (2 marks)
- iii. Use schematic diagrams to illustrate the three core materials used. (3 marks)
- iv. State the formula used in calculating the turns ratio of a matching transformer, knowing input and load impedances. (1 mark)

B.

- i. An ideal step-down transformer has 8000 turns on the primary and 200 turns on the secondary. The cross section of the magnetic core measures 20mm x 20mm. If the voltage V_1 applied to the input is 240V at 50Hz, and an indicator lamp of 20Ω resistance is connected to the output. Calculate the:
 - a) Primary and secondary voltages. (2 marks)
 - b) Primary and secondary currents. (2 marks)
- ii. An ideal transformer is used for matching a source impedance of 150Ω to a load impedance of 600Ω . Calculate the turns ratio. (4 marks)

QUESTION 5

DC MACHINES

[16 MARKS]

A.

- i. Briefly describe the principal of operation of the motor. State any relevant formula or rule used. (4 marks)
- ii. Briefly comment on the four essentials parts of a dc motor. (4 marks)
- iii. List two causes of losses in a motor. (2 marks)

- i. A shunt-connected motor draws 1.5A on a 12V dc supply. If the motor field has a current of 50mA flowing through it and the armature resistance is 0.25Ω , Sketch the circuit and find the value of the back e.m.f. (3 marks)

- ii. The armature of a d.c. machine has a resistance of 0.1Ω and is connected to a 230V supply. Calculate the generated e.m.f. when it is running as a motor taking 60A. (3 marks)

*****THE END*****