KABARAK UNIVERSITY

UNIVERSITY EXAMINATIONS

2008/2009 ACADEMIC YEAR

FOR THE DEGREE OF BACHELOR OF SCIENCE IN TELECOMMUNICATIONS

COURSE CODE: PHYS 126

COURSE TITLE: ELECTRICITY AND ELECTRONIC SYSTEMS

STREAM: Y1S2

DAY: TUESDAY

TIME: 2.00 – 5.00 P.M.

DATE: 10/08/2010

INSTRUCTIONS:

Instructions

- *Answer Question **ONE** and any other **THREE** Questions. Question One carries **20marks** while each of the other Two Questions carry **10marks**.*
- ***The following constants may be useful***
  - Permeability of free space $\mu_0 = 4\pi \times 10^{-7} Wb / A$
  - Permittivity of free space $\varepsilon_0 = 8.85 \times 10^{-12} C^2 / NM^2$
  - Resistivity of Iron $\rho = 9.68 \times 10^{-8} \Omega m$

PLEASE TURN OVER

QUESTION 1 (20 marks)

(a) i) How can a voltage source be created? (1mk)

ii) A charge of 30C is moved when energy of 45J is applied between two points. Find the voltage between the two points. (2mks)

iii) State two properties of voltage and current sources. (2mks)

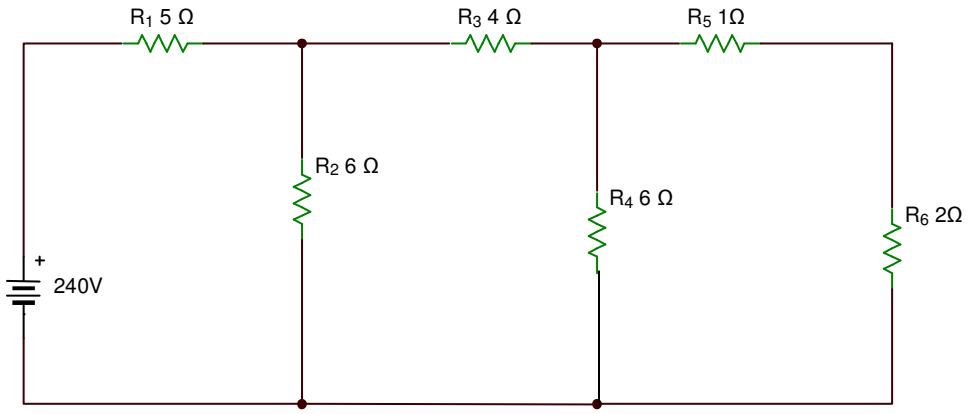
(b) Sketch a circuit diagram showing how a.c. full wave rectification can be achieved using only two diodes. (2mks)

(c) i) A rectangular block of Iron has dimensions 1.2cm by 1.2cm by 15cm. Find the conductance of the block between the two square ends. (2mks)

ii) Explain why for good conductors, increase in temperature leads to decrease in conductivity while for semiconductors, the opposite is true (1mk)

(d) i) State Kirchhoff's current law. (1mk)

ii) Determine the voltage across R_6 in the given circuit (3mks)



(e) Differentiate between extrinsic and intrinsic semiconductors (1mk)

(f) i) Differentiate between poles and zeros (2mks)

ii) A linear system is described by

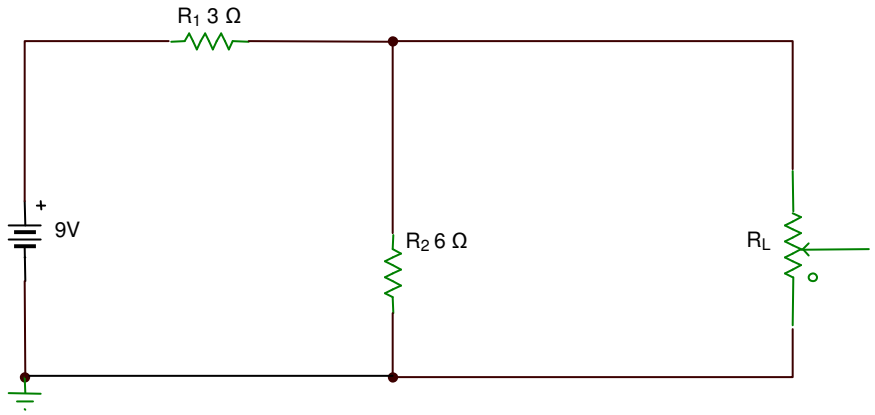
$$\frac{d^2y}{dt^2}+5\frac{dy}{dt}+6y=2\frac{du}{dt}+u$$

Find the system poles and zeros (3mks)

QUESTION 2 (10 marks)

(a) i) State Thevenin's theorem (1mk)

ii) Find the Thevenin equivalent circuit for the given network, hence find the current through R_L for $R_L = 5\Omega$ (4mks)



(b) State maximum power transfer theorem and hence show that $P_{L_{max}} = \frac{E_{Th}^{\ 2}}{4R_{Th}}$ (5mks)

QUESTION 3 (10 marks)

(a) i) What is capacitance? (1mk)

ii) A potential difference of 4KV is applied across the plates of a capacitor of capacitance 25μF. Calculate the charge in the capacitor. (2mks)

(b) i) Define transient period of an RL circuit (1mk)

ii) Derive the expression of finding the current (I) at any time (t) of an inductor during the transient growth, hence show that, time constant (τ) is 63% of maximum value. (6mks)

QUESTION 4 (10 marks)

(a) A series RLC circuit is driven by an a.c of the form $V = V_{max} Sin\varpi t$. Given that R=250Ω, L= 0.6mH, C= 2.5μF, f= 50Hz and V_{max}=240V. Find for this circuit

i). The amplitude current (3mks)

ii). The phase angle (2mks)

(b) Define quality (Q) factor of a series RLC circuit and show that the Q-factor for series RLC circuit is given by

$$Q_s = \frac{1}{R}\sqrt{\frac{L}{C}}$$ (3mks)

(c) Define resonance frequency of a series RLC circuit and show that this frequency is given by

$$f = \frac{1}{2\pi\sqrt{LC}}$$ (2mks)

QUESTION 5 (10 marks)

(a) Sketch a schematic diagram of an inverting operational amplifier and derive its closed-loop gain (A_{vf}). (4mks)

(b) Derive the transfer function of an operational amplifier integrator circuit (4mks)

(c) Calculate the output for a 4 bit R-2R ladder DAC given that the input is 5H (2mks)