UNIVERSITY OF SWAZILAND

SECOND SEMESTER EXAMINATION 2007/2008

FACULTY OF SCIENCE

DEPARTMENT OF ELECTRONIC ENGINEERING

TITLE OF PAPER:	**ANALOG ELECTRONICS IV**
COURSE NUMBER:	**E512**
TIME ALLOWED:	**THREE HOURS**

INSTRUCTIONS:

1. **Answer any FOUR (4) of the following five questions.**
2. **Each question carries 25 marks.**
3. **If you think not enough data has been given in any question you may assume reasonable values.**
4. **Smith Charts are provided.**

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THIS PAPER CONTAINS FOUR (4) PAGES INCLUDING THIS PAGE

QUESTION 1

(a) An rf amplifier is to be designed with f_o = 45 MHz and a 3-dB bandwidth of 6 MHz.

(i) Using two stagger-tuned stages, calculate the centre frequencies and bandwidths: f_{o1}, B_1, f_{o2} and B_2 respectively. [12 marks]

(ii) Using 1 μH inductors, find C and R for each stage. [6 marks]

(b) Qualitatively explain how the cascode circuit achieves wider bandwidth than the common emitter (CE) or common source (CS) transistor amplifier.

[7 marks]

QUESTION 2

An LNA IC has the following S-parameters (magnitude/angle) at 2.3 GHz:

S_{11} = 0.456/135.8°
S_{21} = 3.176/80.4°
S_{12} = 0.11/75.9°
S_{22} = 0.051/-133.9°

The input and output reflection coefficients at 2.3 GHz are calculated to be Γ_s = -0.3813 - j0.3580 and Γ_L = 0.1914 - j0.0421, respectively. By means of Smith chart, determine the values of C1, L1, C2 and L2 that will achieve simultaneous conjugate matching of input and output of the LNA to 50-Ω terminations, as shown in Fig. Q2. Describe whatever you do on the Smith chart.

[25 marks]

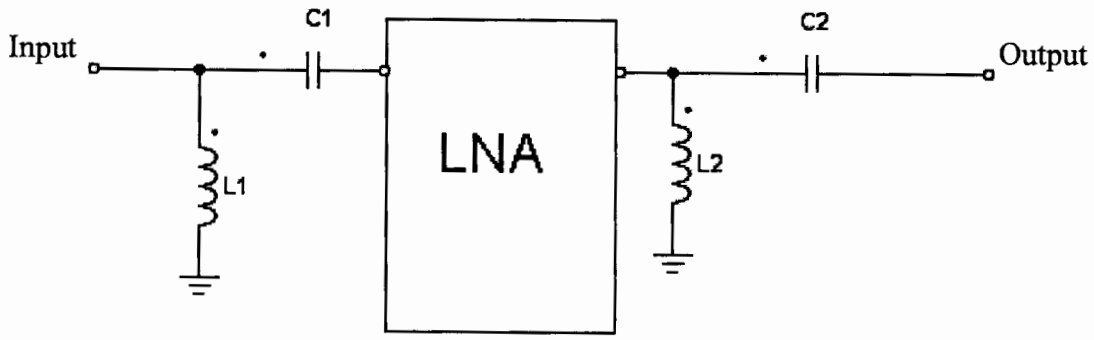

Fig. Q2

QUESTION 3

(a) A class B output stage is required to deliver an average power of 100 W into an 8-Ω load. The power supply should be 4 V greater than the corresponding peak sine-wave output voltage. Determine the power-supply voltage required (to the nearest volt in the appropriate direction), the peak current from each supply, the total supply power, and the power conversion efficiency. Also, determine the maximum possible power dissipation in each transistor for a sine-wave input.

[16 marks]

(b) A V_{BE} multiplier is designed with equal resistances for nominal operation at a terminal current of 2 mA, with half the current flowing in the bias network. If $\beta = 100$ and $V_{BE} = 0.7$ V at $I_C = 1$ mA, find the required resistor values and the voltage across the V_{BE} multiplier.

[9 marks]

QUESTION 4

A power transistor for which $T_{J\max} = 200^{\circ}C$ can dissipate 60 W at a case temperature of 50 °C.

(a) If it is connected to a heat sink using an insulating washer for which the thermal resistance is 0.6 °C/W, what heat-sink temperature is necessary to ensure safe operation at 30 W?

(b) For an ambient temperature of 40 °C, what heat-sink thermal resistance is required?

(c) If, for a particular extruded-aluminum-finned heat sink, the thermal resistance in air is 4.5 °C/W per centimeter of length, how long a heat sink is needed?

[25 marks]

QUESTION 5

(a) Compare the BJT, MOSFET and IGBT in terms of switching speed, on-state losses, need for snubber circuits and reverse blocking voltage rating in power switching applications.

[12 marks]

(b) The full-bridge converter shown in Fig. Q5b is fed with an input voltage of 230 V at 50 Hz. It is required to provide a dc current of 5 A to a coil of inductance 0.5 H and resistance 10 Ω. Find the phase delay angle α.

[13 marks]

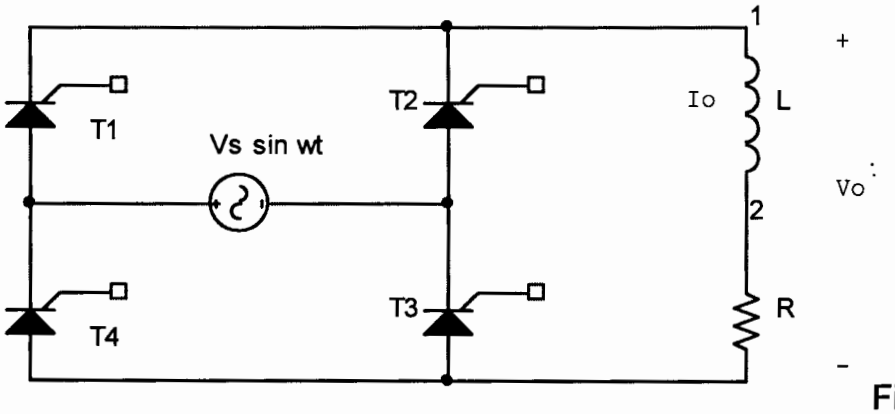

Fig. Q5b

The Smith Chart

Microwaves101.com