NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

APPLIED PHYSICS DEPARTMENT

SPH 1202 – ANALOGUE ELECTRONICS

SUPPLEMENTARY EXAMINATIONS

BSC HONOURS PART II: AUGUST 2004 DURATION: 3 HOURS

ANSWER **ALL** QUESTIONS IN SECTION A AND ANY **THREE** QUESTIONS FROM SECTION B. SECTION A CARRIES 40 MARKS AND SECTION B CARRIES 60 MARKS.

SECTION A

1 (a) Define the following terms
(i) doping in semiconductors,
(ii) p – type semiconductora and
(iii) n – type semiconductor. [6]

(b) Derive an equation for the dc-current of full wave rectification. Give reasons for choosing a centre tape rectifier instead of a full wave bridge rectifier [4]

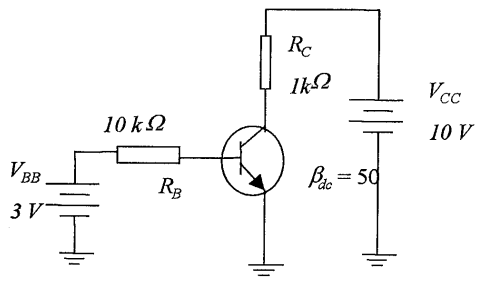
(c) Write down the operative functions of a zener diode and explain these functions graphical. [5]

(d) What is a MOSFET? Write down an expression for drain resistance and show graphically the $I_D - V_{DS}$ circuit characteristics for n – channels in the depletion mode. [5]

(e) What are common-emitter output characteristics for an npn transistor? Illustrate your answer by graphical means. [4]

(f) Determine whether the transistor shown in Figure 1 below is in saturation or not. Assume $V_{CE(sat)}$ is small enough to be neglected. [4]

Figure 1



(g) What is thermal runaway? [4]

(h) The operational amplifier shown in Figure 2 has an open loop gain equal to 25 000 and an open output resistance of 100 Ω. Find
(i) The magnitude of the loop gain
(ii) The closed loop gain
(iii) The input resistance seen by V_{in}
(iv) The closed loop output resistance [8]

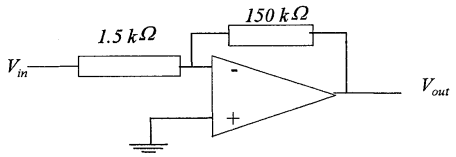


Figure 2

SECTION B

2 (a) What is a filter in rectifiers? Write down the differences between a capacitor filter and an inductor filter [10]

(b) A 120 Hz full wave rectified voltage with a peak value of 162.6 V is applied to the LC filter in Figure 3 below. Determine the filter output in terms of its dc value and the rms ripple voltage. What is the ripple factor? [10]

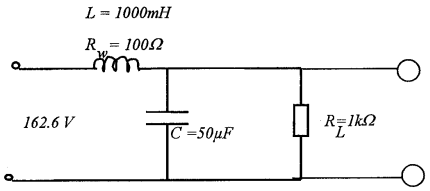


Figure 3

5 (a) Draw a block diagram of an oscillator and state the condition necessary for oscillation to take place. [4]

(b) Draw the circuit diagram of an RC phase shift oscillator and explain its operation. Hence design an RC phase shift oscillator that will oscillate at 100 Hz. [8]

(c) Draw the circuit diagram of a Wein Bridge oscillator and explain its operation. Hence design a Wein Bridge Oscillator that will oscillate at 25 kHz. [8]

6 (a) For a band – pass filter, define

(i) bandwidth

(ii) Q – factor

(iii) Frequency response (sketch) [6]

(b) On the same diagram, show the Chebyshev, Butterworth and Bessel filter responses. [6]

(c) Design a second order, voltage controlled voltage source(VCVS), low pass Butterworth filter with cut off frequency 2.5 kHz, given the gain in the pass band is 2. [8]

Table 1: Second order low pass filter Butterworth filter design

Circuit element values with resistance in kΩ

Gain	1	2
R_1	1.32	1.20
R_2	4.40	2.00
R_3	Open	5.50
R_4	0	5.50
C_1	0.41 C	C

END OF EXAMINATION