

THE UNIVERSITY OF NEW SOUTH WALES

SCHOOL OF PHYSICS

EXAMINATION – JUNE/JULY 2001

PHYS3630 – ELECTRONICS

Time allowed – 2 hours

Total number of questions – 6

Attempt **ALL** questions

The questions are of equal value

This paper may be retained by candidate

Candidates may not bring their own calculators

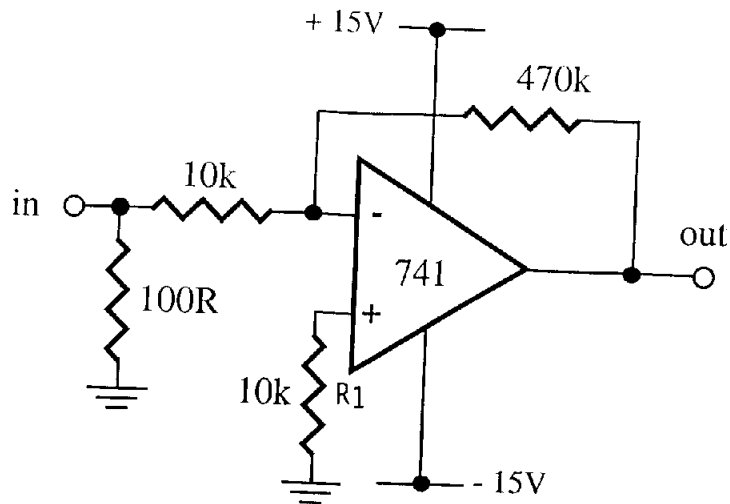
The following materials will be provided by the

Enrolments and Assessment Section: Calculators

Answers must be written in ink. Except where they are expressly required, pencils may only be used for drawing, sketching or graphical work.

### Question 1

Consider the following amplifier circuit:



1. What is the gain of the circuit at 1 kHz?
2. What gain would you expect at 150 kHz?
3. How much could the dc **output** voltage change as a result of a temperature change of 25°C?
4. What is the purpose of R1?
5. What is the quiescent power consumption?
6. What is the input impedance of the circuit?

#### 741 abbreviated data sheet

Input offset voltage 6.0 mV (max)

Input offset voltage drift 15  $\mu$ V/K (typ)

Input bias current 210 nA

Input bias current drift 0.5 nA/K

Open-loop unity gain bandwidth 1.5 MHz

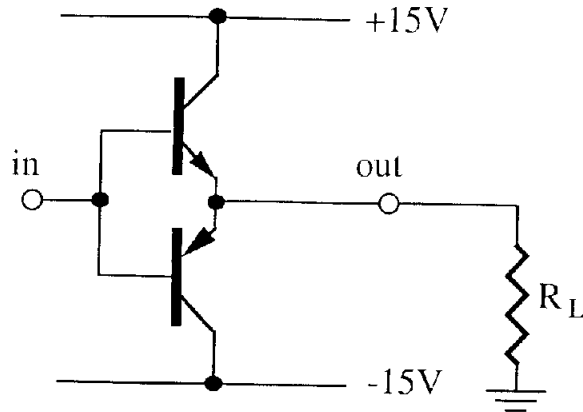
Slope of open-loop gain curve -6 dB/octave

Power supply current 1.7 mA (typ)

### Question 2

(a) Draw the circuit diagram for a 3mA constant-current source which has one end of the load grounded. You may use any design you like. Show all component values.

(b)



- (i) What is meant by the term “crossover distortion”?
- (ii) Show how the above circuit might be modified to minimize crossover distortion, and discuss the function of the additional components.

### Question 3

- (a) Sketch the characteristic output curves for an n-channel JFET – i.e. plot  $I_D$  versus  $V_{DS}$  for various values of the  $V_{GS}$ .
- (b) With reference to these curves, show how a JFET can be used as a voltage-controlled variable resistor.
- (c) Draw a practical circuit diagram for an amplifier whose gain can be varied by application of a dc voltage to a control pin.

### Question 4

- (a) Describe, with the aid of diagrams, what is meant by:
  - (1) amplitude modulation
  - (2) frequency modulation
  - (3) single side-band transmission
- (b) A 1 MHz carrier is modulated with a 500 Hz signal. Draw diagrams showing
  - (1) What you would see on an oscilloscope
  - (2) The resulting spectrum when each of the three techniques described in (a) is employed.

### Question 5

- (a) With the aid of diagrams explain how the following analog/digital converters work
- (1) Flash
  - (2) Successive approximation
  - (3) Dual slope
- (b) What type of A/D converter would you expect to find in
- (1) an ultra high-speed military radar?
  - (2) an inexpensive multimeter

### Question 6

Chose **one** of the following topics and write brief notes on it. Include diagrams and schematics where this is helpful.

- (a) What is a superheterodyne (superhet) receiver and what are its advantages?
- (b) What is spread-spectrum radio communication and why is it used?
- (c) What is a phase-locked loop, and how does it operate?
- (d) What is “lock-in” detection? How does it work, and why is it used?

N.B. Write about only **one** of the above topics.