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University of the Witwatersrand, Johannesburg

Course or topic No(s)	ELEN224
Course or topic name(s) Paper Number & title	Electronics I
Examination/Test* to be held during month(s) of (*delete as applicable)	June 2000
Year of Study (Art & Sciences leave blank)	Second
Degrees/Diplomas for which this course is prescribed (BSc (Eng) should indicate which branch)	B.Sc (Eng) Elec.
Faculty/ies presenting candidates	Engineering & the Built Environment
Internal examiners and telephone number(s)	Prof. A. R. Clark x7223
External examiner(s)	Prof. G. J. Gibbon
Special materials required (graph/music/drawing paper) maps, diagrams, tables, computer cards, etc)	None
Time allowance	Course Nos: ELEN224; Hours: Three
Instructions to candidates (Examiners may wish to use this space to indicate, inter alia, the contribution made by this examination or test towards the year mark, if appropriate)	Answer *ALL* questions. Type '2' Examination.

Internal Examiners or Heads of Department are requested to sign the declaration overleaf

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(1. is applicable to formal examinations as approved by an external examiner, while 2. is applicable to formal tests not requiring approval by an external examiner—Delete whichever is not applicable)

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Note: Show *ALL* workings, complete with the necessary comments!!—regardless of how fast your calculator can print the results in one step. I am not interested in how well you can read your formulae from your formula sheet. I am marking your reasoning, not only the answer!! Marks are awarded for the reasoning as well as the "answer". A correct numerical answer will not necessarily attract any marks!

Question 1

An inverting amplifier with a gain of -100V/V and an input resistance of 100kΩ, uses an op-amp with a 1mV offset voltage, a bias current of 30nA, and an offset bias current of 3nA.

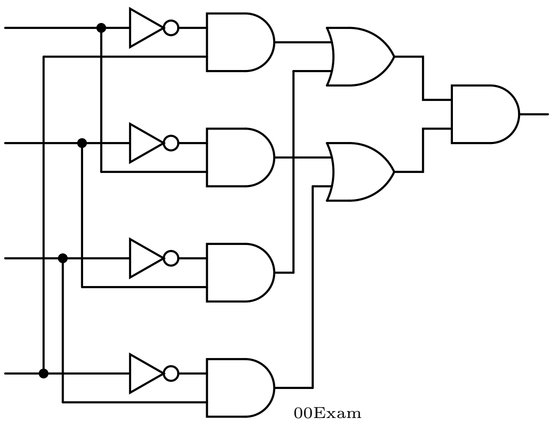
What output voltage offset results with
a) a basic uncompensated design
b) a bias-current compensated design (where a resistor is placed from the non-inverting terminal to ground).

Which offset source dominates in each case?

(20 marks)

Question 2

(a) Simplify the following to a minimum number of gates:



(10 marks)

(b) Design a state-machine which cycles between 5 possible states. (15 marks)

(Total 25 marks)

Question 3

Design a dual-ended power supply for an audio amplifier. It is required that the rails are at ±50V, and that each rail can deliver 4A. Justify all assumptions. *Hint: By "design", I mean specify the characteristics and ratings of all components used.* (20 marks)

Question 4

(a) Fully design and specify a circuit to turn on a security floodlight at night. Amongst other possible components, use an LDR (Light Dependant Resistor) and an NPN Transistor. Make reasonable assumptions about the LDR characteristics.

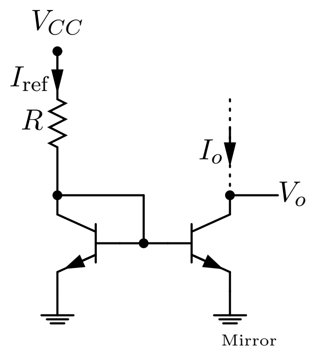
(15 marks)

(b) With the aid of sketches, explain how an N-channel enhancement MOSFET first gains its channel. Further explain what happens when the transistor conducts an appreciable current. (10 marks)

(Total 25 marks)

Question 5

Consider the following circuit:



(a) For the current mirror shown above using two matched-gain transistors, find the value of R that results in $I_o = 1$mA with V_{CC}=5V
i)Assume $\beta = \infty$
ii)Assume $\beta = 100$
iii)For case (ii), for what values of V_o will the current mirror work?

(b) In what application would the above circuit be used?.

(20 marks)

(Total 20 marks)

(Exam Total 110 marks)

(100%=100 marks)