NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY
FACULTY OF INDUSTRIAL TECHNOLOGY
BACHELOR OF ENGINEERING DEGREE
DURATION 3 HOURS – JANUARY 2013
TEE 5111 - ADVANCED INTEGRATED CIRCUITS AND MICROELECTRONICS

INSTRUCTIONS TO CANDIDATES:
1. ANSWER **ALL** QUESTIONS.
2. SHOW YOUR STEPS CLEARLY IN CALCULATIONS
3. START THE ANSWER FOR EACH QUESTION ON A FRESH PAGE

Q.1.

With suitable examples and drawings describe each of the following microelectronics procedures:

a) Diffusion;
b) Ion Implantation;
c) Photolithography;
d) Metalization.

[20 points]

Q.2.

Show the cross-sectional and the top view for:

a) Integrated vertical Bipolar Junction Transistor;
b) Integrated horizontal Bipolar Junction Transistor;

Briefly compare the two devices in terms of their advantages and disadvantages.

[10 points]

Q.3.

Find the ratio between the output and the input current in terms of transistor β for the following circuits:

a) Simple Current Mirror;
b) Wilson Current Source.

Assume that the current sources are built on ideally matched transistors. Compare the performance of the circuits based on the above results.

[15 points]

Q.4.

Give at least three examples for level-shifter circuits. For each circuit derive an expression for the output voltage as a function of the input voltage.

[15 points]

Q.5.

Using the circuit diagram of an instrumentation amplifier, derive an expression for its voltage gain. Discuss the advantages of the amplifier over other types of integrated amplifiers.

[10 points]

Q.6.

A series of digital codes are applied to a Digital – to – Analogue Converter (DAC) in the sequence given in Table 1. The digital signal is to be converted into analogue signal via:

a) Binary-weighted-input DAC;
b) R-2R ladder DAC.

Table 1

	D_0	D_1	D_2	D_3	D_4	D_5	D_6	D_7
1.	1	0	0	0	1	1	1	0
2.	0	0	1	1	0	1	0	0
3.	1	1	0	0	1	0	1	1
4.	0	0	1	1	1	0	0	1

Show the circuit diagram for each of the DACs. Calculate the analogue output for each digital value.

[20 points]

Q.7.

Illustrate the principle of operation for a successive approximation Analogue – to – Digital Converter.

[10 points]