UNIVERSITY OF SWAZILAND

FACULTY OF SCIENCE
DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING
MAIN EXAMINATION 2011

TITLE OF PAPER	:	ANALOG DESIGN - I
COURSE NUMBER	:	EE321
TIME ALLOWED	:	THREE HOURS
INSTRUCTIONS	:	READ EACH CAREFULLY ANSWER ANY **FOUR** QUESTIONS. EACH QUESTION CARRIES **25 MARKS** MARKS FOR EACH SECTION ARE SHOWN ON THE RIGHT-HAND MARGIN

THIS PAPER HAS SIX PAGES INCLUDING THIS PAGE.

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Question No. 1

(a) Write short notes on:

i. Transistor Biasing
ii. Stability factor

[6Marks]

(b) i) With the aid of a neat sketch describe voltage divider method of biasing.

ii) Derive the equations for collector current (I_C) and collector emitter voltage (V_{CE}).

iii) Explain how stabilization of operating point is achieved by this method?

[13Marks]

(c) In voltage divider circuit, the operating point is chosen as $I_C = 2mA$, $V_{CE} = 3V$. If $R_C = 2.2K\Omega$, $V_{CC} = 9V$ and $\beta = 50$, determine the values of R_1, R_2 and R_E. Take $V_{BE} = 0.6V$ and $I_1 = 10I_B$.

[6Marks]

Question No. 2

(a) i) Draw the circuit of a practical single - stage common emitter transistor amplifier.

ii) Explain the function of each component.

[10Marks]

(b) i) With the aid of good sketches explain the small-signal model for the common-emitter configuration.

ii) Use your model to derive expressions for the following amplifier parameters:

Input resistance R_{in},
Overall small-signal voltage gain G_v ,
Partial small-signal voltage gain A_v,
Overall small – signal current gain G_i,
Short circuit small – signal current gain A_{is}, and
Output Resistance R_{out}.

[15Marks]

Question No. 3

(a) Discuss the parallel tuned circuit with special reference to resonant frequency, circuit impedance and frequency response.

[13Marks]

(b) A parallel resonant circuit has a capacitor of 250 pF in one branch and inductance of 1.25mH plus a resistance of 10Ω in the parallel branch. Find:

i. Resonant frequency
ii. Impedance of the circuit at resonance
iii. Q-factor of the circuit.

[6Marks]

(c) Discuss the operation of a single - tuned amplifier circuit.

[6Marks]

Question No.4

a) i) What is an instrumentation amplifier?
ii) List three applications of Instrumentation amplifier.

[6Marks]

(b) i) Draw a circuit of an Instrumentation amplifier which uses a Transducer Bridge.
ii) Derive the equation its output voltage as a function of the change in resistance of the transducer.

[12marks]

(c) An instrumentation amplifier using a Transducer Bridge Circuit has $R_1 = 1K\Omega$, $R_F = 4.7K\Omega$, $R_A = R_B = R_C = 100K\Omega$, $V_{dc} = +5V$ and op-amp supply of voltages = ± 15V.
The transducer is a thermistor with the following specifications:

$R_T = 100K\Omega$ at a reference temperature of 25^0C;
Temperature coefficient of resistance = $-1K\Omega/^0C$ or $(-1\%/^0C)$.

Determine the output Voltage of the amplifier at 0^0C and at 100^0C.

[7Marks]

Question No. 5

(a) i) Draw the Schematic diagram of a triangular wave generator which uses a comparator and an integrator.

ii) With the aid of relevant circuit waveforms, explain the operation of the circuit.

[10 Marks]

(b) Derive the equations for amplitude and frequency of the triangular wave generator, you discussed in (a).

[10Marks]

(c) In a triangular wave generator
$R_2 = 1.2K\Omega$, $R_3 = 6.8K\Omega$, $R_1 = 120K\Omega$ and
$C_1 = 0.01\mu f$ and supply voltage is $\pm 15V$.
Determine:
i) The Peak-to-peak output Amplitude of the triangular wave.
ii) The Frequency of the triangular wave.

[5Marks]