MACHAKOS UNIVERSITY

University Examinations for 2016/2017

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

THIRD YEAR EXAMINATION FOR BACHELOR OF SCIENCE IN ELECTRICAL AND ELECTRONICS ENGINEERING

EEE 309: ANALOGUE ELECTRONICS II

DATE: 12/6/2017 **TIME: 2:00 – 4:00 PM**

INSTRUCTIONS.

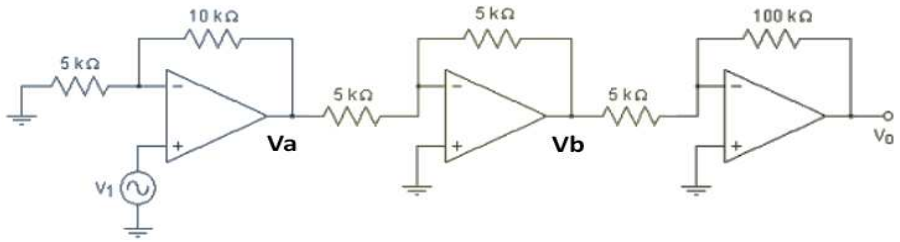
Answer **QUESTION ONE** and **any other TWO.**

QUESTION ONE (COMPULSORY) (30 MARKS)

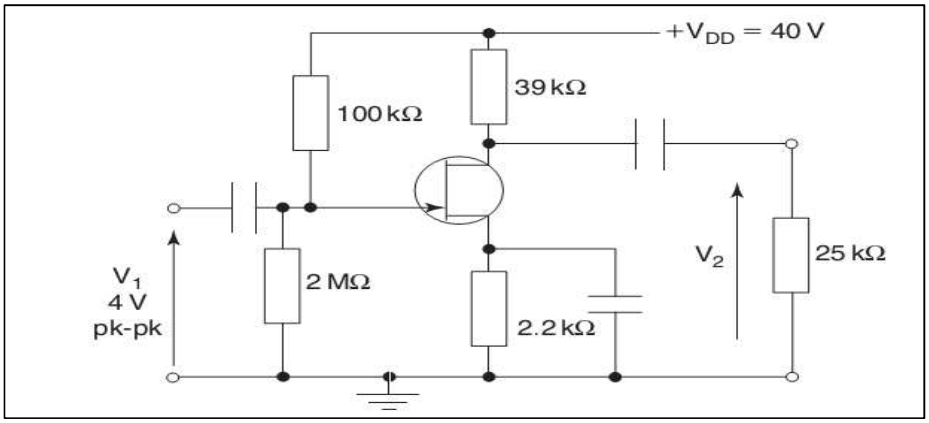
(a) What is an integrator? Derive the formula for its output voltage. Explain its working with neat and clean waveforms i) In case of square wave input ii) In case of sine wave input. (10 marks)

(b) A Hartley Oscillator circuit having two individual inductors of 1mH each, are designed to resonate in parallel with a variable capacitor that can be adjusted between 200pF and 600pF. Determine the upper and lower frequencies of oscillation and also the Hartley oscillators bandwidth. (5 marks)

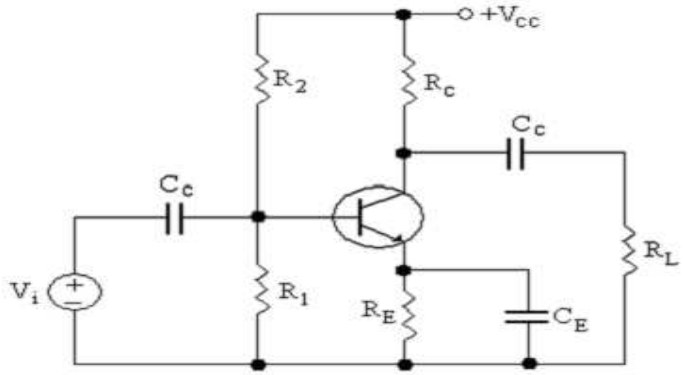
(c) Calculate the input voltage in the circuit below if the final output voltage V_O=10.08 V. (5 marks)



(d) Using FET equivalent parameters, determine the output voltage V_2 and the power delivered to the 25KΩ load in the Figure below (5mks). Use r_{ds}=50kΩ and g_m= 1.5 mS. (5 marks)



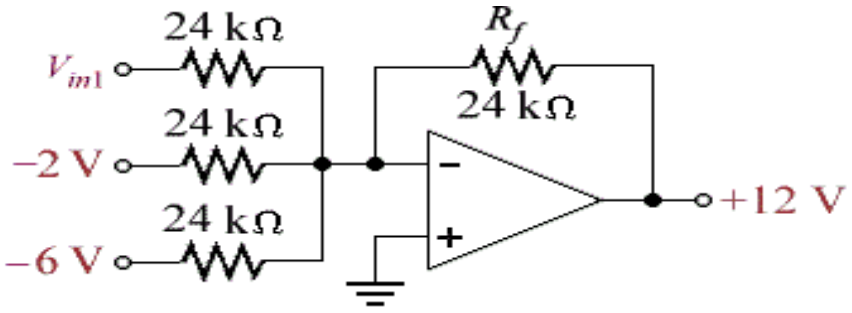
(e) Draw a small signal h-parameter equivalent circuit for the CE amplifier shown in fig below. (5 marks)



Find an expression for voltage gain of the amplifier. Compute the value of voltage gain, if $R_C = R_L =$ 800Ω, $R_1 = 1.5k\Omega$, $R_2 = 3k\Omega$, $h_{re} \approx 0$, $h_{oe} = 100\mu S$, $h_{fe} = 90$ and $h_{ie} = 150\Omega$.

QUESTION TWO (20 MARKS)

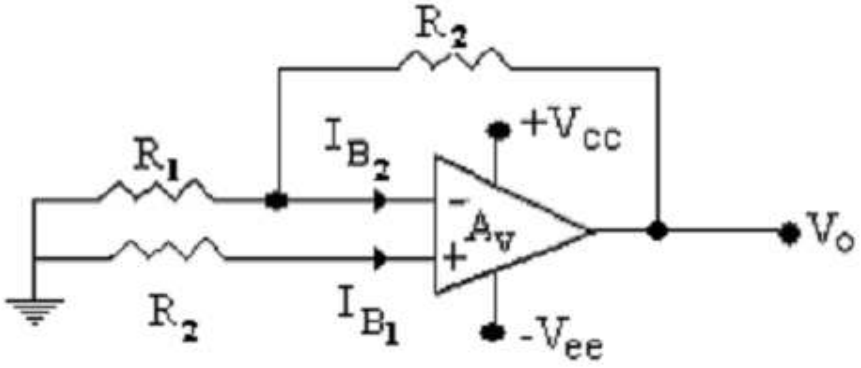
(a) What is the value of V_{in1} from the figure below? (4 marks)



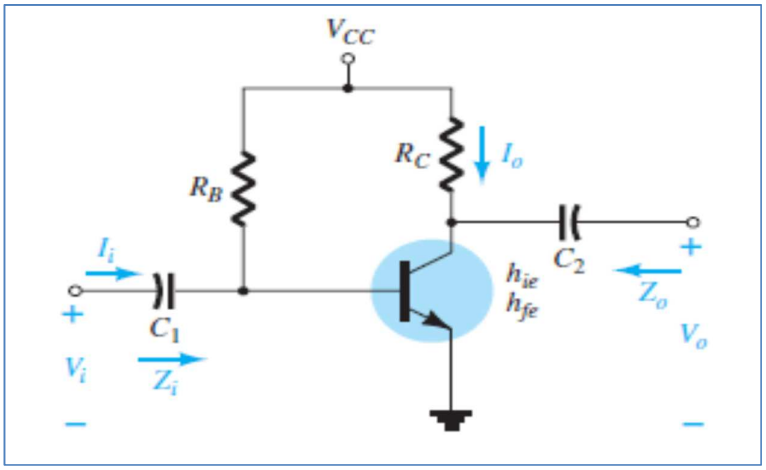
(b) In the circuit below, if input offset voltage is 0,

(i) Find the output voltage V_o due to input bias current, when $I_B = 100nA$ (3 marks)

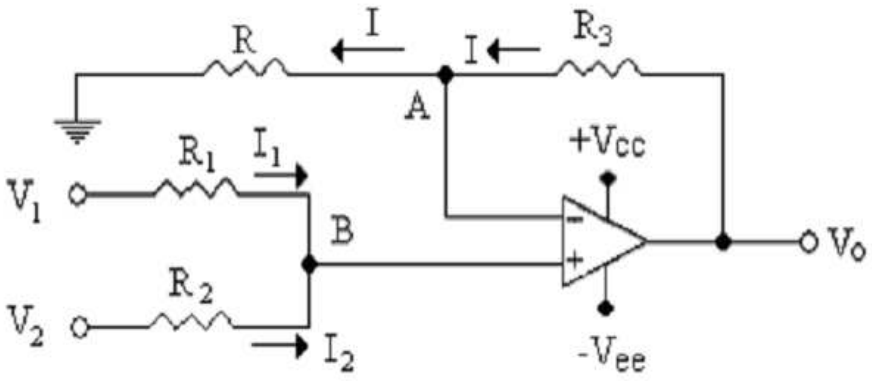
(ii) How can the effect of bias current be eliminated so that output voltage is zero? (3 marks)



(c) Draw the circuit of h-parameter equivalent of the CE amplifier shown below. Then, derive an expression for (i) its input impedance and (ii) output impedance (iii) voltage gain, using the equivalent circuit. (7 marks)



(d) Derive the formula for the output voltage of a summing amplifier in non-inverting configuration by referring to the figure below. (3 marks)

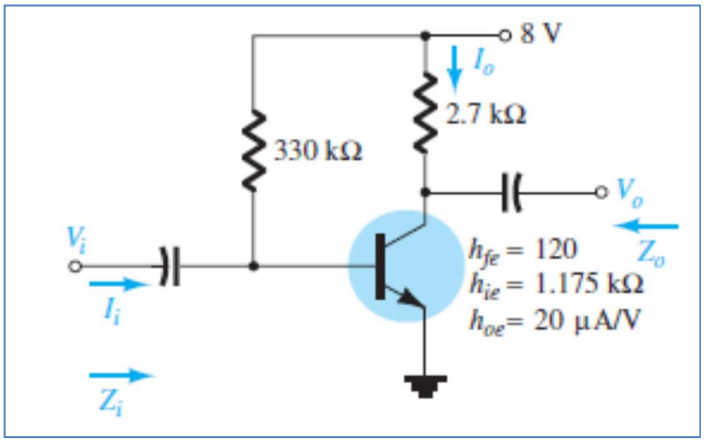


QUESTION THREE (20MARKS)

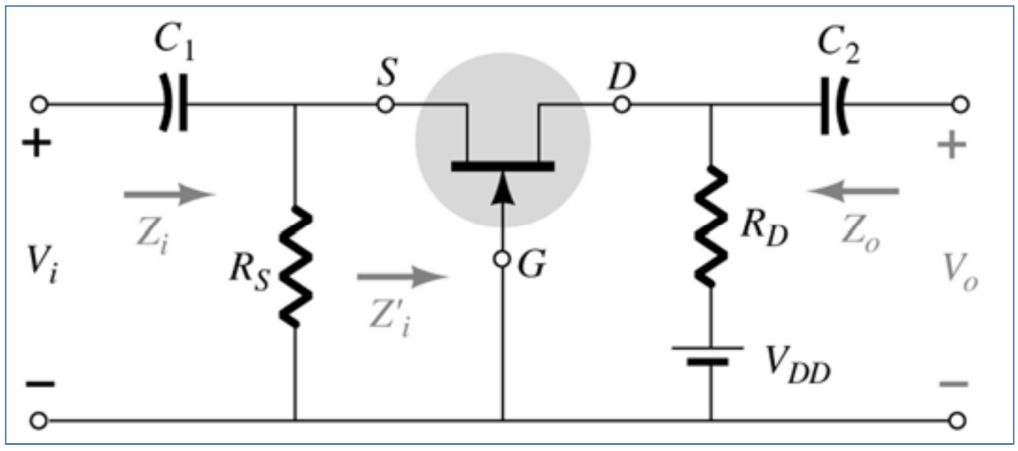
(a) Given, $I_E = 2.5$ mA, $h_{fe} = 140$, $h_{oe} = 20$ µS, and $h_{ob} = 0.5$ µS, determine:

(i) The common-emitter hybrid equivalent circuit.
(ii) The common-base r_e model. (4 marks)

(b) For the amplifier shown below, determine the following: (i) its input impedance (ii) output impedance (iii) voltage gain and (iv) current gain. (8 marks)



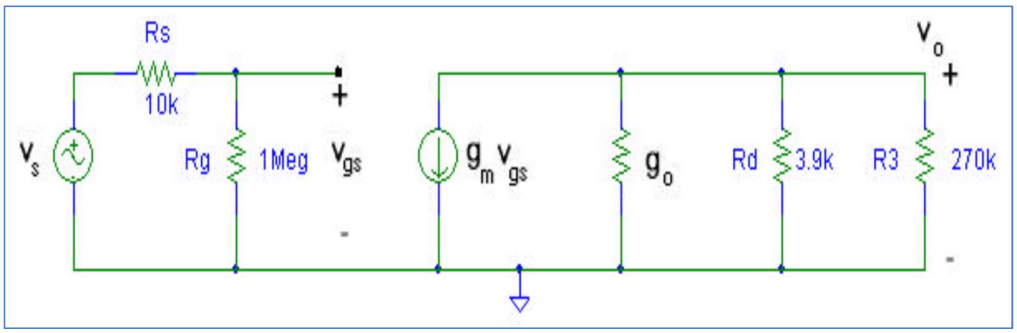
(c) Consider the JFET common-gate configuration as shown below. Draw the AC equivalent circuit and derive expressions for (i) its input impedance (ii) output impedance (iii) voltage gain (8 marks)



QUESTION FOUR (20MARKS)

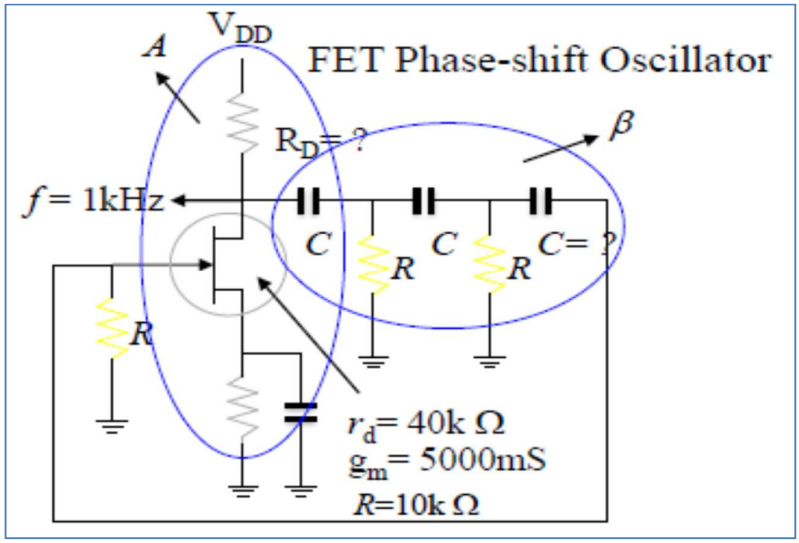
(a) For the MOSFET small signal model shown below, compute the voltage gain using the given parameters. (6 marks)

Given: K_n=1 mA/V^2 , λ=0.015 V^{-1}
Bias Point of: I_{DS}=2 mA, V_{DS}=7.5V

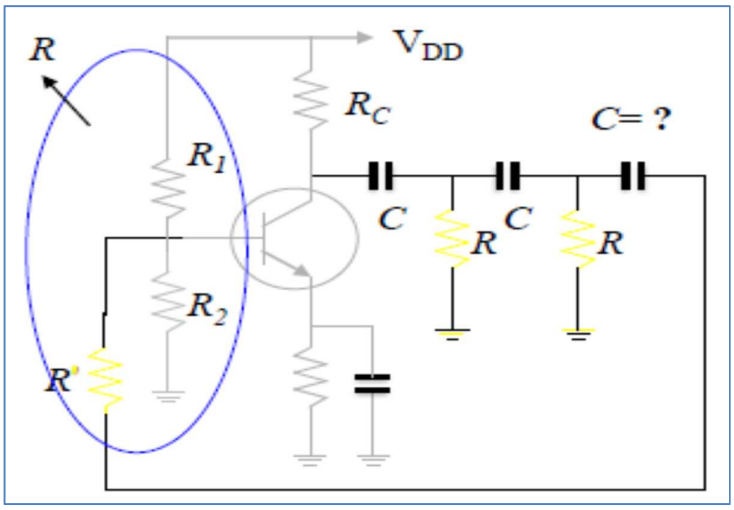


(b) Draw the basic structure of a sinusoidal oscillator and state the *Barkhausen Criterion*. (4 marks)

(c) Determine the value of capacitance C and the value of R_D of the Phase-shift oscillator shown, if the output frequency is 1 kHz. Take r_d = 40k and g_m=5000mS, for the FET and R = 10k. (5 marks)



(d) Determine the value of capacitance C and the value of h_{fe} of the Phase-shift oscillator shown, if the output frequency is 1kHz. Take R=10 k. R_C =1 k. (5 marks)



QUESTION FIVE (20MARKS)

(a) A transistor used in CE arrangement has the following set of h parameters when the d.c. operating point is V_{CE} = *10 volts* and I_C = *1 mA* : h_{ie} = *2000* Ω; h_{oe} =*10–4 mho;* h_{re} = *10–3;* h_{fe} = *50* Determine (i) input impedance (ii) current gain and (iii) voltage gain. The a.c. load seen by the transistor is r_L = *600* Ω. What will be approximate values using reasonable approximations?

(6 marks)

(b) Explain the principle underlying the working of R-C oscillators. Mention the applications of R-C oscillators. (5 marks)

(c) Draw a neat circuit diagram of saw-tooth wave generator using op-amps and describe its operation. Derive an expression for the frequency of the wave. (9 marks)