UNIVERSITY OF SWAZILAND

FACULTY OF SCIENCE

Department of Physics

MAIN EXAMINATION 2016

Tittle of paper:
Analogue Electronics II

Course Code: **P312**
Time allowed: **Three Hours**

Instructions:

1. To answer, pick 5 from 7 questions in the following pages.
2. The answer must be written in the space provided in the question book; solutions found elsewhere will be considered invalid. Use the answer book as scratch pad. Both question and answer book must be handed-in and marked with ID number.
3. This paper has 8 pages including this page.

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PERMISSION HAS BEEN GIVEN BY THE INVIGILATOR.

Q1: (20 pts) List (no derivation) A_v, A_i, R_i, and R_o (3 pts each) of the single BJT (or FET) amplifier of any one configuration of these, CE, CB, and CC; and also the rough range of each spec as well (2 pts each).

config	R_{in}	R_{ot}
	equ	equ
	vlu	vlu
	A_v	A_i
	equ	equ
	vlu	vlu

Q2: (20 pts) Give 2 examples of positive feedback circuit in schematic diagram, (i)(5 pts). wideband feedback and (ii)(5 pts). narrowband feedback. (iii)(10 pts) Compare the differences of the output voltage time trace.

Q3: (20 pts) Fig. Q3-1 shows an active op filter. (i). Derive an expression in Laplace variable for the transfer function of this filter. (ii). Determine which filter is this? (iii). Calculate the cutoff frequency as the components values given in the figure. And (iv). Draw Bode frequency response plot. (5 pts each)

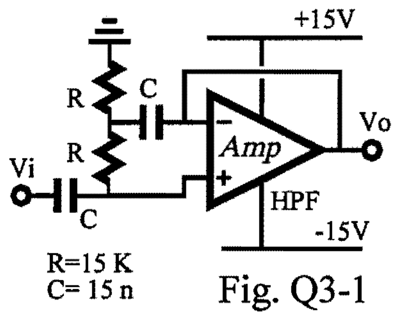


Fig. Q3-1

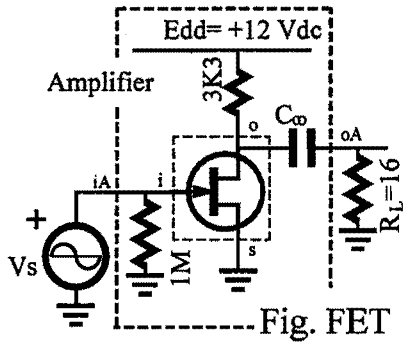


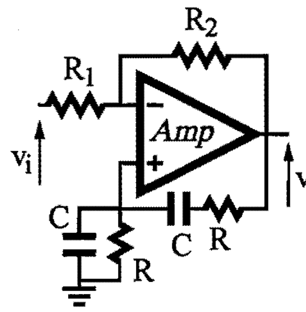
Fig. FET

Q4: (20 pts) Given Vs=1 V_{rms}, the g_m of the FET, 12 mMho in the circuit, and all components values marked in the circuit.

(i). Calculate the FET power output to the speaker under a direct coupled the speaker load 16Ω.

(ii). Use an ideal transformer (replace the C_∞ at output with the trans- former) to match the load 16Ω. Design the transformer turn-ratio to let the load absorb the maximum power. Find the maximum power to the speaker. (10 pts each)

Q5: (20 pts) A Wien amplifier is shown on the right. (i)(10 pts). Derive the voltage amplification factor in terms of the component symbols, given R_s=0. (ii)(4 pts). Find the poles of the amplification factor. Discuss the stability of the amplifier in terms of the resistor ratio, $R_2/R_1=\eta$; that is, discuss the boundary of η. On one side of the boundary, the circuit is a stable BPF amplifier; while on the other side the circuit is a frequency oscillator. (iii)(3 pts) Determine the boundary, and (iv)(3 pts). Find the oscillator or peak BPF frequency.



Q6: (20 pts) An electric circuit shown in Fig. Q6-1 is excited by a voltage source, v(t)=1. cos(ωt). Using analogue computing, find the current in the circuit. (i)(5 pts). Give the circuit loop equation. (ii)(10 pts). With op integrators (stable than differentiators), design the computing circuit. (iii) (5 pts). Mark all components values and the result output point.

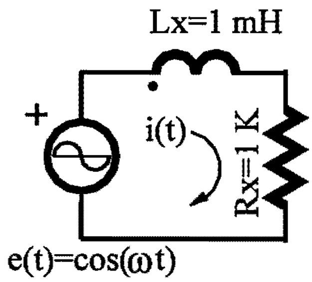


Fig. Q6-1

Q7: (20 pts) A 2-BJT linear feedback amplifier is shown on the right. (i)(5 pts) Identify whether the feedback is positive or negative. (No gauss but mark as in the class lecture) Find (ii)(5 pts) A_o and (iii) (5 pts) A_f, and (iv). (5 pts) β and check if $\beta = R_e/(R_e+R_f)$. Consider the two BJT has the same parameters. (hint: set R_f symbollical and all the rest numerical, and calculate open loop gain A_o as $R_f \to \infty$ and A_f as R_f=8K).