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UNIVERSITY OF SWAZILAND

FACULTY OF SCIENCE
Department of Physics

MAIN EXAMINATION 2017

Title of the paper:
Analogue Electronics II

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

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

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Q1: (20 pts) Give in the table below the distinct feature and the main application of each configuration of a single transistor amplifier (pick FET or BJT as you wish).

confi	the distinct feature and the main application
CB/ CG 4 pts, 3 pts	
CC/ CD 4 pts, 3 pts	
CE/ CS 4 pts, 2 pts	

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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.

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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)

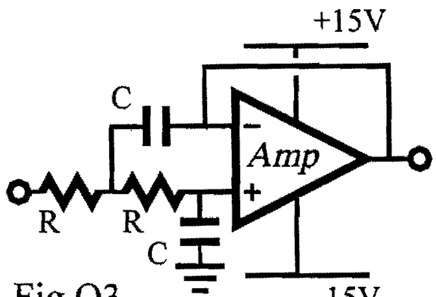

Fig.Q3

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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 16 Ω.

(ii). Use an emitter follower as the matching device (not an exact maximum power match) to the load 16 Ω. Draw the schematic circuit and find the new power output to the speaker. (10 pts each)

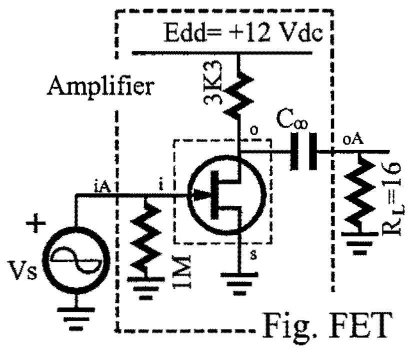

Fig. FET

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Q5: (20 pts) A BPF 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, $r_1/(r_1+r_2)=\eta$; 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.

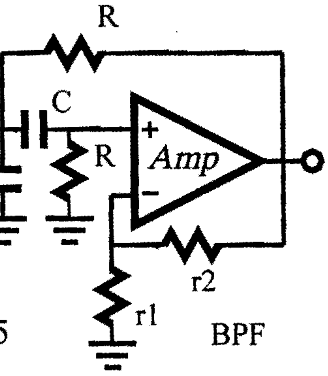

Fig. Q5

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Q6: (20 pts) Given the integral equation below:

$$i(t) \cdot R + \frac{1}{C}\int_0^t i(t) \cdot dt = u(t)$$

Using analogue computing, find the current i(t). (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.

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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).