UNIVERSITY OF SWAZILAND

FACULTY OF SCIENCE

Department of Electronic and Electrical Engineering

July 2016

SUPPLEMENTARY EXAMINATION

Title of the Paper:

Analogue Design I

Course Code: **EE321**

Time Allowed: **Three Hours.**

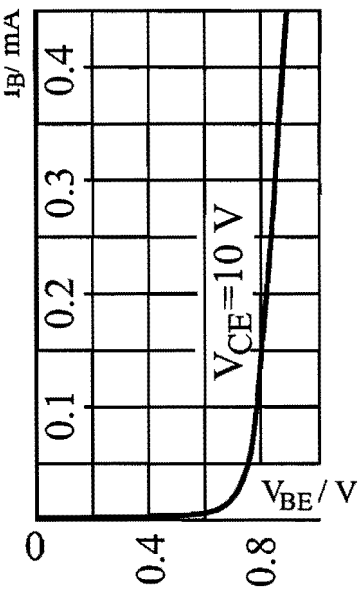
Instructions:

1. Answer all 8 questions: no choice.
2. The answer must be written in the space provided in the question book. Use the answer book as a scratch pad. Consider valid the only answer under the assigned the space. Hand in both question and answer book, and mark the name and ID on both book.
3. This paper has 7 pages, including this page.

DO NOT OPEN THE PAPER
UNTIL PERMISSION HAS BEEN GIVEN BY THE INVIGILATOR.

Q1: Give high frequency equivalent circuits respectively of BJT and FET. All component symbols must be marked professionally correct. Each circuit must have its title. (5pts each).

Q2: Given the diode physical I_d -V_d curve on the right, draw the diode equivalent circuit **(2 pts)** of level 2, which including forward resistance **(4 pts)** and off-set voltage **(4 pts)**. Level 0 is the idealized diode. The components values must be calculated from the curve.



Q3: (20 pts) List R_{in}, R_{ot}, A_i, and A_v of the single FET amplifier of the configurations, CS. (5 pts each)

	R_{in}	R_{ot}
CS		
	A_v	A_i
CS		

Q4: (10 pts) Use OCTC method, estimate ω_H, for the CE amplifier shown in Fig. Q4-1. The BJT parameters is: h_{fe}=140, h_{ie}=3.8 KΩ, C_{ob}=4 pF, and C_{ib}=8 pF. (6 pts for 2 time-constants and 4 pts for the final result)

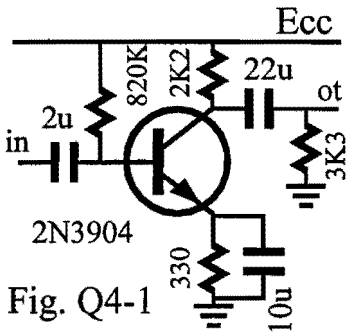


Fig. Q4-1

Q5: (i) Find the A_{vf} of the feed-back circuit. The circuit schematic diagram is shown on the left, where C_1, C_2, and R_b are negligibly large. (ii) What is the type of the feedback **(4 pts)**. (iii) What is A_{vo} **(3 pts)** and β **(3pts)**.

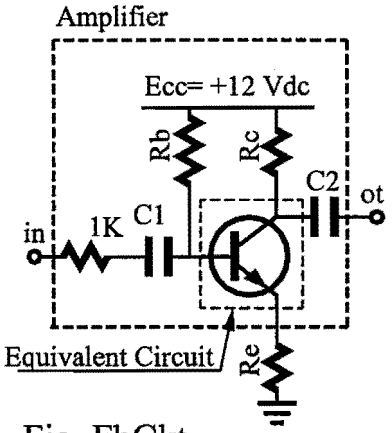


Fig. FbCkt

Q6: Given an amplifier amplification factor:

$$A(s) = \frac{A_0 s}{s_n^{\,2} + s_n(2-\eta)+1}$$

Discuss the stability of the amplifier in terms of η; that is, discuss the boundary of η. In one region of the boundary, the circuit is a stable BPF amplifier; while in another region, the circuit is a frequency oscillator. Draw the η-domain on a line and mark the regions **(4 pts for pole location, 3 pts for the boundary, 3 for stable or not)**.

Q7: 2N3055 has a power dissipation rating 120 Watts at case temperature 25°C, and thermal resistance from junction to case θ_{jc}=1.25 C/W. (i) Find the junction temperature **(3 pts)**; and Draw the curve P_D~T_C **(2 pts)**. (ii) Design a practical heat sink to dissipate the heat to the air at a temperature 25°C. Assume the transistor case and heat sink have a perfect thermal contact. Case temp may be high to 75°C; calculate sink θ_{ca} **(2 pts)**, where ca is between the case and the air. Find the new power dissipation again **(3pts)**.

Q8: An amplifier has a voltage amplification factor:

$A(s) = \dfrac{2\pi \cdot 10^{10}}{(s + 2\pi \cdot 10^{6})}$ (i). Draw the frequency response in Bode form; find mid-band gain **(6 pts)**; and find the dominant ω_L and ω_H **(2 pts each)**. (ii). If use feedback technique and reduce the mid-band gain to 200, what are the new dominant ω_L and ω_H **(5 pts each)**.