KING FAHD UNIVERSITY OF PETROLEUM & MINERALS

ELECTRICAL ENGINEERING DEPARTMENT

FIRST SEMESTER 2012-2013 (S121)

Course Title:	**Electronics II**
Course Number:	**EE 303**

Exam Type:	**Exam II**
Date:	**Thursday November 27, 2014**
Time:	**5:30PM-7:00PM**

Student Name: Key

Student ID: _____

GRADING		
Question 1	**25**	25
Question 2	**20**	20
Question 3	**30**	30
Question 4	**25**	25
Total:	**100**	100

Show all your work and results. Do not give more than one answer otherwise the wrong one will be considered.

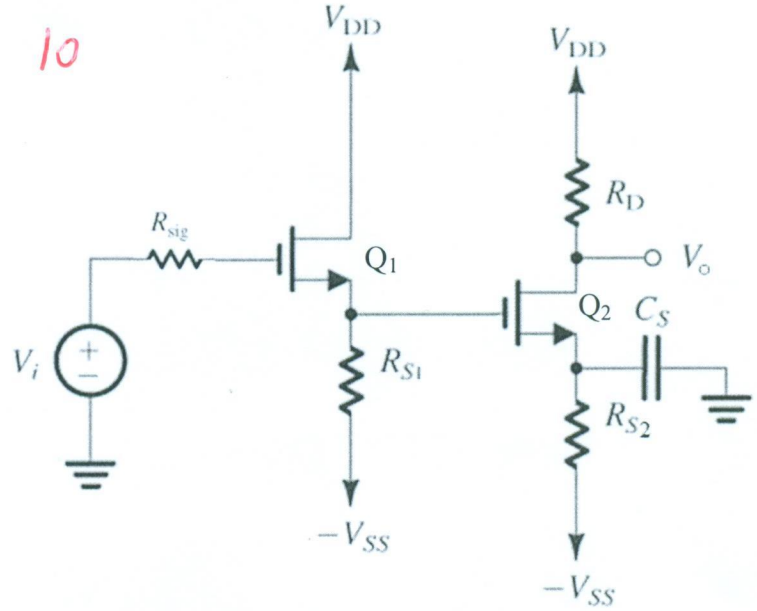
Question No.1: (25 points)

For the amplifier circuit shown below, ignore r_o

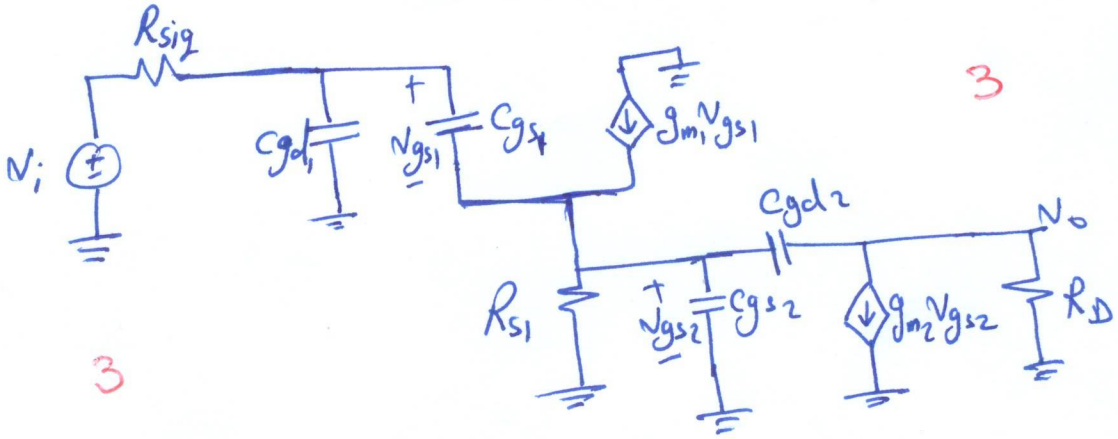
(a) Drive an expression for the **midband voltage gain** $A_M = V_o/V_i$.

(b) Find all high frequency poles.

a) $\frac{V_o}{V_i} = \frac{R_{S1}}{R_{S1} + \frac{1}{g_{m1}}} (-g_{m2} R_D)$ 10



b) High freq. poles:



3

$$\omega_{H1} = \frac{1}{C_{gd1} R_{sig}}$$ 3

$$\omega_{H2} = \frac{1}{C_{gs1} R_{C_{gs1}}} \; ; \; R_{C_{gs1}} = \frac{R_{sig} + R_{S1}}{1 + g_{m1} R_{S1}}$$ 3

$$\omega_{H3} = \frac{1}{(C_{gs2} + C_1)(R_{S1} \| \frac{1}{g_{m1}})} \; ; \; C_1 = C_{gd2}(1 + g_{m2} R_D)$$ 3

$$\omega_{H4} = \frac{1}{C_2 R_D} \; ; \; C_2 = C_{gd2}\left(1 + \frac{1}{g_{m2} R_D}\right)$$ 3

Question No.2: (20 points)

i. Determine the type of the feedback configuration for an amplifier circuit to achieve the following objectives: **[10 points]**

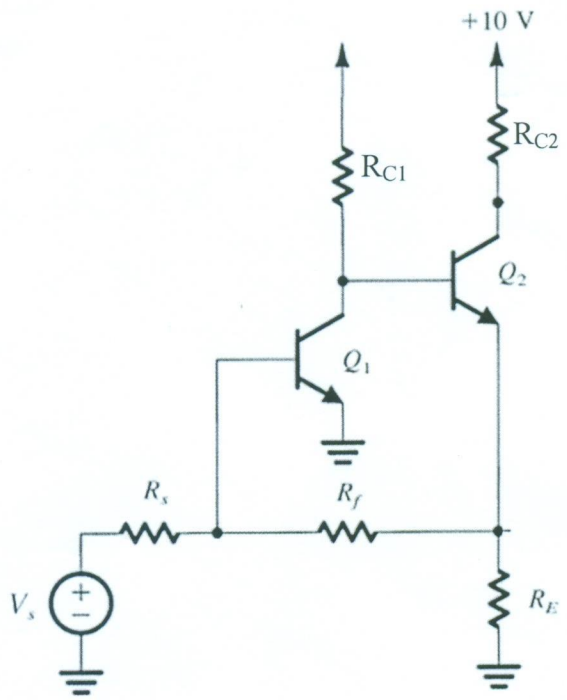
a) **Low** Input Resistance R_{in} and **Low** Output Resistance R_{out}..... Shunt-Shunt 5

b) **Low** Input Resistance R_{in} and **High** Output Resistance R_{out}..... Shunt-Series 5

ii. Determine the type of the feedback configuration in the amplifier circuit shown below in the following cases: **[10 points]**

a) Feed back network B consists of resistor R_f: Shunt- Shunt 5

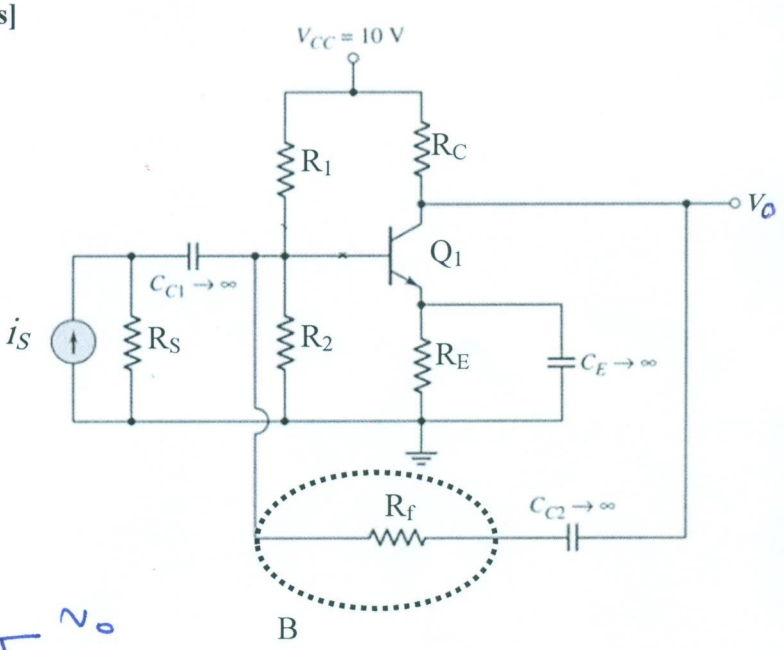
b) Feed back network B consists of resistor R_f and R_E: shunt- Series 5



Question No.3: (30 points)

The following figure shows an amplifier circuit, ignore r_o

1. Determine: type of the feedback configuration, R_{11}, and R_{22} **[6 points]**
2. Sketch A circuit **[6 points]**
3. Drive expression for the open loop gain A. **[8 points]**
4. Drive expression for feedback factor **B**. **[5 points]**
5. Determine the closed loop gain (v_o/i_s) **[5 points]**



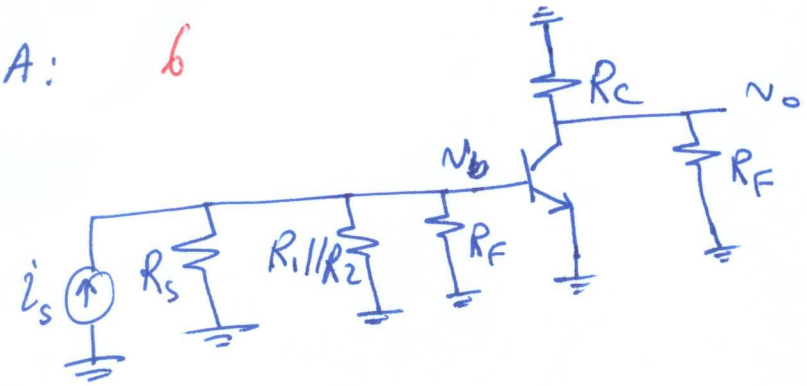
1) shunt - shunt 4

$R_{11} = R_F$ 1

$R_{22} = R_F$ 1

① ②

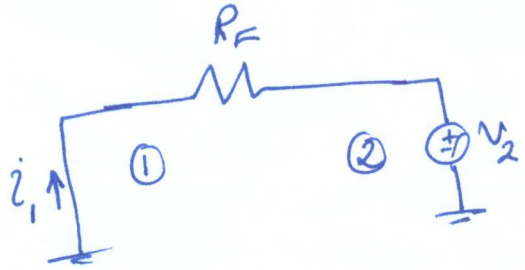
2) A: 6



3) $A = \frac{v_o}{i_s} = \frac{v_b}{i_s}\frac{v_o}{v_b} = (R_S // R_1 // R_2 // R_F // r_{\pi_1})\left(-\frac{\alpha R_F // R_C}{r_{e_1}}\right)$ 8

4) B:

$B = \frac{i_1}{v_2} = -\frac{1}{R_F}$ 5



5) closed loop gain: $A_f = \frac{v_o}{i_s} = \frac{A}{1+AB}$ 5

Question No. 4: (25 points)

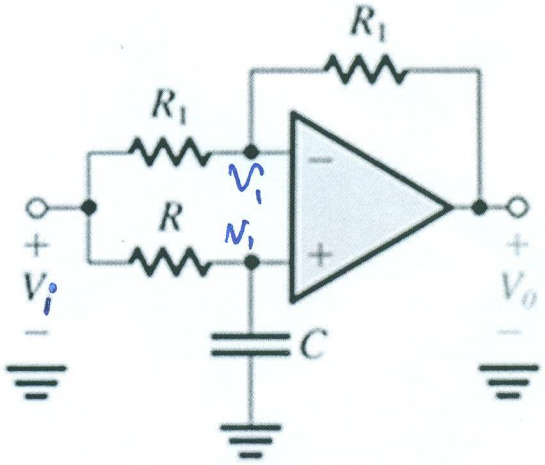
i. Write a general transfer function T(s) for a first order Low pass filter. **[5 Points]**

$$T(s) = \frac{a_0}{s + \omega_0}$$ 5

ii. For the shown active filter circuit:

a) Derive an expression for the transfer function $v_o(s)/v_i(s)$. **[8 Points]**
b) What is the filter type? **[4 Points]**
c) Find an expression for the pole frequency ω_0. **[4 Points]**
d) Find the dc and high frequency gains. **[4 Points]**

a)



Nodal at (-):

$$\frac{N_1 - N_i}{R_1} + \frac{N_1 - N_o}{R_1} = 0 \quad (1)$$ 2

$$N_1 = \frac{1}{2} N_i + \frac{1}{2} N_o$$

Nodal at (+)

$$\frac{N_1 - N_i}{R} + N_1 SC = 0 \quad (2)$$ 2

$$N_1 [1 + SCR] - N_i = 0 \Rightarrow \left(\frac{1}{2} N_i + \frac{1}{2} N_o\right)(1 + SCR) - N_i = 0$$ 2

$$N_i \left(-\frac{1}{2} + \frac{1}{2} SCR\right) + N_o \left(\frac{1}{2} + \frac{1}{2} SCR\right) = 0$$

$$\frac{N_o}{N_i} = \frac{1 - SCR}{1 + SCR} = -\frac{S - \frac{1}{CR}}{S + \frac{1}{CR}}$$ 2

b) ALL Pass first order filter - OpAmp RC 4

c) $\omega_0 = \frac{1}{CR}$ 4

d) DC Gain = +1, high freq gain = -1 4