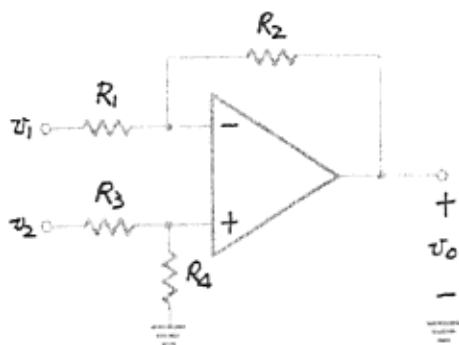


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1. (25%) The difference amplifier circuit is shown in Fig. 1. Assume the operational amplifiers are ideal. Analyze the circuit to determine v_o as a function of v_1 and v_2 .
2. (25%) The small signal equivalent circuit is shown in Fig. 2. Assuming $g_m \gg \omega C_\mu$, please determine the current gain (I_c/I_b) and the unity-gain bandwidth as a function of g_m , C_π , C_μ , r_π , r_x and r_o .
3. (25%) The cascode current mirror is shown in Fig. 3. Find the ac output resistance R_{out} of the cascode current mirror with transconductance g_m and output resistance r_o of the MOSFETs Q_1 , Q_2 , Q_3 and Q_4 , assuming the MOSFETs Q_1 , Q_2 , Q_3 and Q_4 have the same aspect ratio (W/L).
4. (25%) The basic BJT differential-pair configuration is shown in Fig. 4, assuming

$$i_C \approx I_S e^{\frac{v_{BE}}{V_T}}$$

Please determine i_{E1} and i_{E2} as the functions of I , v_{B1} , v_{B2} and V_T .



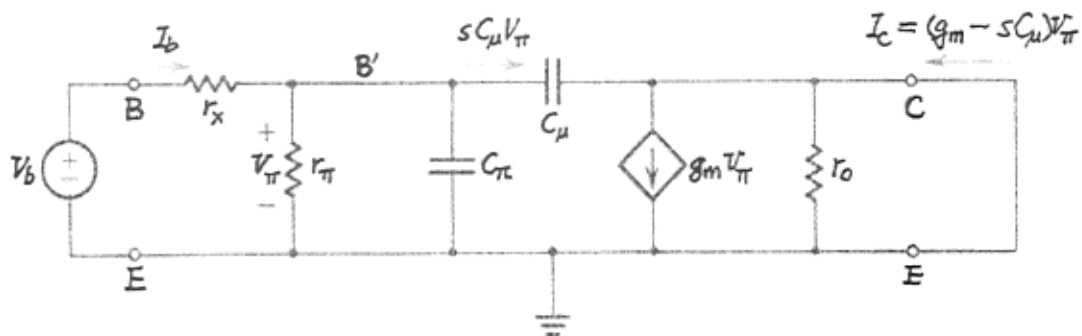


Fig. 2

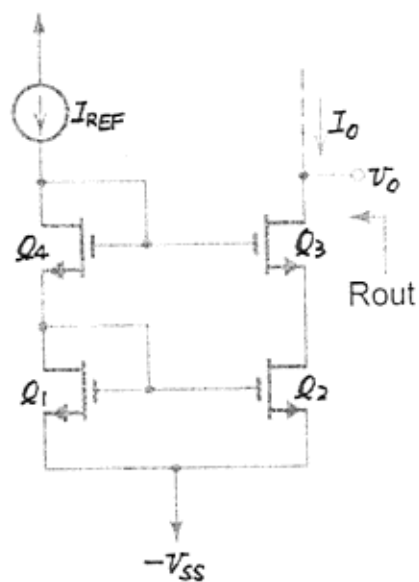


Fig. 3

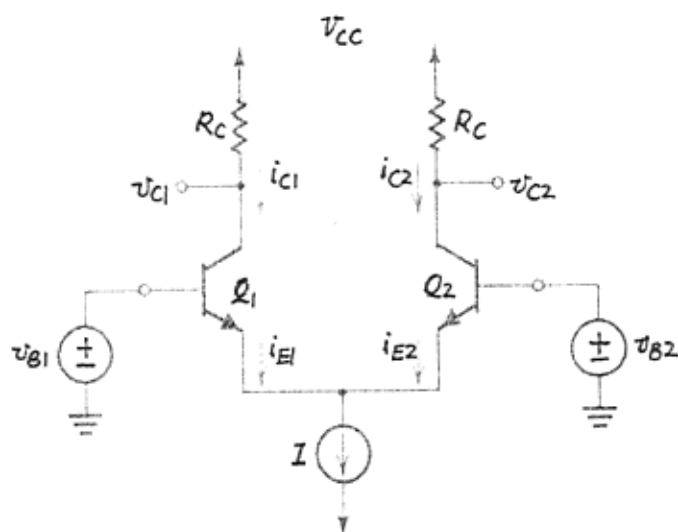


Fig. 4

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1. (20 points) Describe the differences between the following pairs of terms:
 - a) symmetric and asymmetric multiprocessing
 - b) internal and external fragmentation
 - c) a trap and an interrupt
 - d) preemptive and nonpreemptive scheduling
2. (15 points) Suppose that the following processes arrive for execution at the times indicated. Each process will run the listed amount of time. In answering the following questions, use nonpreemptive scheduling and base all decisions on the information you have at the time the decision must be made.

Process	Arrival Time	Burst Time
P1	0.0	8
P2	0.6	5
P3	1.0	2

- a) What is the average turnaround time for these processes with the FCFS scheduling algorithm?
 - b) What is the average turnaround time for these processes with the SJF scheduling algorithm?
 - c) The SJF algorithm is supposed to improve performance, but notice that we chose to run process P1 at time 0 because we did not know that two shorter processes would arrive soon. Compute what the average turnaround time will be if the CPU is left idle for the first 1 unit and then SJF scheduling is used.
3. (15 points) Consider the following page reference string:
1, 2, 3, 4, 2, 1, 3, 5, 6, 2, 1, 2, 3, 7, 6, 3, 2, 1, 2, 3.
How many page faults would occur for the following replacement algorithms, assuming four frames? Remember all frames are initially empty, so your first unique pages will all cost one fault each.
 - LRU replacement
 - FIFO replacement
 - Optimal replacement

4. (20 points) Explain the following terms:
- Microprogrammed control
 - Memory-mapped I/O
 - VLIW
 - Cache coherence

5. (15 points)

For the following pipeline reservation table,

- calculate the forbidden set F ,
- find the collision vector,
- calculate the minimum average latency, and
- draw the state diagram.

Stage	Time t							
	1	2	3	4	5	6	7	8
S_1	X					X		X
S_2		X		X				X
S_3			X		X		X	

6. (15 points) Design a 4-bit magnitude comparator at register level.

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「工程數學」科目試題卷

1. Find the general solutions of the following differential equations:(20%)

(a) $x^2 y'' - 2xy' + 10y = 0, x > 0$

(b) $y'' - 3y' + 2y = 3e^x + 4x$

2. Use the Laplace transform to solve the differential equation (20%)

$$y'' + 4y' + 13y = 26e^{-4t}; y(0) = 5, y'(0) = -29.$$

3. Find a fundamental matrix for the system and write the general solution in terms of this fundamental matrix. (20%)

$$x_1' = 2x_1 + x_2 - 2x_3$$

$$x_2' = 3x_2 - 2x_3$$

$$x_3' = 3x_1 + x_2 - 3x_3$$

4. Find the Fourier transform of the function (20%)

$$f(t) = 3e^{-4|t+2|}$$

5. Let $A = \begin{bmatrix} 3 & 1 & 0 \\ 1 & 3 & 0 \\ -1 & -1 & 2 \end{bmatrix}$, please find A^{10} . (20%)