KATHMANDU ENGINEERING COLLEGE
Department of Electronics, Computer and Electrical Engineering

Tutorial Set No.2 **ELECTRONIC CIRCUITS I**
BEX Section A Instructor: Ajay Kumar Kadel
Deadline: Falgun 5, Monday (2:00 PM)

- ***Please promptly turn in your assignments. 10 % of your marks from this assignment will be deducted in case of late submission.***
- ***Please try to do the problems yourself since this course is best learned through problem solving.***

Problem 1 (7 points)
Draw the block diagram of an operational amplifier and describe each block.

Problem 2 (5 points)
Draw a circuit diagram of widlar current source which supplies 10 μA from a reference source current of 1mA and 0.7V of bias.

Problem 3 (6 points)
Draw a differential amplifier which uses active load. Also find its output voltage if the differential input voltage is "v_{id}".

Problem 4 (10 points)
Describe how a simple current mirror circuit produces the output current which is a mirror of its input reference current. Give two reasons for the output current I_0 of a simple current mirror not being exactly equal to the reference current I_{ref}.

Problem 5(4 points)
Explain how a number of constant currents are generated by using current steering circuits for biasing various circuits in IC?

Problem 6 (7 points)
Define the input and output resistance of a differential amplifier. Show that the input resistance R_i of a dual input balanced output differential amplifier is equal to $2\beta r_e$.

Problem 7 (5 points)
What are the benefits of Widlar current source as compared to a simple current source?

Problem 8 (4 points)
Draw a circuit diagram of a current mirror whose output is one-half the reference current **without** using widlar current source.

Problem 9 (10 points)
Draw a Widlar current source and compare it with simple current mirror. Derive an equation for the output resistance of Widlar current source.

Problem 10 (6 points)
Prove that a differential amplifier amplifies the difference between two input signals. Draw the input and output waveforms of the dual input, balanced output differential amplifier.

Problem 11 (8 points)
For the dual input, balanced output differential amplifier (i) determine the output voltage if V_{in1}=50mv peak to peak at 1 KHZ and V_{in2}=20mv peak to peak at 1 KHZ. Assume voltage gain=86. (ii) What is the maximum peak to peak output voltage without clipping? Assume the current flowing through each collector is 1 mA.

Problem 12 (2 points)
Explain why open loop configurations of operational amplifiers aren't used in linear applications.

Problem 13 (2 points)
Sketch the output stage (dc level shifting) of any two op-amp circuit.

Problem 14 (5 points)
Explain any two d.c. level shifting circuits of op-amp.

Problem 15 (5 points)
Compare the voltage gain and output resistance of differential amplifier with active load and passive load (R_c).

Problem 16 (9 points)
Draw the circuit diagram and compare the output resistances of the following current mirrors

- Simple current mirror
- Improved current mirror
- Wilson current mirror

Problem 17 (5 points)
Compare the voltage gain and output resistance of differential amplifier with active load and passive load (R_c).

Problem 18 (2 points)
Explain why current mirrors are required in integrated circuit fabrication?

Problem 19 (2 points)
Explain why level shifting stage is required in operational amplifier?

Problem 20 (8 points)
Find the values of R1, R2, R3 and R4 in the given circuit of fig. P.20. Given data are
$V_{BE} = 0.7V$ when $I_C = 1mA$
$\eta = 1$
I_{ref}= (your roll number) μA
I_{01}= (0.25 × your roll number) μA
I_{02}= (0.5 × your roll number) μA
I_{03}= (0.75 × your roll number) μA

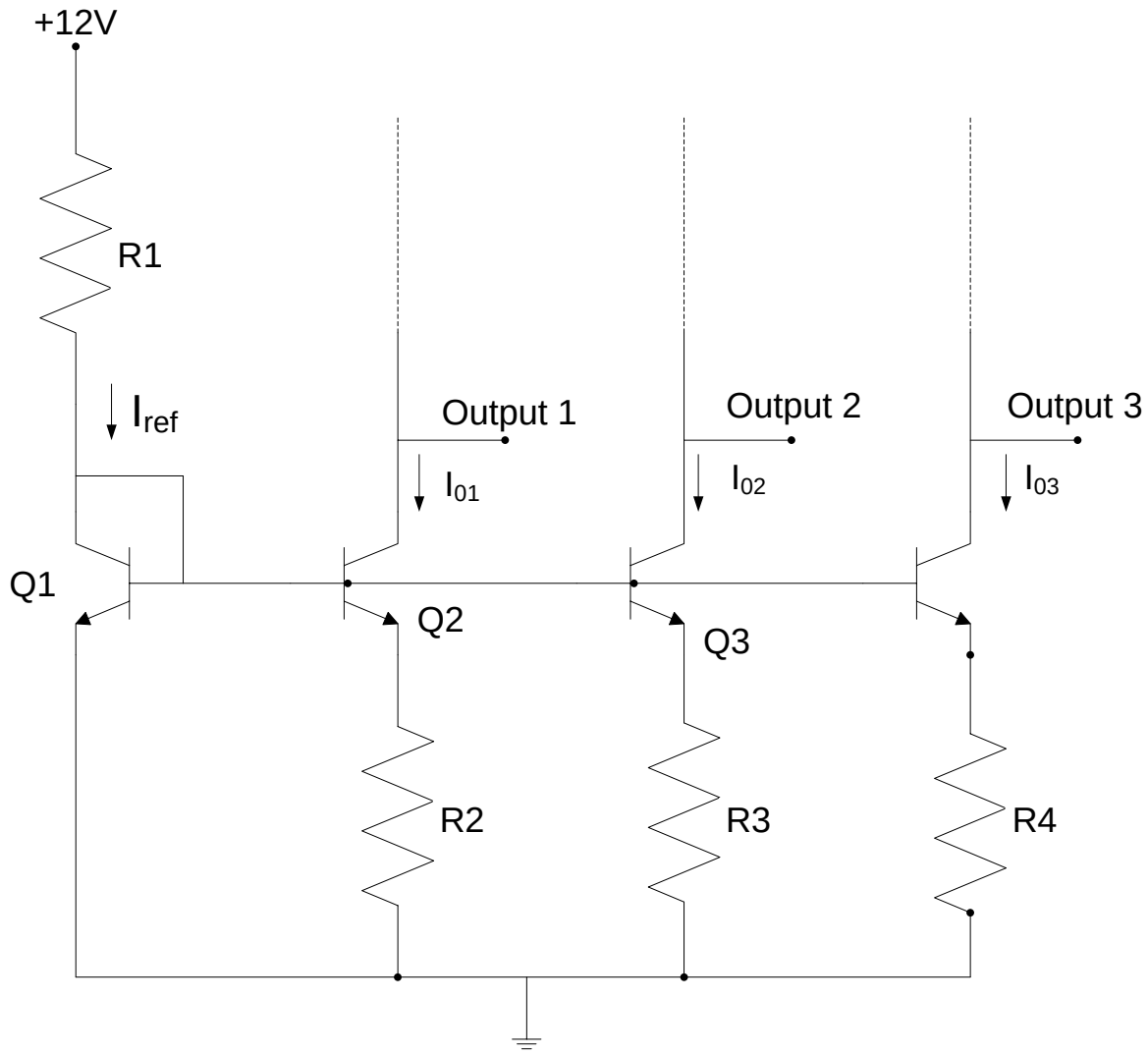
+12V
R1
I_{ref}
Output 1
Output 2
Output 3
I_{01}
I_{02}
I_{03}
Q1
Q2
Q3
R2
R3
R4

Fig. P.20