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Internal Assessment Test – II

Sub:	**Introduction to Electronics Engineering**							**Code:**	**BESCK204C**
Date:	**22/ 05 / 2024**	**Duration:**	**90 mins**	**Max Marks:**	**50**	**Sem:**	**II**	**Sec:**	**K, L**

	Answer Any **FIVE FULL** Questions	Marks	OBE CO	OBE RBT
1.	What is a regulated power supply? With neat block diagram Summarize the working of DC power supply. Also mention the principal components used in each block.	[10]	CO1	L2
2.	(a) Discuss the need of filter circuit. With circuit diagram and waveforms brief out the operation of smoothing filter for full wave rectifiers. (b) With neat diagram Summarize working principle of the voltage divider bias CE amplifier with feedback.	[5+5]	CO1	L2
3.	A 5V zener diode has a maximum rated power dissipation of 800 mW. If the diode is to be used in a simple regulator circuit to supply a regulated 5V to a load having a resistance of 500 Ω, determine a suitable value of series resistor for operation in conjunction with a supply of 9V.	[10]	CO1	L4

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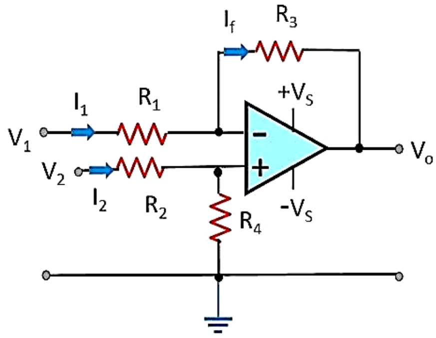
4	What is voltage multiplier and mention its applications? With circuit diagram brief out the operation of voltage Tripler circuit.	[5+5]	CO1	L3
5	(a) Sketch the circuits of each of the following based on use of Operational Amplifier i) Differentiator. ii) Integrator. (b) Write a note on Ideal characteristics of Op-Amp	[5+5]	CO2	L2
6	Sketch the circuits of each of the following with direction of flow of current under positive and negative half cycle of input AC signal (i) Half Wave Rectifier (ii) Bi-Phase Full Wave Rectifiers (iii) Bridge Rectifier	[2+4+4]	CO1	L2
7	(a) What is an amplifire? List out four types of Amplifires. (b) Define following terms (i) Input and output resistance (ii) Bandwidth	[6+4]	CO1	L2
8.	Drive the V_o in term of V_1 and V_2 for Differential Amplifier as given in fig. 	[10]	CO2	L4

CI CCI HOD

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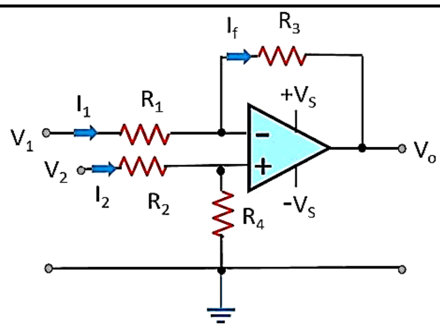
8.	Drive the V_o in term of V_1 and V_2 for Differential Amplifier as given in fig. 	[10]	CO2	L4

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Solution Sheet

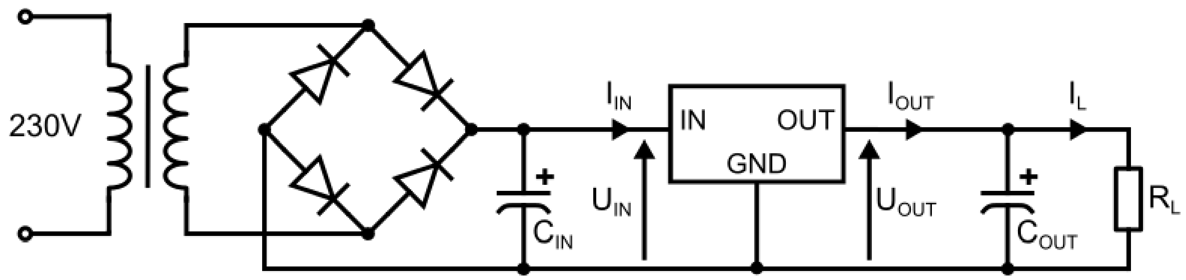
Solution for Question 1.

Regulated Power Supply – Working, Circuit Diagram and Applications

We know that there are different types of electrical & electronic circuits which use a DC power supply. Universally, we cannot use the DC batteries due to expensive as well as require replacement when discharged. In this situation, we require a circuit which can change AC supply to DC supply. A rectifier filter circuit includes a normal **DC power supply**. The normal DC power supply o/p remains stable if the load is contrast. Although in several electronic circuits it is extremely significant to maintain the DC power supply constant irrespective of alternative AC supply. Otherwise, the circuit will get damage. To overcome this problem, voltage regulating devices can be used. So the blend of the voltage regulating devices by the normal dc power supply is named as **DC regulated power supply**. This is an electrical device, used to generate the steady DC supply irrespective of alternative AC supply.

What is Regulated Power Supply?

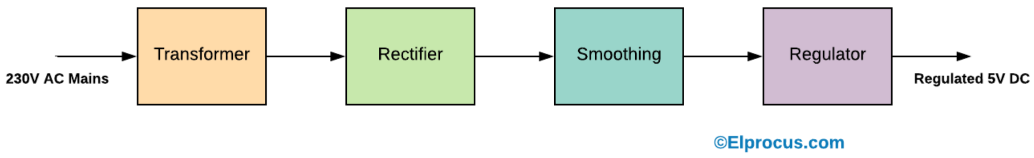
The **IC Regulated power supply (RPS)** is one kind of electronic circuit, designed to provide the stable DC voltage of fixed value across load terminals irrespective of load variations. The main function of the regulated power supply is to convert an unregulated alternating current (AC) to a steady direct current (DC). The RPS is used to confirm that if the input changes then the output will be stable. This power supply is also called a linear power supply, and this will allow an AC input as well as provides steady DC output. Please refer the link to know more about – Power Supply Classification and Its Various Types



Regulated Power Supply Circuit

Block Diagram of Regulated Power Supply

The **block diagram of a regulated power supply** mainly includes a **step-down transformer**, a rectifier, a DC filter, and a regulator. The **Construction & working of a regulated power supply** is discussed below.



Regulated Power Supply Block Diagram

Transformer and AC Supply

A power supply can be used for providing the necessary amount of power at the precise voltage from the main source like a battery. **A transformer** alters the AC mains voltage toward a necessary value and the main function of this is to step up and step down the voltage. For instance, a step-down transformer is used in a transistor radio, and a step-up transformer is used in **a CRT**. Transformer gives separation from the power-line, and must be used even as any modify within voltage is not required.

Rectifier

A rectifier is an electrical device used to convert alternating current into direct current. It can be a full wave rectifier as well as half wave rectifier with the help of a transformer by a bridge rectifier otherwise center tapped secondary winding. However, the rectifier's o/p can be variable.

Filter

A filter in the regulated power supply is mainly used for leveling the ac differences from the corrected voltage. Rectifiers are classified into four types namely capacitor filter, Inductor filter, LC filter & RC filter.

Voltage Regulator

A **voltage regulator** in the regulated power supply is essential for keeping a steady DC output voltage by supplying load regulation as well as line regulation. For this reason, we can employ regulators like a Zener, transistorized, otherwise 3-terminal integrated regulators. An SMPS-switched mode power supply can be used for supplying huge load current by small power dissipation within the series pass transistor.

Applications of Regulated Power Supply

The applications of the regulated power supply include the following.

A regulated power supply (RPS) is an embedded circuit, used to convert unregulated alternating current into a stable direct current by using a rectifier. The main function of this is to supply a constant voltage to a circuit that should be functioned in a particular power supply limit.

- Mobile phone chargers
- Regulated power supplies in different appliances
- Various oscillators & amplifiers

Thus, this is all about a **regulated power supply (RPS)**. From the above information, finally, we can conclude that an RPS changes unregulated alternating current to a stable direct current. A regulated DC power supply is also named as a linear power supply. This supply will allow an AC input as well as provides a stable DC o/p.

Solution for Question 2.

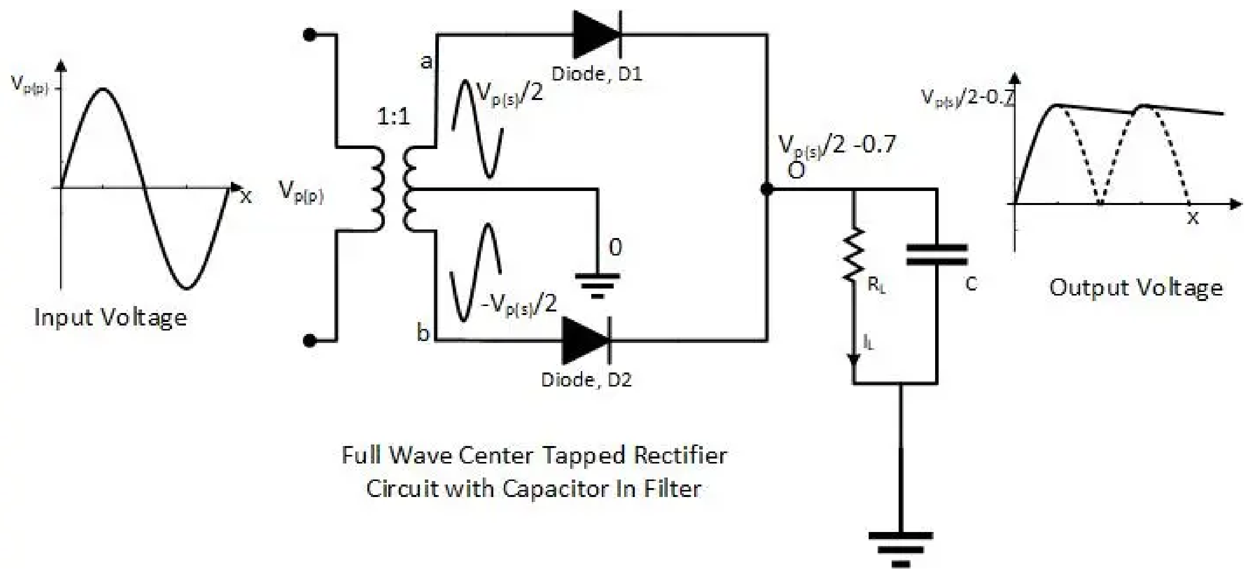
Need for Filter Circuits in Power Supplies

In power supplies, filter circuits are used to remove the ripple voltage from the rectified output to provide a pure DC voltage. After rectification, the output is pulsating DC, containing significant AC components (ripples). The role of a filter is to smooth the output, reducing the ripple and making the voltage more stable and suitable for electronic devices.

Smoothing Filter for Full-Wave Rectifier

A smoothing filter is commonly a capacitor filter placed across the output of a rectifier circuit. It smooths the pulsating DC from the full-wave rectifier by storing and discharging energy, filling the voltage dips between peaks.

Circuit Diagram of a Capacitor Filter for Full-Wave Rectifier



- Full-wave rectifier: Converts the AC input into pulsating DC.
- Capacitor: Placed across the output to smooth out the ripples.
- Load Resistor (RL): Represents the load where the smoothed DC is supplied.

Waveforms of Full-Wave Rectifier and Filter Output

1. Without Filter (Pulsating DC):
   The output from a full-wave rectifier looks like a series of positive half-sine waves

with peaks at every half cycle. This output is not suitable for most electronic circuits because it contains ripples.

2. With Capacitor Filter (Smoothed DC):
   After placing a capacitor across the rectifier output, the waveform becomes smoother. The capacitor charges to the peak voltage and discharges slowly into the load during the intervals between peaks, resulting in a more constant voltage.

Operation of Smoothing Filter with Waveforms

1. Charging Phase:
   During the positive peaks of the rectified waveform, the capacitor charges to the peak voltage of the waveform.
2. Discharging Phase:
   When the rectified voltage starts to drop, the capacitor discharges slowly, maintaining the output voltage close to the peak. This prevents the voltage from dropping to zero between cycles, thus reducing ripple.
3. Ripple Voltage:
   Despite the capacitor, a small ripple remains, which depends on the load current and the capacitor size. A larger capacitor reduces the ripple further.

Key Points in Filter Design

- Capacitor Value: A higher value capacitor provides better smoothing but is more expensive and larger in size.
- Load Resistance: The output ripple increases with higher load current.
- Ripple Frequency: In a full-wave rectifier, the ripple frequency is twice the input AC frequency, making it easier to filter compared to a half-wave rectifier.

Solution for Question 3.

The ratio of Rs to RL is significant as the input voltage is voltage divided by them and made available as Vz

$$V_z = V_{IN}\ X\ \frac{R_L}{R_L +\ R_s}$$

Where V_{IN} is unregulated input voltage

The maximum value of Rs can be calculated from $R_{s(max)} =\ R_L\ X\ \left(\frac{V_{IN}}{V_z} - 1\right)$

The power dissipated in the Zener diode will be given as **Pz= Iz X Vz**.

The minimum value for Rs is determined from **off-load condition** –

$$R_{s\,min} = \frac{(V_{IN}\,V_Z - V_Z^2)}{Pz\ \max}$$

$$R_{s(Min)} = \frac{V_{in} - V_Z}{I_Z}$$

where Pz max is the maximum rated power dissipation for the Zener diode.

Solution for Question 4.

What is a Voltage Multiplier?

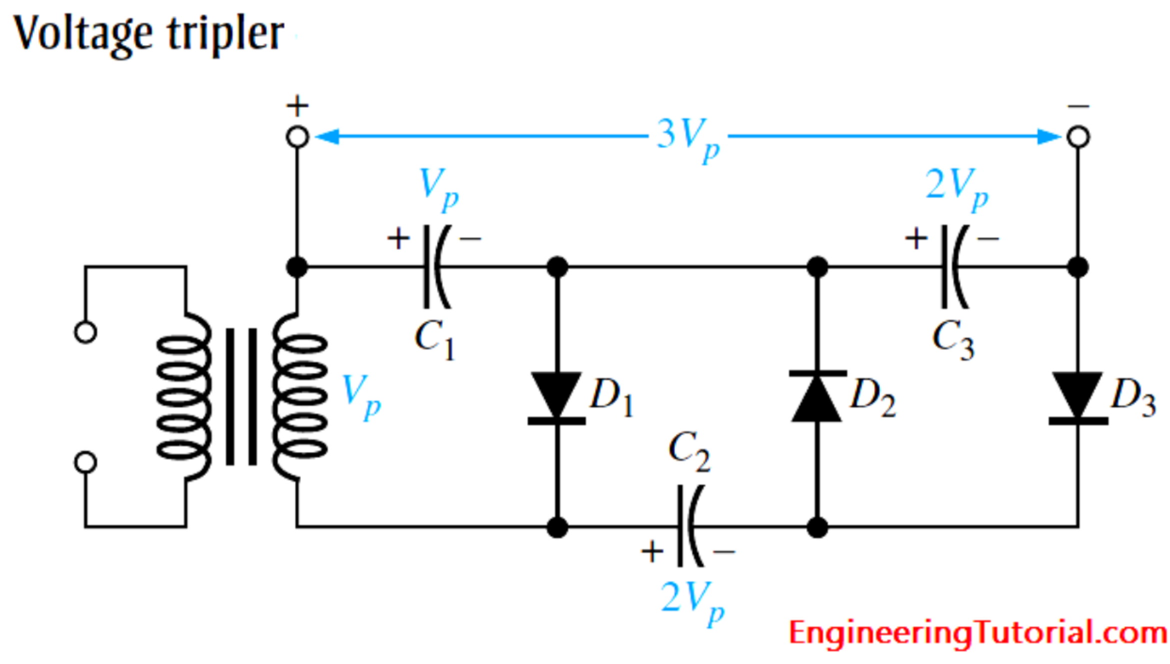
A voltage multiplier is an electrical circuit that converts a low AC voltage input into a higher DC voltage output by using a combination of diodes and capacitors. It produces a multiple of the input voltage without using a transformer with an increased winding ratio. Depending on the design, multipliers can double, triple, or quadruple the input voltage.

Types of Voltage Multipliers

1. Voltage Doubler
2. Voltage Tripler
3. Voltage Quadrupler
4. Cascaded Voltage Multiplier (Cockcroft-Walton multiplier)

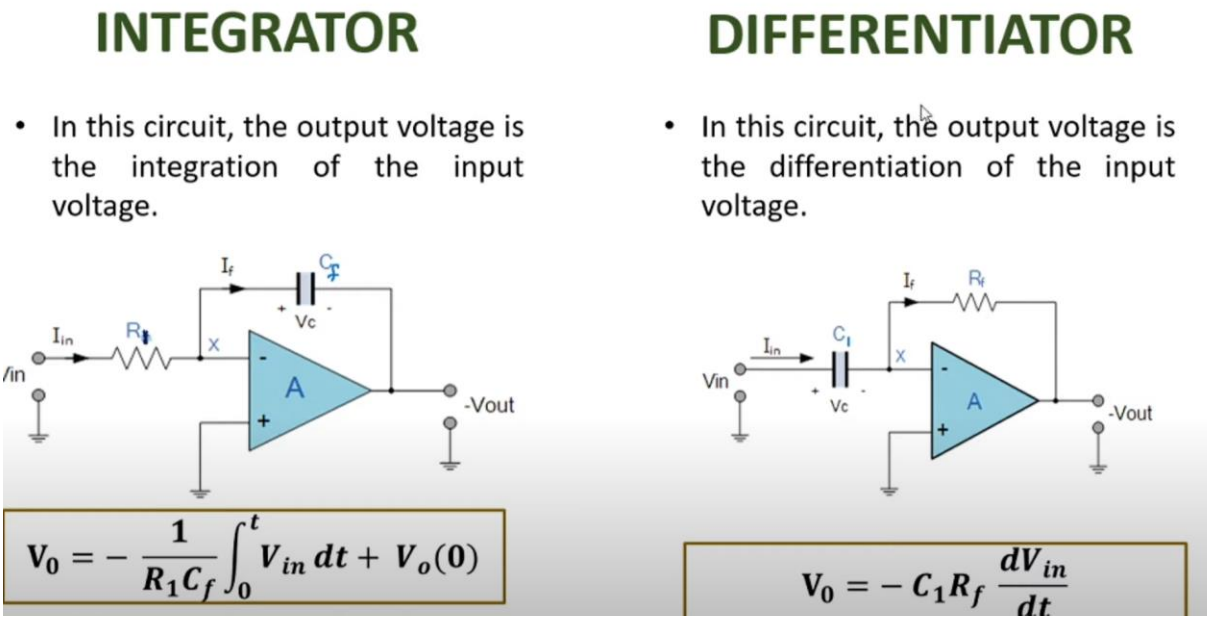
Applications of Voltage Multipliers

- CRT Displays: Generating high voltages for cathode ray tubes in TVs and oscilloscopes.
- X-ray and Laser Equipment: High-voltage generation.
- Power Supplies: For devices requiring DC voltage higher than the AC mains voltage.
- Electrostatic Applications: Used in photocopiers and ionizers.
- High-Energy Physics: Particle accelerators (e.g., Cockcroft-Walton generators).



Solution for Question 5.

Sketch the circuits of each of the following based on use of Operational Amplifier i) Differentiator. ii) Integrator.



Solution for Question 6.

An operational amplifier (op-amp) is a versatile electronic device used in various applications, including signal amplification, filtering, and mathematical operations. Ideal op-amps are theoretical models that help in understanding their behavior. Here are the ideal characteristics of an op-amp:

Infinite Open-Loop Gain (AOL):

The gain of the op-amp without any feedback is infinitely high, allowing for significant amplification of the input signal.
Infinite Input Impedance (Zin):

An ideal op-amp has infinite input impedance, meaning it draws no current from the input signal sources, thus preventing any loading effect.
Zero Output Impedance (Zout):

The output impedance is zero, allowing the op-amp to drive any load without affecting the output voltage.
Infinite Bandwidth:

An ideal op-amp can amplify signals of any frequency without attenuation, meaning it has infinite bandwidth.
Infinite Common-Mode Rejection Ratio (CMRR):

An ideal op-amp completely rejects any common-mode signals, ensuring that only the differential input is amplified.
Infinite Power Supply Rejection Ratio (PSRR):

The performance of an ideal op-amp is unaffected by variations in power supply voltage, maintaining consistent output.
Zero Offset Voltage:

There is no voltage difference between the inverting and non-inverting inputs when the output is zero, leading to accurate amplification.
Linear Operation:

The output is a linear function of the input voltages when operating within the linear range, allowing for predictable behavior.
High Slew Rate:

The ideal op-amp can respond instantaneously to changes in the input signal, allowing for rapid signal changes without distortion.
No Noise:

An ideal op-amp generates no noise, ensuring that the output signal is free from unwanted interference.

Solution for Question 7.

(a) What is an Amplifier?
An amplifier is an electronic device that increases the amplitude of a signal, which can be either a voltage, current, or power signal. Amplifiers are widely used in various applications, including audio devices, radio communications, and signal processing, to boost weak signals for better performance or to drive loads
Types:
AC coupled Amplifier
□***Stages are coupled together in such a way that dc levels are isolated*** and only the ***AC*** *components of a signal are transferred*
from stage to stage.
DC(Direct) coupled Amplifier
□***Stages are coupled together in such a way that stages are not isolated to d.c. potentials.***
□*Both a.c. and d.c. signal components are transferred from stage to stage.*
Large Signal Amplifiers
□ Designed to cater for 1V – 100V or more
Small signal amplifier
□Designed to cater for low-level signals (normally ***less than 1 V*** and often much smaller).
□Specially designed to combat the effects of noise.
Audio frequency amplifiers
□ Operate in the band of frequencies that is normally associated with audio signals (e.g***. 20 Hz to 20 kHz***).
Radio Frequency amplifiers
□ Operate in the band of frequencies that is normally associated with radio.
Low noise amplifiers
□ Designed so that they contribute negligible noise (signal disturbance) to the signal being amplified.
□Designed for use with very small signal levels (usually less than 10 mV or so).

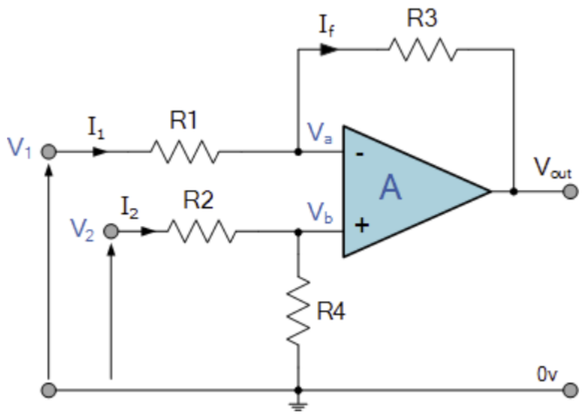
(b) Definitions
(i) Input and Output Resistance:

- Input Resistance (Rin):
    - The resistance seen by the input signal at the amplifier's input terminals. High input resistance is desirable as it minimizes loading effects on the source and ensures that the signal source can drive the amplifier without significant loss of voltage.
- Output Resistance (Rout):
    - The resistance seen by the load connected to the amplifier's output. Ideally, an amplifier should have low output resistance to ensure maximum power transfer to the load and minimize voltage drop across the output terminals.

(ii) Bandwidth:

- Bandwidth:
    - The range of frequencies over which an amplifier can operate effectively without significant attenuation of the signal. It is typically defined as the difference between the upper and lower frequency limits at which the gain falls to a specified level (usually -3 dB) relative to the maximum gain. A wider bandwidth indicates that the amplifier can handle a broader range of signal frequencies.

Solution for Question 8.



By connecting each input in turn to 0v ground we can use superposition to solve for the output voltage Vout. Then the transfer function for a **Differential Amplifier** circuit is given as:

$$I_1 = \frac{V_1 - V_a}{R_1}, \quad I_2 = \frac{V_2 - V_b}{R_2}, \quad I_f = \frac{V_a - (V_{out})}{R_3}$$

$$\text{Summing point } V_a = V_b$$

$$\text{and } V_b = V_2\left(\frac{R_4}{R_2 + R_4}\right)$$

$$\text{If } V_2 = 0, \text{ then: } V_{out(a)} = -V_1\left(\frac{R_3}{R_1}\right)$$

$$\text{If } V_1 = 0, \text{ then: } V_{out(b)} = V_2\left(\frac{R_4}{R_2 + R_4}\right)\left(\frac{R_1 + R_3}{R_1}\right)$$

$$V_{out} = -V_{out(a)} + V_{out(b)}$$

$$\therefore V_{out} = -V_1\left(\frac{R_3}{R_1}\right) + V_2\left(\frac{R_4}{R_2 + R_4}\right)\left(\frac{R_1 + R_3}{R_1}\right)$$