Subject Name: Industrial Electronics

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Year and Sem, Department: III Year- II Sem, ECE

Unit-I: DC Amplifiers

Important points / Definitions: (Minimum 15 to 20 points covering complete topics in that unit)

1. Direct coupled amplifiers are called DC amplifiers. Direct coupled amplifiers are capable of amplifying over a band of frequencies down to zero frequency i.e. dc.
2. These amplifiers are needed in measurement and control work where dc component, initial displacement and similar quantities, ac(the time varying) components are required to be retained.
3. DC amplifiers are required to amplify signals of extremely small in magnitude, derived from thermo-couplers, photodiodes, photo-transistors operating on low intensity light and strain gauges etc.
4. DC amplifiers are also used to amplify voltage signals containing dc components with voltage gain of several hundred in electronic and control measurement.
5. Drift is an unwanted change in the output current without change in the input current. The changes in output is due to the age or time and change in supply voltage. Any noise at the input of the amplifier is amplified at the output, due to high gain and reduces the stability of amplification.
6. Drift in dc amplifier reduced by maintaining supply voltage constant, using resistors having high temperature and humidity stability, by letting the components in the amplifier to attain steady temperature before operation.
7. At low temperatures, drift current is due to changes in the transistor parameters. While at high temperatures, drift current is mainly due to change in reverse saturation current(I_{CBO}).
8. Darlington emitter follower is an amplifier uses a Darlington pair. Darlington pair uses two transistors, the emitter of transistor Q_1 is connected to base of transistor Q_2. The collector

terminals of both transistors Q_1 and Q_2 are connected together to $+V_{cc}$ power supply. The input impedance of transistor Q_2 is the load impedance of transistor Q_1 working as emitter follower.

9. Characteristics of the Darlington Emitter follower are very high input impedance(MΩ), very high current gain A_I (several thousands), very low output impedance(few Ω), voltage gain A_V is almost unity.
10. Input resistance of the first stage is the overall input resistance of Darlington Emitter follower circuit is given by

$$R_i = R_{i1} \approx \frac{(1+h_{fe})^2 R_e}{(1+h_{oe}.h_{fe}.R_e)}$$

11. The overall voltage gain A_V of Darlington Emitter follower is

$$A_V \approx \left(1 - \frac{h_{ie}}{R_{i2}}\right) \qquad where\ R_{i2} = (1+h_{fe})R_e$$

12. The overall current gain A_I of Darlington Emitter follower is

$$A_I \approx \frac{(1+h_{fe})^2}{(1+h_{oe}.h_{fe}.R_e)}$$

13. The **Cascode** is a two-stage amplifier that consists of a common-emitter stage feeding into a common-base stage. Compared to a single amplifier stage, this combination may have one or more of the following characteristics: higher input–output isolation, higher input impedance, high output impedance, higher bandwidth.
14. Cascode amplifier circuit consists of CE amplifier stage in series with a CB stage. The collector current of transistor Q_1 forms the emitter current of transistor Q_2. The two transistors Q_1 and Q_2 are said to be connected in Cascode and form one CE transistor with negligible internal feedback.
15. The reverse open-circuit voltage amplification h_{12} of Cascode amplifier is much smaller than reverse open-circuit voltage amplification, h_{re} for a single stage CE transistor or h_{rb} for a single stage CB transistor. Due to small value of h_{12} of Cascode amplifier, it is used in tuned amplifiers.
16. In ac amplifiers, each transistor stage in amplifier circuit is isolated from the other stages for dc variations, due to this the stability factor of each stage is also isolated from the other stages and it is easy to maintain stable operation. Whereas in dc amplifiers, it is difficult to maintain stable operation.

17. The reason is, in basic two stage dc amplifier, if the collector current of first transistor stage varies slightly due to temperature variation, as this collector current will be input to the second transistor stage as base current, the second transistor stage amplifies this change and also adds its own variation caused by temperature variation. This interdependent of each transistor stage on other transistor stages reduces the stability of the operating point in dc amplifier. The stability of basic two stage dc amplifier is improved by adding series and shunt stabilization resistors.
18. Differential amplifier is used as a dc amplifier and it provides good stability. In differential amplifier the output voltage(v_o) is proportional to the difference between the input voltages(v_{i1}~v_{i2}).
19. The ideal operational amplifier has two input signals v_{i1} and v_{i2} applied to inverting and non-inverting terminals and output will be amplification of difference between these two signals.
20. The instrumentation amplifiers are used to amplify the low level differential signals very precisely, in presence of the large common mode noise and interference signals.

Short Questions (minimum 10 previous JNTUH Questions)

1. What is meant by dc amplifier?
2. In what respects does a dc amplifier differ from an ac amplifier?
3. What are the principal applications of dc amplifiers?
4. What is meant by drift in dc amplifiers?
5. What are the main causes of drift in dc amplifiers?
6. How can drift be minimized in dc amplifiers?
7. What is meant by operational amplifier?
8. List any three ideal specifications of operational amplifier?
9. Draw the basic circuit of differential amplifier?
10. Write short notes on need for dc amplifiers?

Long Questions (minimum 10 previous JNTUH Questions)

1. Draw the circuit and describe the working of a basic two stage dc amplifier?
2. Draw the circuit and describe the operation of Darlington emitter follower as dc amplifier?
3. Write expressions for input resistance, overall voltage gain, overall current gain and output resistance of Darlington emitter follower?
4. Draw the basic circuit and explain about Cascode amplifier?
5. Give the principle of chopper stabilized dc amplifier?

6. Draw the circuit and describe the working of ring bridge type of chopper?
7. Draw the circuit and describe the working of a single transistor chopper and two transistor chopper?
8. Draw the circuit and describe the working of differential dc amplifier using Op Amp?
9. Draw the circuit and describe the working differential bridge type dc amplifier using Op amp?
10. How can stability factor can be improved? Write expression for the overall stability factor of a two stage direct coupled CE amplifier?

Fill in the Blanks / Choose the Best: (Minimum 10 to 15 with Answers)

1. DC amplifiers are capable of amplifying frequency components **down to zero frequency**.
2. DC amplifiers uses the **direct coupling** arrangement for coupling the output of one stage to the next.
3. The main problem associated with a dc amplifier is **drift in the output current**.
4. Drift in a basic dc amplifier minimized by maintaining **supply voltage constant** and using resistors having **high temperature and humidity stability**.
5. A dc amplifier using Darlington emitter follower as compared with a single stage emitter follower offers **high current gain** and **higher input resistance**.
6. A Cascode dc amplifier offers **extremely small internal feedback** and **high output impedance**.
7. In a dc amplifier, as the number of stages is increased, **the stability factor increases**.
8. Stability of a dc amplifier improved by **using negative resistance**.
9. In a differential amplifier type of dc amplifier, stability is greatly increased by using **high value of emitter circuit resistor R_e**.
10. A chopper stabilized dc amplifier **chops the signal in time domain**.

Unit-II: Regulated Power Supplies, Switched Mode and IC Regulators

Important points / Definitions: (Minimum 15 to 20 points covering complete topics in that unit)

1. A voltage regulator is an electronic or electrical device which can sustain the voltage of power supply within suitable limits. It regulates the voltage regardless of the alteration in the input voltage or connected load.
2. There are two main types of voltage regulators, they are Linear Voltage Regulators and Switching Voltage Regulators.
3. Linear voltage regulator performs as a voltage divider. There are two types of linear voltage regulators. They are Series voltage regulator and Shunt voltage regulator.
4. Series Voltage Regulator implements a variable element positioned in series with the connected load. Further series voltage regulator is classified in to two. They are Discrete Transistor Series Voltage Regulator and Zener Diode as Voltage Regulator
5. In shunt voltage regulator the control element is in parallel to the load. There are two types of shunt voltage regulators. They are Discrete Transistor Shunt Voltage Regulator and Zener Controlled Transistor Shunt Voltage Regulator
6. Voltage regulators required to handle wide range of supply voltage and load currents. Therefore it is necessary to use protection circuit to avoid damage to the circuit in the presence of short duration over loads.
7. A switching regulator rapidly switches a series device on and off. The switch's duty cycle sets the amount of charge transferred to the load.
8. Unlike linear regulators, Switching regulators are able to generate output voltages that are higher than the input voltage or of opposite polarity.
9. The switching voltage regulator switches on and off rapidly to alter the output. It requires a control oscillator and also charges storage components.
10. Constant duty cycle and noise spectrum is imposed in a switching regulator with Pulse Rate Modulation varying frequency and it is more difficult to filter out that noise.
11. A switching regulator with Pulse Width Modulation, having constant frequency and varying duty cycle is efficient and easy to filter out noise.
12. In a switching regulator, continuous mode current through an inductor never drops to zero. It allows the highest output power and gives better performance.

13. In a switching regulator, discontinuous mode current through the inductor drops to zero. It gives better performance when the output current is low.
14. Servo voltage stabilizer is a closed loop control mechanism which is used to maintain balance three or single phase voltage output in spite of fluctuations at the input due to unbalanced conditions.
15. There are two types of Monolithic IC voltage regulators, they are with adjustable positive or negative outputs and with fixed positive or negative outputs.
16. In with adjustable positive or negative output IC regulators, the regulated output voltage may be chosen and set to any desired value between two fairly wide limits.
17. With fixed positive or negative outputs is a 3-terminal device and is commonly used for +5V supply for logic gates such as TTL or +24V for certain relays.
18. Advantages of Monolithic IC Voltage regulators are adjustable output voltage, facilities of building positive and negative regulated voltages, output current limiting facilities, remote shut down control, better ripple rejection, higher regulated currents possible with the use of series pass elements.
19. Monolithic IC voltage regulators are series control type. It consists of the basic circuit elements like sampling element, reference element, comparison element, d.c. amplifier and series control element.
20. 3-terminal linear fixed voltage regulators are a popular choice for creating either positive or negative voltages. There are fixed and adjustable three terminal voltage regulators.

Short Questions (minimum 10 previous JNTUH Questions)

1. Draw the block diagram of regulated power supplies?
2. What is regulated power supply?
3. Explain the working principle voltage regulation?
4. Write short notes on short circuit protection?
5. Explain about over voltage protection technique?
6. Explain about thermal protection?
7. Compare linear and switched mode voltage regulators?
8. Explain about three terminal voltage regulator?
9. Write about current boosting in three terminal voltage regulators?
10. Draw the block diagram of series type linear voltage regulator?

Long Questions (minimum 10 previous JNTUH Questions)

1. Draw the block diagram and explain about shunt type linear voltage regulator?
2. Draw the block diagram and explain about series type linear voltage regulator?
3. Explain about protection techniques in voltage regulators?
4. Draw the circuit diagram and explain about switched mode voltage regulator?
5. Explain briefly about servo voltage regulator?
6. Explain about fixed monolithic IC voltage regulator?
7. Explain about adjustable monolithic IC voltage regulator?
8. Explain briefly about three terminal voltage regulators?
9. Draw the block diagram of regulated power supply and describe about it?
10. Give the schematic circuit of a monolithic voltage regulator and describe its working?

Fill in the Blanks / Choose the Best: (Minimum 10 to 15 with Answers)

1. Linear voltage regulator performs as a **voltage divider**.
2. In **shunt voltage** regulator the control element is in parallel to the load.
3. A **switching regulator** rapidly switches a series device on and off.
4. **Switching regulators** are able to generate output voltages that are higher than the input voltage.
5. Monolithic IC voltage regulators are **series control** type.
6. **Three-terminal linear fixed** voltage regulators are a popular choice for creating either positive or negative voltages.
7. Servo voltage stabilizer is a **closed loop** control mechanism.
8. **Series Voltage** Regulator implements a variable element positioned in series with the connected load.
9. A **voltage regulator** is an electronic or electrical device which can sustain the voltage of power supply within suitable limits.
10. In a switching regulator, continuous mode current through an inductor never drops to **zero**.