

Unit-I

Chapter 1 : Low Power Amplifiers **1-1 to 1-38**

Syllabus : Classification of amplifiers, BJT as an amplifier, Single stage CE amplifier, Frequency response, Gain, Bandwidth, Multistage amplifier : General multistage amplifier, BJT based. Type of BJT amplifier coupling : Circuit diagram, Operation, Frequency response and applications of RC, Transformer and direct coupling.
 FET amplifier : Common source amplifier, Working principle and applications.

1.1	Introduction	1-2
1.2	Amplification and Amplifier	1-2
1.3	Block Diagram of an Amplifier	1-2
1.3.1	Amplifier Characteristics	1-3
1.4	Classification of Amplifiers	1-4
1.4.1	Classification Based on the Purpose of Amplification	1-4
1.4.2	Classification Based on the Frequency Range	1-5
1.4.3	Classification Depending on the Position of Q Point	1-5
1.4.4	Classification Depending on the Type of Coupling	1-5
1.5	BJT Small Signal Amplifier	1-6
1.5.1	Transistor as a Current Amplifier	1-6
1.5.2	Transistor as a Voltage Amplifier	1-7
1.5.3	Meaning of Small Signal Amplifier	1-8
1.6	Single Stage RC Coupled CE Amplifier	1-8
1.6.1	Circuit Components their Functions and Selection Criteria	1-9
1.6.2	Operation of the RC Coupled Amplifier	1-11
1.6.3	Graphical Analysis of Amplifier Operation	1-13
1.6.4	Effects of Q-point Position	1-15
1.6.5	AC Load Line	1-15
1.6.6	Single Stage RC Coupled Amplifier using PNP Transistor	1-15
1.7	AC Equivalent Circuit	1-17
1.8	Frequency Response and Bandwidth of RC Coupled CE Amplifier	1-18
1.8.1	Different Regions in Frequency Response	1-18
1.8.2	Bandwidth of an Amplifier	1-19



1.8.3	Definitions of Upper and Lower Cutoff Frequencies	1-19
1.8.4	Factors Affecting the Bandwidth of the RC Coupled Amplifier	1-20
1.8.5	Effect of Coupling Capacitors	1-20
1.8.6	Effect of Bypass Capacitor	1-20
1.8.7	Effect of Transistor Internal Capacitance	1-21
1.8.8	Important Features of a CE Amplifiers	1-21
1.9	Multistage Amplifier	1-21
1.9.1	Requirements of a Multistage Amplifier	1-22
1.9.2	Gain of the Cascaded Configuration	1-22
1.9.3	A General Multistage Amplifier	1-23
1.9.4	Gain in Decibels	1-23
1.10	BJT Based Multistage Amplifier	1-24
1.10.1	Frequency Response and Bandwidth of Multistage Amplifier	1-25
1.11	Types of Amplifier Coupling	1-25
1.11.1	R-C Coupled Amplifiers	1-26
1.11.2	Transformer Coupled Amplifiers	1-27
1.11.3	Direct Coupled Amplifiers	1-29
1.11.4	Comparison of Different Coupling Techniques	1-30
1.12	Common Source (CS) FET Amplifier	1-31
1.12.1	Circuit Description	1-31
1.12.2	Working	1-32
1.12.3	Features of CS Amplifier	1-33
1.12.4	Applications	1-33
1.12.5	Graphical Representation	1-33
1.12.6	CS Amplifier with P-channel JFET	1-33
1.13	I-Scheme Solved Examples	1-35
1.14	MSBTE Questions and Answers	1-35
1.15	I-Scheme Questions and Answers.....	1-38
	• Review Questions	1-34

Unit-I

Chapter 2 : Tuned Amplifiers

2-1 to 2-15

Syllabus : Need for tuned amplifier, Basic tuned circuit, Circuit diagram, Operating principle and frequency response of single tuned, Double tuned and stagger tuned amplifiers.

2.1	Introduction	2-2
2.1.1	Need of Tuned Amplifiers	2-2
2.1.2	Basic Tuned Circuits	2-3
2.1.3	Role of Tuned Circuit in Tuned Amplifier	2-3
2.2	Classification of Tuned Amplifiers	2-3
2.3	Single Tuned CE Amplifier	2-4
2.3.1	Operation	2-4
2.3.2	Frequency Response and Bandwidth	2-5
2.3.3	Advantages of Single Tuned Amplifiers	2-6
2.3.4	Disadvantages	2-6
2.3.5	Applications	2-6
2.4	Double Tuned Amplifier	2-6
2.4.1	Frequency Response and Bandwidth	2-7
2.4.2	Advantages of Double Tuned Amplifiers	2-8
2.4.3	Disadvantages	2-8
2.4.4	Applications	2-8
2.5	Stagger Tuned Amplifiers	2-8
2.5.1	Advantage of Stagger Tuning	2-9
2.5.2	Disadvantages	2-9
2.5.3	Application	2-10
2.6	Neutralization in RF Tuned Amplifiers	2-10
2.6.1	Advantages of Tuned Amplifiers	2-11
2.6.2	Disadvantages of Tuned Amplifiers	2-11
2.6.3	Applications of Tuned Amplifier	2-11
2.7	Comparison of Single, Double and Stagger Tuned Circuits	2-11

2.8	I-Scheme Solved Examples.....	2-12
2.9	MSBTE Questions and Answers	2-13
2.10	I-Scheme Questions and Answers	2-14
	• Review Questions.....	2-12

Unit-II

Chapter 3 : High Power Amplifiers

3-1 to 3-39

Syllabus : Comparison between small signal amplifier and power amplifier, Performance parameter of power amplifier like : Bandwidth, Gain, Frequency band, Efficiency, Classification : class A, class B, class AB and class C, Circuit operation, Input /output waveforms, Efficiency and power equations of single stage class A, Class B, Class AB and Class C power amplifiers.

3.1	Introduction	3-2
3.1.1	Comparison of Small Signal and Power Amplifiers	3-2
3.1.2	Block Schematic of AF Amplifier	3-3
3.1.3	Applications of Power Amplifier	3-3
3.1.4	Important Features of a Power Amplifier	3-3
3.1.5	Efficiency	3-4
3.2	Classification of Power Amplifiers	3-5
3.2.1	Class A Power Amplifier	3-5
3.2.2	Class B Power Amplifiers	3-7
3.2.3	Class AB Amplifier	3-8
3.2.4	Class C Amplifiers	3-9
3.2.5	Comparison of Different Types of Power Amplifiers	3-10
3.3	Single Stage Class A Power Amplifiers	3-10
3.3.1	Series Fed, Directly Coupled Class A Amplifier	3-11
3.3.2	Voltage Equations and Efficiency	3-12
3.3.3	Advantages of Directly Coupled Class A Amplifier	3-16
3.3.4	Disadvantages of Directly Coupled Class A Amplifier	3-16
3.4	Transformer Coupled Class A Power Amplifier	3-16
3.4.1	Power Equations and Efficiency	3-17



3.4.2	Advantages of Transformer Coupled Class A Amplifier	3-19
3.4.3	Disadvantages of Transformer Coupled Class A Amplifier	3-19
3.5	Class A Push-Pull Amplifier	3-20
3.5.1	Harmonic Analysis	3-21
3.5.2	Advantages of Push-Pull Amplifiers	3-22
3.5.3	Disadvantages of Push-Pull Amplifiers	3-22
3.6	Class B Power Amplifier	3-22
3.6.1	Class B - Push Pull Amplifier	3-22
3.6.2	Power Equations and Efficiency	3-24
3.6.3	Advantages of Class B Amplifier	3-26
3.6.4	Disadvantages	3-26
3.6.5	Applications of Class B Amplifiers	3-26
3.6.6	Complementary Symmetry Class B Amplifier	3-26
3.6.7	Advantages of Complementary Symmetry Amplifier	3-28
3.6.8	Disadvantages of Complementary Symmetry Amplifier	3-28
3.6.9	Comparison of Class B Push-pull and Complementary Symmetry Circuits	3-29
3.7	Concept of Cross-over Distortion	3-29
3.7.1	Complementary Push Pull and Crossover Distortion	3-30
3.8	Class AB Push Pull Amplifier	3-31
3.8.1	Complementary Symmetry Class AB Amplifier	3-31
3.9	Class C Amplifiers	3-32
3.10	I-Scheme Solved Examples.....	3-35
3.11	MSBTE Questions and Answers	3-35
3.12	I-Scheme Questions and Answers	3-38
	• Review Questions.....	3-34

Unit-III

Chapter 4 : Feedback Amplifiers**4-1 to 4-25**

Syllabus : Principle of feedback amplifier, Types of feedback : Negative and positive feedback, Advantages and disadvantages of negative feedback. Types of feedback connections, Voltage shunt, Voltage series, Current series and current shunt, Block diagram, Circuit diagram and operation.



4.1	Introduction	4-2
4.1.1	Comparison of Positive and Negative Feedback	4-2
4.2	Classification of Amplifiers Based on Feedback Topology	4-3
4.3	Concept of Feedback	4-3
4.3.1	Amplifier without Feedback	4-3
4.3.2	Amplifier with Feedback	4-4
4.3.3	Amplifier with a Negative Feedback	4-4
4.3.4	Sampling Network	4-5
4.3.5	Comparator or Mixer Network	4-6
4.3.6	Feedback Network	4-7
4.3.7	Positive or Negative Feedback	4-7
4.4	Types of Negative Feedback	4-9
4.4.1	Voltage Series Feedback	4-9
4.4.2	Voltage Shunt Feedback	4-9
4.4.3	Current Series Feedback	4-10
4.4.4	Current Shunt Feedback	4-10
4.4.5	Advantages of using Negative Feedback	4-11
4.4.6	Disadvantages of Negative Feedback	4-11
4.4.7	Applications of Negative Feedback	4-12
4.5	Effects of Negative Feedback	4-12
4.5.1	Stabilization of Gain (Desensitivity of Transfer Amplification)	4-12
4.5.2	Effect of Negative Feedback on Input Resistance of Amplifier	4-13
4.5.3	Effect on the Output Resistance	4-13
4.5.4	Effect on Bandwidth	4-14
4.5.5	Effect on the Nonlinear Distortion	4-15
4.5.6	Effect on Noise	4-16
4.5.7	Comparison of Various Feedback Topologies	4-16
4.6	Voltage Series Feedback	4-17
4.6.1	Emitter Follower using Transistor	4-17



4.7	Current Series Feedback	4-19
4.7.1	CE Transistor Amplifier with Unbypassed Re	4-19
4.8	Current Shunt Feedback	4-20
4.9	Voltage Shunt Feedback	4-21
4.10	I-Scheme Solved Examples.....	4-23
4.11	MSBTE Questions and Answers	4-24
4.12	I-Scheme Questions and Answers	4-25
	• Review Questions	4-23

Unit-IV

Chapter 5 : Oscillators**5-1 to 5-20**

Syllabus : Oscillators : Need, Oscillator and amplifier, Condition for oscillation (Barkhausen's criteria), Classification of oscillators, Sine wave oscillator : RC phase shift oscillator and crystal oscillator, Concept, Working and applications.

5.1	What is Oscillators ?	5-2
5.1.1	Need of Oscillators.....	5-2
5.1.2	Block Diagram of an Oscillator	5-2
5.1.3	Oscillator and Amplifier	5-3
5.1.4	Comparison of Amplifier and Oscillator	5-3
5.2	Positive Feedback	5-3
5.2.1	Expression for the Gain with Positive Feedback (A_f)	5-5
5.3	Barkhausen Criteria (Condition for Oscillations)	5-5
5.4	Classification of Oscillators	5-6
5.4.1	RC Oscillators	5-6
5.4.2	LC Oscillators	5-7
5.5	RC Phase Shift Oscillator	5-7
5.5.1	RC Network for the Phase Shift Oscillator	5-7
5.5.2	R-C Phase Shift Oscillator using Transistor	5-8
5.5.3	Phase Shift Oscillator using FET	5-9
5.5.4	Advantages of Phase Shift Oscillator	5-10
5.5.5	Disadvantages of Phase Shift Oscillator	5-10
5.5.6	Examples on RC Phase Shift Oscillator	5-10



5.5.7	Applications of RC Oscillators	5-11
5.6	Crystal Oscillators	5-11
5.6.1	Equivalent Circuit of a Crystal	5-12
5.6.2	Types of Crystal Oscillators	5-13
5.6.3	Pierce Crystal Oscillator	5-13
5.6.4	Miller Crystal Oscillator	5-14
5.6.5	Advantages of Crystal Oscillator	5-14
5.6.6	Disadvantages of Crystal Oscillator	5-15
5.6.7	Applications of Crystal Oscillators	5-15
5.7	General Applications of Oscillator	5-15
5.8	Comparison of RC, LC and Crystal Oscillators	5-16
5.9	I-Scheme Solved Examples.....	5-17
5.10	MSBTE Questions and Answers	5-18
5.11	I-Scheme Questions and Answers.....	5-19
	• Review Questions.....	5-16

Unit-IV

Chapter 6 : Sweep Generators**6-1 to 6-23**

Syllabus : Sweep generators : Miller sweep, Bootstrap circuit, Current time base generator.
--

6.1	Sweep (Time Base) Generators	6-2
6.1.1	Applications of Time Base Generators	6-2
6.1.2	Time Domain Display	6-2
6.2	Classification of Time Base Generators	6-3
6.3	General Features of a Time Base Signal	6-3
6.3.1	Errors in Generation of Sweep Waveform	6-4
6.3.2	The Slope or Sweep Speed Error (e_s)	6-4
6.3.3	The Displacement Error (e_d)	6-4
6.3.4	The Transmission Error (e_t)	6-5
6.3.5	Parameters of Time Base Generator	6-5



6.4	Methods of Generating a Voltage Time Base Waveform	6-7
6.4.1	Exponential Charging	6-7
6.4.2	Constant Current Charging	6-7
6.4.3	The Miller Circuit	6-7
6.4.4	The Phantastron Circuit	6-7
6.4.5	The Bootstrap Circuit	6-7
6.4.6	Compensating Networks	6-8
6.4.7	An Inductor Circuit	6-8
6.5	The Exponential Sweep Circuit (Voltage Time Base Generator)	6-8
6.6	Miller Time-Base (Sweep) Generator	6-9
6.6.1	Principle of Operation	6-9
6.6.2	Miller Time Base (Sweep) Generator	6-10
6.6.3	Miller Sweep Generator using OP-AMP	6-11
6.6.4	Applications of Miller Sweep Generator.....	6-11
6.7	Basic Bootstrap Time Base Generator	6-12
6.7.1	Practical Bootstrap Circuit	6-12
6.8	The Complete Bootstrap Sweep Circuit	6-14
6.8.1	Operation of the Circuit	6-14
6.8.2	Comparison of Miller Sweep and Bootstrap Sweep	6-16
6.9	Current Time Base (Sweep) Generator	6-17
6.10	A Simple Current Sweep	6-18
6.10.1	A Transistor Current Time Base Generator	6-20
6.10.2	Applications of the Current Sweep Circuit	6-20
6.11	MSBTE Questions and Answers	6-21
6.12	I-Scheme Questions and Answers.....	6-22
	• Review Questions.....	6-20

Unit-V

Chapter 7 : IC Voltage Regulators & SMPS

7-1 to 7-40

Syllabus : Types of IC voltage regulator : Fixed and variable : 78XX, 79XX, Specification, Series and LM 723, LM 317, Line and load regulation.

SMPS : Block diagram, Working principle, Specifications, Special features, Advantages, Disadvantages and applications, Use of heat sink for regulated power supply.

7.1	Introduction to Voltage Regulators	7-2
7.2	Factors Affecting the Output Voltage	7-3
7.3	Specifications or Performance Parameters of a Voltage Regulator	7-4
7.3.1	Load Regulation	7-4
7.3.2	Line Regulation or Source Regulation	7-5
7.4	Block Diagram of a Linear Series Regulator	7-5
7.5	IC Voltage Regulators	7-6
7.5.1	Important Features of IC Regulators	7-6
7.5.2	Classification of IC Voltage Regulators	7-7
7.6	Three Terminal IC Regulators	7-7
7.6.1	Advantages of IC Regulators	7-7
7.6.2	Classification of Three Terminal IC Voltage Regulators	7-8
7.6.3	Block Diagram of a Three Pin IC Voltage Regulator	7-8
7.7	Three Terminal Fixed Voltage Regulators	7-9
7.7.1	78XX Series (Fixed Positive Voltage Regulator)	7-9
7.7.2	79XX Series (Fixed Negative Voltage Regulator)	7-9
7.7.3	Standard Connections for Positive Fixed Voltage Regulator (78XX)	7-10
7.7.4	A Positive 12 V Power Supply using IC 7812	7-11
7.7.5	Adjustable Voltage Regulator using 78XX Series	7-11
7.7.6	Standard Connections for Negative Fixed Voltage Regulators (79XX Series)	7-12
7.7.7	A – 12 V Power Supply using IC 7912	7-13
7.7.8	+5 V, 100 mA Fixed Voltage Supply for Logic Circuits	7-14
7.7.9	Dual Polarity Power Supply	7-14
7.7.10	Specifications of Three Pin Regulator ICs	7-15



7.7.11	Advantages and Features of IC 78XX and 79XX	7-16
7.7.12	Applications of 78XX Series	7-17
7.8	IC 723 - The General Purpose Regulator	7-17
7.8.1	Features of IC 723	7-17
7.8.2	Functional Block Diagram	7-18
7.9	Applications of IC 723	7-19
7.9.1	A Low Voltage Low Current (Basic Low Voltage Regulator)	7-20
7.9.2	Low Voltage High Current Regulator	7-21
7.9.3	A High Voltage Low Current Regulator (Basic High Voltage Regulator)	7-22
7.9.4	High Voltage High Current Regulator	7-23
7.9.5	Variable Output Voltage Power Supply	7-24
7.10	Three Terminal Adjustable Voltage Regulators	7-24
7.10.1	Adjustable Positive Voltage Regulators (LM 317)	7-25
7.10.2	Block Diagram of LM 317	7-25
7.10.3	Features of IC LM 317	7-26
7.10.4	Typical Connection Diagram for LM 317 Regulator	7-26
7.10.5	Practical Regulator using LM 317	7-28
7.10.6	Design of Three Terminal Adjustable Voltage Regulator	7-28
7.11	Comparison of 78 XX and LM 317 Regulators	7-31
7.12	Switch Mode Power Supply (SMPS)	7-31
7.12.1	Block Diagram I-Scheme	7-31
7.12.2	Working Principle I-Scheme	7-31
7.12.3	Complete Switched Mode Regulator	7-32
7.12.4	Special Features	7-33
7.12.5	Classification of SMPS	7-34
7.13	Advantages and Disadvantages of SMPS	7-34
7.14	Specifications of SMPS	7-35
7.15	Applications of SMPS	7-35
7.16	Comparison of Linear and Switching Mode Regulators	7-35



7.17	Use of Heat Sink for Regulated Power Supply	7-36
7.18	MSBTE Questions and Answers	7-39
7.19	I-Scheme Questions and Answers	7-40
	• Review Questions	7-37

□□□