

# Content Product

## Detailed syllabus

### ELECTRONIC CIRCUITS - I

#### UNIT I - BIASING OF DISCRETE BJT AND MOSFET

**Transistor** - Introduction to transistor, Formation of transistor, Types of transistor, PNP transistor, NPN transistor, Transistor currents, Operation region of a transistor (CB configuration). **Transistor configurations** - Common base configuration, Common emitter configuration, Common collector configuration, Comparison of three configurations. **Need for biasing and fixed bias circuit** - Need for biasing, Operating point and Stability factor, Fixed bias circuit, Design example for fixed bias circuit. **DC Load Line** - DC Load Line, Problem to locate the dc operating point, Problem to determine the operating point, Selection of operating point. **Variation of Quiescent point** - Variation of quiescent point, Temperature, Variation of  $h_{FE}$  ( $\beta$ ) within manufacturers tolerance, Requirements of a biasing circuit. **Stability factors** - Stability factors, Stability factor,  $S$ , Stability factor,  $S'$ , Stability factor,  $S''$ . **Various biasing methods for BJT** - Transistor biasing, Various biasing methods for BJT. **Fixed bias using a PNP transistor** - Fixed bias using a PNP transistor, Stability factor  $S$ , Stability factor,  $S'$ , Stability factor,  $S''$ , Advantages and disadvantages of fixed bias circuit, Problem to find stability factor  $S$ , Problem to determine  $R_C$ . **Collector to base bias circuit** - Collector to base bias circuit, Problems to determine  $I_C$  and  $V_C$ , Design Examples, Modified collector to base bias circuit, Problems to determine operating point, Stability Factor  $S$  for collector to base bias circuit, Stability factor,  $S'$ , Stability factor,  $S''$ , Problems to determine  $R_B$ , Problems to determine operating point of the circuit. **Voltage divider bias / Self bias circuit** - Voltage divider bias / Self bias circuit, Simplified circuit of voltage divider bias, Problem to calculate  $V_{CE}$  and  $I_C$ , Problem to find the  $Q$  – point, Stability factor for Voltage divider bias, Voltage divider (self ) Bias using PNP transistor, Design example. **Emitter stabilized bias circuit** - Emitter stabilized bias circuit, Circuit analysis, Problem to determine  $I_B$ ,  $I_C$ ,  $V_{CE}$ ,  $V_C$ ,  $V_E$  and  $V_{BC}$ , Stability improvement. **Miscellaneous bias configurations** - Miscellaneous bias configurations, Problems to determine  $I_B$ ,  $I_C$ ,  $V_{CE}$  and  $I_E$ , Comparison of basic biasing circuits. **Bias Compensation** - Bias Compensation, Need for Bias compensation, Types of bias compensation. **Diode compensation techniques** - Diode compensation, Thermistor compensation, Sensistor compensation. **Thermal Stability** - Thermal Stability, Thermal resistance, The Condition for thermal stability. Problem to calculate the value of thermal resistance. **Design of biasing for JFET** - Introduction to JFET, Fixed bias, Problem to determine  $V_{DSQ}$ ,  $V_{GSQ}$ ,  $V_D$ ,  $I_{DQ}$ , Voltage divider bias circuit, Problem to determine  $V_{DQ}$ ,  $V_{GSQ}$ ,  $V_D$ ,  $V_S$ ,  $V_{DS}$  and  $V_{DG}$ , Self bias circuit, Problem to find out the value of feedback resistor, Design a JFET circuit with a voltage divider bias. **Design of biasing for MOSFET** - Introduction to biasing of MOSFET, Biasing of E-MOSFET Common-Source Circuit, Problem to find  $I_D$  and  $V_{DS}$  or Problem to calculate D.C operating condition, Biasing circuit for p-channel enhancement-mode MOSFET, Problem to find  $I_D$  and  $V_{SD}$ , Load line and modes of operation, Problem to find the transition parameters for the circuit. D.C. analysis of common MOSFET configurations- CS circuit with source resistor, Problem to calculate  $V_{DS}$ ,  $V_{GS}$ ,  $V_G$ ,  $I_D$ , Constant current source biasing circuit, Problem to design a circuit using MOSFET, Biasing common source circuit with enhancement load device, Problem to calculate  $V_{GS}$  and  $I_D$ , Voltage transfer characteristics, Biasing common source circuit with depletion load device, Design examples, Voltage transfer characteristics. **Constant-current source biasing** - Constant-current source

biasing, Problem to determine currents and voltages in the MOSFET constant current source, Biasing Circuit for D MOSFET, Problem to calculate  $I_D$ ,  $V_{DS}$ ,  $V_G$  and  $V$ .

### UNIT II - BJT AMPLIFIERS

**BJT amplifiers** - Introduction to amplifiers, Classification of amplifiers. **BJT device models** - BJT device models, Small signal models. **Hybrid parameter** - Hybrid parameter, Equivalent circuit for h parameter, Benefits of h-parameters. **Hybrid-pi model** - Hybrid-pi model, BJT mid-frequency analysis of a CE amplifier using the hybrid-p model, Small-signal Voltage Gain ( $A_V$ ) of a CE amplifier using the hybrid-p model, Hybrid –  $\pi$  equivalent circuit including early effect. **Small signal analysis of common emitter amplifier** - Small signal analysis of common emitter amplifier, Derivation of  $R_i$ ,  $A_V$ ,  $R_O$ , Problem to determine  $R_i$ ,  $A_V$  and  $R_O$ , Common emitter amplifier with unbypassed  $R_E$ . **Load lines and voltage swing limitations** - Introduction to transistor load lines, A.C load lines, Problem to draw a.c and d.c load lines, Voltage swing limitation, Problem to determine the maximum symmetrical voltage swing. **Small signal analysis of common collector (emitter follower) amplifier** - Small signal analysis of common collector (emitter follower) amplifier, Derivation of  $R_i$ ,  $A_V$ ,  $A_i$ , Derivation of  $R_o$ . **Small signal analysis of Common base amplifier** - Small signal analysis of Common base amplifier, Derivation of  $A_V$ , Derivation of  $A_i$ , Derivation of  $R_i$ , Derivation of  $R_o$ . **Small signal analysis using h-Parameter model** - h-Parameters for all three configurations, Midband analysis of BJT Single Stage Amplifiers, Small signal analysis of common emitter using h-Parameter model, Method for analysis of a transistor circuit, Problem to calculate the values of  $A_i$ ,  $A_V$ ,  $Z_i$ , and  $Y_O$ . **Small signal analysis using simplified h-Parameter model** - Analysis using Simplified Hybrid Model, Analysis of Common Emitter Circuit using Simplified Hybrid Model, Analysis of Common Collector Circuit using Simplified Hybrid Model, Analysis of Common Base Circuit using Simplified Hybrid Model. **Differential amplifier** - Differential amplifier, Features of differential amplifier, Problem to determine the output voltage of differential amplifier. **BJT differential amplifier** - BJT differential amplifier, Differential mode operation, Common mode operation, Configurations of differential amplifier. **DC transfer characteristics** - DC transfer characteristics. **Small signal analysis of differential amplifier** - Small signal analysis of differential amplifier, Common Mode Rejection Ratio (CMRR), Problem to calculate  $A_d$ ,  $A_{cm}$  and CMRR. **Darlington amplifier** - Darlington amplifier, Darlington transistors. **Bootstrap technique** - Bootstrap technique. **Multistage amplifier** - Need for cascading, Two stage cascaded amplifier. **Cascade amplifier** - Cascade amplifier, Features of cascade amplifier.

### UNIT III - JFET AND MOSFET AMPLIFIERS

**Junction Field Effect Transistor (JFET)** - Introduction to field effect transistor, Terminal details of JFET, Classification of Field Effect Transistor (FET), Junction Field Effect Transistor (JFET), JFET as an amplifier. **Small signal analysis of JFET** - Small signal analysis of JFET, Approximate a.c. equivalent circuit, Common source amplifier with fixed bias, Analysis of common source amplifier with fixed bias, Problem to determine input impedance, output impedance and voltage gain. **Small signal analysis of common drain amplifiers** - Common drain amplifier with fixed bias, Input impedance  $Z_i$  and output impedance  $Z_o$ , Voltage gain  $A_V$ , Problem to determine input impedance, output impedance and voltage gain. **Small signal analysis of common gate amplifiers** - Common gate amplifier with fixed bias,

## Content Product

### Detailed syllabus

Input impedance  $Z_i$ , Output impedance  $Z_o$  and voltage gain  $A_V$ , problem to determine input impedance, output impedance and voltage gain. **MOSFET** - Introduction to MOSFET, MOSFET structure, Classification of MOSFET, Operation of MOSFET, MOSFET amplifier. **Small signal parameters** - Small signal parameters. **Small signal equivalent circuit** - Small signal equivalent circuit, Problems to determine the small signal voltage gain, Steps in the a.c analysis of MOSFET amplifier, CS MOSFET amplifier with p-channel MOSFET. **Common source amplifier**- Basic common-source configuration, Problem to determine the small signal voltage gain, Common-source amplifier with source resistor, Problem to calculate the voltage gain of amplifier, Common-source circuit with source bypass capacitor, Problem to calculate the voltage gain, Voltage swing limitation. **MOSFET source follower amplifier** - MOSFET source follower amplifier, PMOS source follower amplifier, Problem to determine  $R_i$ ,  $A_v$  and  $R_o$ . **MOSFET common gate amplifier** - MOSFET common gate amplifier, Input resistance ( $R_i$ ) and Voltage gain ( $A_V$ ), Current gain ( $A_i$ ) and output resistance ( $R_o$ ). **BiCMOS cascode amplifier** - BiCMOS cascode amplifier, Basic amplifier stages, Circuit analysis, Bipolar cascode configuration, Current sources, BiCMOS differential amplifier, BiCMOS inverter. **Comparison between JFET and MOSFET** - Comparison of JFET and MOSFET, Advantages of MOSFET over JFET, Application of MOSFET.

### UNIT IV - FREQUENCY ANALYSIS OF BJT AND MOSFET AMPLIFIERS

**Frequency Response of Amplifier** - I General shape of frequency response of amplifiers, Cutoff frequency and bandwidth. **Frequency response of BJT circuits** - The Decibel Unit, Significance of Octaves and Decades, Midband Gain, Effect of various capacitors on frequency response, Miller effect, Low frequency analysis of BJT, Problem to find the low frequency response of the amplifier circuit, High frequency response of BJT. **Hybrid -  $\pi$  Equivalent Circuits of BJTs** - Hybrid -  $\pi$  Equivalent Circuits of BJTs, Hybrid -  $\pi$  Common Emitter Transistor Model, Hybrid -  $\pi$  conductances, The input and feedback conductance, The output conductance, Hybrid -  $\pi$  capacitances. **CE short circuit current gain** - CE short circuit current gain using hybrid  $\pi$  model, Current gain with resistive load, Current gain including source resistance, Voltage gain including source resistance, The cutoff frequency including source resistance, Gain bandwidth product, Problem to determine the bandwidth of amplifier. **Internal capacitance of MOSFET and High frequency model** - Internal capacitance of MOSFE, Gate capacitance, Junction capacitance, High frequency MOSFET model, Unity-Gain frequency ( $f_T$ ). **Frequency response of CS amplifier** - Frequency response of CS amplifier, High frequency response, Low frequency response. **Bandwidth of multistage amplifier** - Overall lower cut-off frequency of multistage amplifier, Over all higher cut-off frequency of multistage amplifier. **Rise Time and its relation to Upper Cut-off frequency** - Upper 3 dB frequency, Relation between bandwidth and rise time. **Sag and its Relation to Lower Cut-off Frequency** - Sag and its Relation to Lower Cut-off Frequency, Problems to calculate percentage tilt.

### UNIT V - IC MOSFET AMPLIFIERS

**IC amplifiers**- IC MOSFET amplifier, MOSFET current sources. **MOSFET current mirror circuit** - MOSFET current source circuit, Problem solving for MOSFET cascade current source, Wilson current mirror. **MOSFET current steering circuit** - MOSFET current steering circuit. **Amplifiers with active load** - NMOS amplifier with Enhancement load, NMOS amplifier with depletion load. **CMOS Common-Source Amplifier** - CMOS Common-Source Amplifier, Advantages of CMOS Common-Source Amplifier. **CMOS**

## Content Product

### Detailed syllabus

**source-follower amplifier** - CMOS source-follower amplifier, Problems based on NMOS source follower amplifier. **CMOS differential amplifier** - CMOS differential amplifier, Differential gain ( $A_d$ ), Common mode gain ( $A_{cm}$ ).