COURSE CODE: 23EC0402 **R23**

SIDDHARTH INSTITUTE OF ENGINEERING & TECHNOLOGY: PUTTUR

(AUTONOMOUS)

Siddharth Nagar, Narayanavanam Road – 517583

QUESTION BANK (DESCRIPTIVE)

Subject with Code: Electronic Devices and Circuits(23EC0402)

Course & Branch: B.Tech.–ECE

Regulation: R23 **Year & Sem:** II-B.Tech.& I-Sem.

UNIT –I

PN JUNCTION DIODE AND SPECIAL DIODES

1.	a)	Define efficiency of a rectifier.	[L1] [CO2]	[2M]
	b)	Draw the symbol of SCR, UJT and photo diode.	[L1] [CO2]	[2M]
	c)	Define clipper and list types.	[L1] [CO2]	[2M]
	d)	List the applications of clampers.	[L1] [CO2]	[2M]
	e)	Formulate the Diode current equation.	[L2] [CO2]	[2M]
2.	a)	Explain the construction of PN Junction Diode.	[L2] [CO1]	[4M]
	b)	Illustrate the working of a PN Junction diode under biasing with neat diagrams and draw the VI characteristics.	[L2] [CO1]	[6M]
3.	a)	Discuss the effect of temperature on V-I characteristics of a PN Junction Diode.	[L2] [CO2]	[5M]
	b)	When a reverse bias is applied to a germanium PN Junction Diode, the reverse saturation current at room temperature is 0.3µA. Determine the current flowing in the diode when 0.3V forward bias is applied at room temperature.	[L3] [CO3]	[5M]
4.	a)	Calculate the forward resistance of a PN Junction Diode when the forward current is 5mA at T = 300 K. Assume Silicon diode.	[L3] [CO3]	[5M]
	b)	Discuss the following terms with respect to PN diode i) Transition capacitance ii) Diffusion capacitance iii) forward and reverse resistances	[L2] [CO2]	[5M]
5.	a)	Draw the circuit diagram of a half Wave Rectifier and explain its operation with the help of waveforms.	[L2] [CO4]	[4M]
	b)	Derive the expressions for Average DC Voltage, RMS Value of voltage, DC output Power and AC input Power, Efficiency and Ripple factor for a Half Wave Rectifier.	[L4] [CO4]	[6M]
6.	a)	A Half Wave Rectifier is supplied from a 230V, 50 Hz supply with a step-down ratio of 3:1 to a resistive load of 10kΩ. The diode forward resistance is 75Ω while transformer secondary is 10Ω. Calculate maximum, average, RMS values of current, DC output voltage, efficiency of rectification.	[L4] [CO4]	[5M]
	b)	With the help of neat sketch describe the working of capacitive and inductive filter with full wave rectifier.	[L2] [CO4]	[5M]
7.	a)	Compare Half Wave, Full Wave and Bridge Wave rectifiers.	[L4] [CO4]	[5M]
	b)	A Full Wave Rectifier circuit is fed from a transformer having a centre-tapped secondary winding. The RMS voltage from either end of secondary to centre tap is 30V. If the diode forward	[L4] [CO4]	[5M]

		resistance is 2Ω and that of the half secondary is 8Ω, for a load of 1 KΩ. Calculate DC power delivered to the load, efficiency of rectification.		
8.	a)	Design the Positive and Negative Diode Clippers and explain with neat waveforms.	[L2] [CO5]	[5M]
	b)	What is a Clamper? Describe positive and negative clampers with neat circuit diagram.	[L2] [CO4]	[5M]
9.	a)	Discuss the characteristics of Photo diode with its symbol.	[L2] [CO2]	[3M]
	b)	With neat diagram explain working of SCR and draw the VI characteristics.	[L1] [CO2]	[7M]
10.	a)	Discuss the working of LCD with LED with neat diagrams.	[L2] [CO1]	[5M]
	b)	With basic structure, symbol and equivalent circuit explain working of UJT and draw characteristics.	[L2] [CO2]	[5M]
11.	a)	Explain the working principle of Varactor diode and list its applications.	[L1] [CO1]	[3M]
	b)	Draw the circuit symbol of Tunnel diode. Explain the Volt-Ampere (V-I) characteristics with neat sketch.	[L2] [CO2]	[7M]

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UNIT –II

BIPOLAR JUNCTION TRANSISTOR CHARACTERISTICS AND BIASING

1.	a)	What is BJT and Draw its symbol.	[L2] [CO1]	[2M]
	b)	Classify BJT based on construction and define operating regions in BJT.	[L1] [CO2]	[2M]
	c)	List applications of BJT.	[L1] [CO2]	[2M]
	d)	State the need of biasing.	[L2] [CO2]	[2M]
	e)	Mention any three BJT specifications.	[L1] [CO1]	[2M]
2.	a)	With the help neat diagram discuss the operation of NPN and PNP transistor.	[L2] [CO1]	[5M]
	b)	Illustrate the operation of a transistor as an amplifier and as a switch with suitable diagrams.	[L4] [CO3]	[5M]
3.	a)	Derive the relation among α, β and ϒ of a Transistor.	[L3] [CO5]	[6M]
	b)	If the base current in a transistor is 20µA, when the emitter current is 6.4mA, what are the values of α and β? Also calculate the collector current.	[L4] [CO4]	[4M]
4.	a)	With neat circuit diagram, explain the Input and Output characteristics of a BJT in CB Configuration.	[L3] [CO4]	[5M]
	b)	Compare the characteristics of Common Emitter (CE), Common Base (CB), and Common Collector (CC) configurations.	[L2] [CO4]	[5M]
5.	a)	With neat circuit diagram, explain the Input and Output characteristics of a BJT in CC Configuration.	[L2] [CO4]	[5M]
	b)	For a transistor, the leakage current is 0.1µA in CB configuration, while it is 19µA in CE configuration. Calculate α & β of the same transistor.	[L4] [CO3]	[5M]
6.	a)	Discuss the Input and Output characteristics of a BJT in CE Configuration. Indicate the regions of operations in the output characteristics.	[L3] [CO2]	[6M]
	b)	Explain the limits of operation of BJT.	[L3] [CO1]	[4M]
7.	a)	Describe the DC and AC load lines of a transistor and explain the criteria for determining the Q-point.	[L2] [CO2]	[5M]
	b)	List the different types of transistor biasing methods and explain the Fixed Bias configuration with a neat circuit diagram.	[L2] [CO2]	[5M]
8.	a)	Explain the Collector-to-Base biasing method of a transistor with a neat circuit diagram and derive stability factor.	[L2] [CO4]	[6M]
	b)	Differentiate between NPN and PNP transistors based on their characteristics.	[L3][CO6]	[4M]
9.	a)	Describe the self-bias method of transistor biasing with the help of a neat circuit diagram.	[L2] [CO2]	[5M]
	b)	Derive the stability factors S and S' of a BJT self-bias.	[L2] [CO5]	[5M]
10.	a)	Compare the various biasing techniques of a BJT.	[L3][CO6]	[4M]
	b)	Consider the self-bias circuit where Vcc = 22.5volts, Rc =5.6kΩ, R_2 = 10kΩ and R_1 = 90kΩ, hfe = 55, V_{BE} =0.6V. the transistor operates in active region. Determine i) Operating point ii) stability factor.	[L3] [CO2]	[6M]
11.	a)	Discuss Thermal Runaway and derive the expression for thermal Resistance.	[L4] [CO6]	[6M]
	b)	Explain the concept of thermal stability in transistor biasing and discuss the conditions necessary for achieving it.	[L4] [CO2]	[4M]

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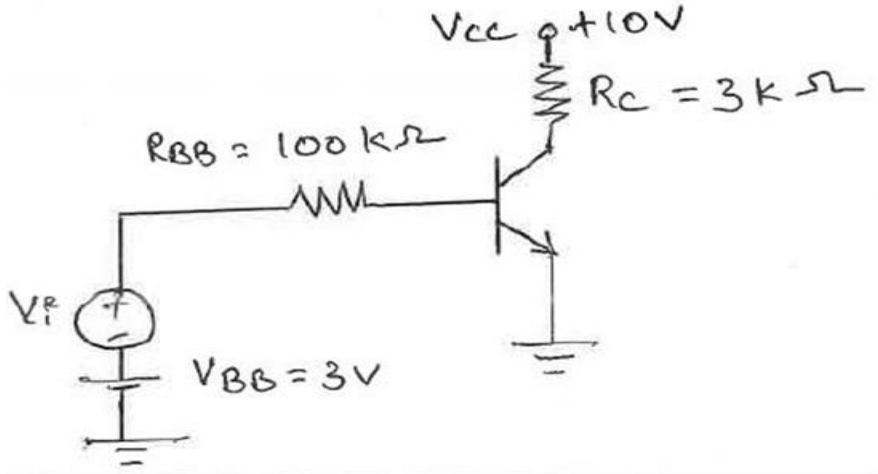
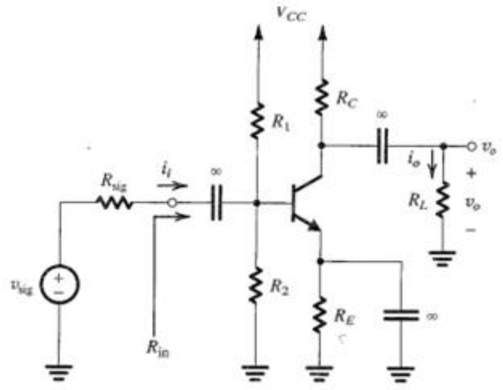
UNIT –III
BJT SMALL SIGNAL OPERATION AND MODELS

1	a)	Define trans conductance g_m in BJT.	[L1] [CO1]	2M
	b)	Give the expression for r_π (input resistance) in hybrid-π model?	[L2] [CO1]	2M
	c)	Mention the characteristics of CE amplifier.	[L1] [CO1]	2M
	d)	Express the open circuit over all voltage gain of BJT amplifier.	[L2] [CO1]	2M
	e)	List the applications of CC amplifier.	[L1] [CO1]	2M
2	a)	Discuss the need of small-signal analysis in BJT circuits.	[L2] [CO1]	[4M]
	b)	Explain the term thermal voltage V_T and its effect on small-signal model in detail.	[L2] [CO1]	[6M]
3	a)	Derive the transconductance g_m for a given collector current I_C.	[L3] [CO2]	[5M]
	b)	Determine base current and input resistance at Base of BJT.	[L3] [CO1]	[5M]
4	a)	Determine Emitter current and input resistance at Emitter of BJT.	[L3] [CO2]	[5M]
	b)	Describe the process of finding the DC operating point (quiescent point) of a BJT.	[L2] [CO1]	[5M]
5		Evaluate the voltage gain for transistor amplifier as shown in figure below, assume β=100. 	[L5] [CO2]	[10M]
6	a)	With a neat diagram describe the key components of the hybrid-pi model of BJT.	[L2] [CO3]	[5M]
	b)	Sketch the T-model of transistor and list out the applications of Small-signal Equivalent circuits.	[L1] [CO3]	[5M]
7	a)	Specify the significance of the base-emitter resistance in the T-model and state its effect on voltage gain.	[L3] [CO2]	[5M]
	b)	Compare the T-model and the hybrid-π model.	[L4] [CO3]	[5M]
8	a)	Discuss the process of separating the signal and the DC quantities with suitable diagrams.	[L2] [CO4]	[6M]
	b)	Define voltage gain and derive A_v for CE amplifier with emitter resistance.	[L1] [CO3]	[4M]
9	a)	Evaluate the small-signal voltage gain A_v, R_i and R_o of a common-emitter amplifier Without an emitter resistor R_E with equivalent circuit.	[L4] [CO4]	[7M]
	b)	List out the characteristics of CE amplifier with emitter resistance.	[L1] [CO1]	[3M]
10	a)	Derive the small-signal voltage gain A_v, R_i and R_o of a common-Base amplifier with Equivalent circuit.	[L2] [CO4]	[5M]
	b)	Design the small-signal, common-collector amplifier with equivalent circuit and explain its working in detail.	[L2] [CO2]	[5M]
11		For the CE amplifier shown in figure Vcc = 9V, R_1 = 27 kΩ, R_2 = 15 kΩ, R_E=1.2kΩ and R_c=2.2 kΩ. The transistor has β =100, V_A=100 V.	[L3] [CO4]	[10M]

		Calculate the DC bias current I_E.If the amplifier operates between source for which R_{sig} = 10 kΩ and a load of 2 kΩ, replace the transistor with its hybrid π-model, and compute the values of R_{in} ,Voltage gain V_o/V_{sig}, and the current gain i_o/i_i. 		

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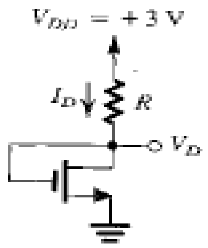
UNIT- IV

Junction Field Effect Transistor and MOS Field Effect Transistors

1.	a)	Mention the applications of JFET.	[L1] [CO2]	[2M]
	b)	Define Pinch off Voltage.	[L1] [CO2]	[2M]
	c)	Classify the types of JFET with its symbols.	[L1] [CO2]	[2M]
	d)	What is the principle of a MOSFET?	[L1] [CO2]	[2M]
	e)	Draw the CMOS structure.	[L1] [CO2]	[2M]
2.	a)	State the working principle of FET and list important features.	[L1] [CO2]	[4M]
	b)	Explain the construction and working of N-channel JFET.	[L2] [CO2]	[6M]
3.		Elaborate the Transfer and drain characteristics of N-channel JFET with neat sketches.	[L2] [CO4]	[10M]
4.	a)	Explain the process of fixing the Q point in FET?	[L2] [CO2]	[4M]
	b)	Distinguish the features of BJTs and FETs.	[L5] [CO2]	[6M]
5.	a)	Explain JFET works as a voltage variable resistor.	[L4] [CO3]	[6M]
	b)	Classify the types of MOSFET and draw their symbols.	[L2] [CO3]	[4M]
6.	a)	Explain the construction & operation of an enhancement type NMOS Transistor.	[L2] [CO2]	[6M]
	b)	Plot the V-I Characteristics of an n-channel enhancement MOSFET and explain in detail.	[L2] [CO2]	[4M]
7.	a)	Design the circuit in Fig. below to obtain a current I_D of 80 µA. Find the value required for R, and find the dc voltage V_D. Let the NMOS transistor have $V_t = 0.6$ V, $\mu_n C_{ox} = 200$ µA/V^2.L = 0.8 µm, and W = 4µm. Neglect the channel-length modulation effect (i.e., assume $\lambda = 0$). 	[L4] [CO2]	[6M]
	b)	Design a switch using a MOSFET.	[L4] [CO5]	[5M]
8.	a)	Design an amplifier using a MOSFET.	[L4] [CO5]	[6M]
	b)	Consider a process technology for which $L_{min} = 0.4$ µm, $t_{ox} = 8$ nm, $\mu_n = 450$ cm²/V-s, and V_t=0.7 V. (i) Calculate C_{ox} and k_n. (ii) For a MOSFET with W/L = 8 µm/0.8 µm, calculate the values of V_{GS} and V_{DSmin} needed to operate the transistor in the saturation region with a de current $I_D = 100$ µA. (iii) For the device in (ii), calculate the value of V_{GS} required to cause the device to operate as a 1000-Ω resistor for very small V_{DS}	[L3] [CO3]	[4M]
9.	a)	Explain the biasing technique by fixing V_{GS} without source resistance for MOSFET amplifier with neat circuit diagram.	[L2] [CO2]	[5M]
	b)	Discuss the biasing technique for MOSFET amplifier using drain to gate feedback resistor in detail.	[L2] [CO4]	[5M]
10.	a)	Explain the concept of modelling of Body Effect.	[L2] [CO2]	[4M]
	b)	Distinguish between Depletion MOSFET and Enhancement MOSFET.	[L5] [CO2]	[6M]
11		Discuss the characteristic parameters of the JFET and show the relation among the JFET parameters µ, rd and gm.	[L2] [CO3]	[10M]

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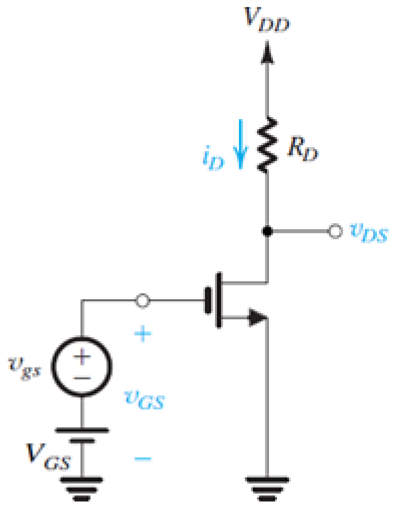
UNIT- V

MOSFET SMALL SIGNAL OPERATION MODELS

1	**a)**	List the small-Signal Parameters of MOSFET.	[L1] [CO1]	2M
	b)	Explain the concept of small-signal analysis for a MOSFET.	[L1] [CO4]	2M
	c)	Define Transconductance.	[L1] [CO5]	2M
	d)	Draw an alternative representation of the T model.	[L1] [CO5]	2M
	e)	List the applications of the Small-Signal Equivalent Circuits.	[L1] [CO2]	2M
2	**a)**	Demonstrate the Small-Signal Operation of the MOSFET amplifier with neat diagrams.	[L2] [CO5]	6M
	b)	Explain the separating the DC Analysis and the Signal Analysis.	[L2] [CO4]	4M
3		For the below amplifier, let V_{DD}= 5V, R_D = 10KΩ, V_t = 1V, K'_n = 20 µ A/V^2 , W/L = 20, VGS=2V, and λ = 0. Determine i) the dc current I_D and dc voltage V_{DS} ii) gm iii) Voltage gain iv) If V_{GS} = 0.2 sin wt, find V_{DS} 	[L3] [CO3]	10M
4		Explain the operation of Small-Signal Equivalent-Circuit Models for: i) Neglecting the dependence of i_D on v_{DS} in saturation ii) Including the effect of channel length modulation, modulated	[L2] [CO3]	10M
5	**a)**	Define the MOSFET Transconductance g_m with mathematical expression.	[L1] [CO2]	6M
	b)	A MOSFET is to operate at I_D = 0.1 mA and is to have g_m = 1 mA/ V. If K'_n = 2	[L3] [CO3]	4M
6		Develop and Illustrate the T Equivalent-Circuit Model for the MOSFET.	[L3] [CO5]	10M
7	**a)**	Evaluate the overall voltage gain of the Common-Source Amplifier with a Source Resistance with suitable circuits.	[L5] [CO5]	6M
	b)	Build the equivalent circuit with the MOSFET represented by its T-Model.	[L3] [CO5]	4M
8	**a)**	Construct and Evaluate the overall voltage gain of the Common-Gate (CG) Amplifier with biasing circuit omitted.	[L5] [CO5]	6M
	b)	Develop the equivalent circuit of the CG amplifier with the MOSFET replaced with its T-Model.	[L6] [CO5]	4M
9	**a)**	Illustrate the need for Voltage Buffers or unity gain buffer amplifier with figures.	[L3] [CO5]	6M
	b)	List the important features of Source Follower.	[L1] [CO5]	4M

10	**a)**	A CS amplifier utilizes a MOSFET biased at I_D = 0.25Ma with V_{OV} = 0.25V and R_D = 20kΩ. The device has V_A = 50V. The amplifier is fed with a source having R_{sig} = 100KΩ, and a 20kΩ load is connected to the output. Calculate R_{in}, A_{vo}, R_o, A_v and G_v.	[L4] [CO3]	6M
	b)	Compare the various parameters of CS, CG & CD amplifiers.	[L4] [CO6]	4M
11	**a)**	Derive the characteristic Parameters of the Source Follower with figures.	[L4] [CO4]	6M
	b)	Illustrate the MOSFET Transconductance g_m with graphical construction.	[L3] [CO2]	4M

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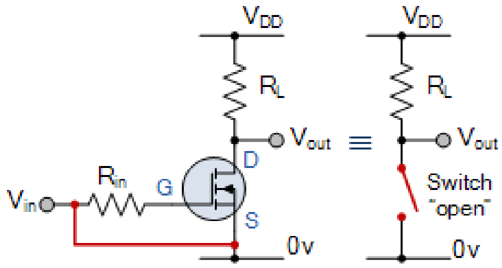
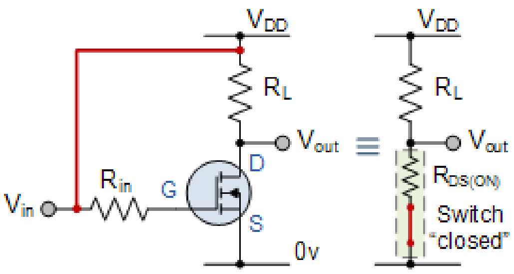


- The input and Gate are grounded (0V)
- Gate-source voltage less than threshold voltage $V_{GS} < V_{TH}$
- MOSFET is "OFF" (Cut-off region)
- No Drain current flows ($I_D = 0$ Amps)
- $V_{OUT} = V_{DS} = V_{DD} =$ "1"
- MOSFET operates as an "open switch"



- The input and Gate are connected to V_{DD}
- Gate-source voltage is much greater than threshold voltage $V_{GS} > V_{TH}$
- MOSFET is "ON" (saturation region)
- Max Drain current flows ($I_D = V_{DD} / R_L$)
- $V_{DS} = 0V$ (ideal saturation)
- Min channel resistance $R_{DS(on)} < 0.1\Omega$
- $V_{OUT} = V_{DS} \cong 0.2V$ due to $R_{DS(on)}$
- MOSFET operates as a low resistance "closed switch"