COURSE CODE: 23EC0402 **R23**

SIDDHARTH INSTITUTE OF ENGINEERING & TECHNOLOGY:: PUTTUR

(AUTONOMOUS)

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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][CO4]**	**[2M]**
	b)	Define regulation and write formula to find regulation of a rectifier.	**[L1][CO4]**	**[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.	**[L1][CO2]**	**[2M]**
2.	**a)**	Describe the construction of PN Junction Diode.	**[L2][CO1]**	**[4M]**
	b)	Illustrate the working of a PN Junction diode under forward bias and reverse bias with neat diagrams and draw 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)**	Discuss about the forward and reverse resistances of a PN junction diode.	**[L2][CO1]**	**[5M]**
	b)	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]**
5.	**a)**	Discuss the following terms i) Transition capacitance ii) Diffusion capacitance of a PN Junction Diode.	**[L3][CO2]**	**[5M]**
	b)	Draw the circuit diagram of a Half Wave Rectifier and explain its operation with the help of waveforms.	**[L2][CO4]**	**[5M]**
6.	**a)**	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.	**[L2][CO4]**	**[5M]**
	b)	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]**
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 center-tapped secondary winding. The RMS voltage from either end of secondary to center 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 circuit? Describe about positive and negative clampers with neat circuit diagram.	**[L2][CO4]**	**[5M]**
9.	**a)**	Discuss the characteristics of Photo diode with its symbol.	**[L3][CO2]**	**[3M]**
	b)	With neat diagram explain working of SCR and draw the VI characteristics.	**[L1][CO2]**	**[7M]**
10.	**a)**	Compare the characteristics of LCD with LED.	**[L4][CO1]**	**[3M]**
	b)	With basic structure, symbol and equivalent circuit explain working of UJT and draw characteristics.	**[L2][CO2]**	**[7M]**
11	**a)**	Define the basic 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	**[L2][CO2]**	**[7M]**

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UNIT –II
BIPOLAR JUNCTION TRANSISTOR CHARACTERISTICS AND BIASING

1.	**a)**	Define BJT and Draw its symbol.	**[L2][CO1]**	**[2M]**
	b)	List the types of BJT and operating regions.	**[L1][CO2]**	**[2M]**
	c)	List applications of BJT.	**[L1][CO2]**	**[2M]**
	d)	Discuss the need of biasing.	**[L2][CO2]**	**[2M]**
	e)	List out BJT specifications.	**[L1][CO1]**	**[2M]**
2.	**a)**	Discuss the operation of NPN and PNP transistor with diagram.	**[L2][CO1]**	**[5M]**
	b)	With a neat diagram, explain how a transistor acts as an amplifier and switch.	**[L4][CO3]**	**[5M]**
3.	**a)**	Derive the relation among α, β and Υ of a Transistor.	**[L2][CO2]**	**[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.	**[L3][CO4]**	**[4M]**
4.	**a)**	With neat circuit diagram, explain the Input and Output characteristics of a BJT in CB Configuration.	**[L3][CO4]**	**[5M]**
	b)	Differentiate among CE, CB & 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.	**[L3][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][CO4]**	**[6M]**
	b)	Explain the limits of operation in BJT.	**[L3][CO1]**	**[4M]**
7.	**a)**	Explain the concept of DC and AC Load lines and discuss the criteria for fixing the Q-point.	**[L2][CO2]**	**[5M]**
	b)	Mention different types of Biasing a Transistor and explain the Fixed Bias of a Transistor.	**[L2][CO5]**	**[5M]**
8.	**a)**	Explain Collector to Base bias of a Transistor with neat circuit diagram.	**[L2][CO4]**	**[6M]**
	b)	Compare and contrast the characteristics of NPN and PNP transistors	**[L3][CO2]**	**[4M]**
9.	**a)**	Explain self-bias of a Transistor with neat circuit diagram.	**[L2][CO2]**	**[4M]**
	b)	Derive the stability factors S, S' and S'' of a BJT self-bias.	**[L2][CO4]**	**[6M]**
10.	**a)**	Compare the various biasing techniques of a BJT.	**[L3][CO4]**	**[4M]**
	b)	Consider the self-bias circuit where Vcc = 22.5 volts, 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 Thermal Resistance.	**[L1][CO2]**	**[6M]**
	b)	Discuss the condition for achieving Thermal Stability.	**[L2][CO2]**	**[4M]**

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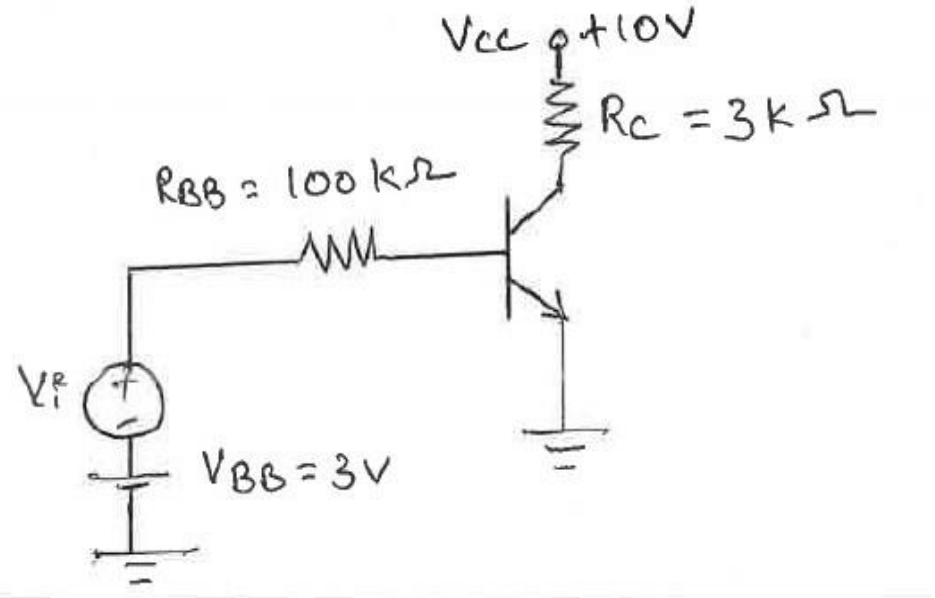
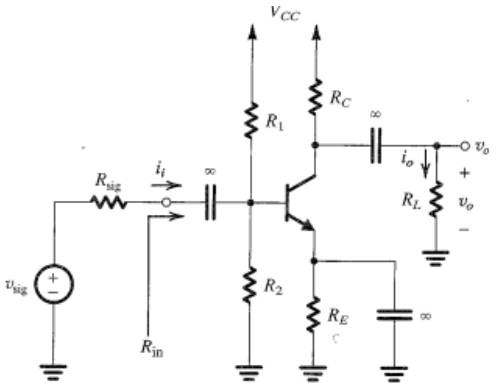
UNIT –III
BJT SMALL SIGNAL OPERATION AND MODELS

1	**a)**	What is the trans conductance $\mathbf{g_m}$ in a BJT?	**[L1] [CO1]**	**2M**
	b)	How is r_π (input resistance) calculated in the hybrid-π model?	**[L2] [CO1]**	**2M**
	c)	List out the characteristics of CE amplifier.	**[L1] [CO1]**	**2M**
	d)	Express the open circuit over all voltage gain of BJT amplifier.	**[L2] [CO1]**	**2M**
	e)	Name the applications of CC amplifier.	**[L1] [CO1]**	**2M**
2	**a)**	Discuss the purpose of small-signal analysis in BJT circuits.	**[L2] [CO1]**	**[5M]**
	b)	Explain the thermal voltage V_T and how does it affect the small-signal model?	**[L2] [CO1]**	**[5M]**
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 a voltage gain for transistor amplifier as shown in figure, assume β =100. 	**[L5] [CO2]**	**[10M]**
6	**a)**	Describe the key components of the hybrid-pi model for a BJT.	**[L2] [CO3]**	**[5M]**
	b)	List out the applications of Small-signal Equivalent circuits.	**[L1] [CO3]**	**[5M]**
7	**a)**	Identify the significance of the base-emitter resistance in the T-model.	**[L3] [CO2]**	**[5M]**
	b)	Compare the T-model and the hybrid-π model.	**[L4] [CO3]**	**[5M]**
8	**a)**	Discuss about separating the signal and the DC quantities with suitable diagrams.	**[L2] [CO4]**	**[6M]**
	b)	Define voltage gain and derive A_v for CE amplifier.	**[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]**	**[7M]**
	b)	Design the small-signal, common-collector amplifier with equivalent circuit	**[L2] [CO2]**	**[3M]**
11		For the common emitter amplifier shown in figure Vcc = 9V,R_1 = 27 kΩ , R_2 = 15 kΩ,R_E=1.2 kΩ 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} ,Volatge gian V_o/V_{sig} , and the current gain i_o/i_i.  		

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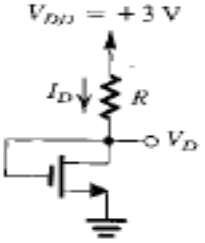
UNIT- IV

Junction Field Effect Transistor and MOS Field Effect Transistors

1.	**a)**	State the application of JFET	**[L1][CO2]**	**[2M]**
	b)	Define Pinchoff 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)**	What is meant by FET? List important features of FET.	**[L1][CO2]**	**[4M]**
	b)	Explain the construction and working of N-channel JFET.	**[L2][CO2]**	**[6M]**
3.		Discuss the Transfer and output characteristics of N-channel JFET with neat sketches.	**[L2] [CO4]**	**[10M]**
4.	**a)**	How do you fix the Q point for FET?	**[L2] [CO2]**	**[4M]**
	b)	Distinguish between BJT and FET.	**[L5] [CO2]**	**[6M]**
5.	**a)**	Discuss how a 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.	**[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, $\mu_n C_{ox} = 200$ $\mu A/V^2$.L = 0.8 µm, and W = 4µm. Neglect the channel-length modulation effect (i.e., assume $\lambda = 0$). 	**[L2] [CO2]**	**[6M]**
	b)	Design a switch using a MOSFET.	**[L4] [CO5]**	**[5M]**
8.	**a)**	Design an amplifier using a MOSFET.	**[L4] [CO5]**	**[5M]**
	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]**	**[5M]**
9.	**a)**	Explain the biasing technique by fixing V_{GS} without source resistance for MOSFET amplifier.	**[L1] [CO2]**	**[5M]**
	b)	Explain the biasing technique using drain to gate feedback resistor for MOSFET amplifier.	**[L2] [CO4]**	**[5M]**
10.	**a)**	Explain the concept of modeling 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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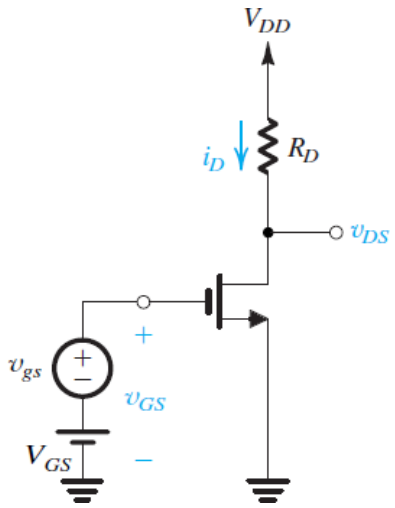
UNIT- V

MOSFET SMALL SIGNAL OPERATION MODELS

1	**a)**	List the small-Signal Parameters of MOSFET.	**[L1][CO1]**	**[2M]**
	b)	What is Small-Signal Analysis of 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.	**[L2][CO5]**	**[6M]**
	b)	Explain the separating the DC Analysis and the Signal Analysis.	**[L2][CO4]**	**[4M]**
3		 For the above 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) g_m 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 by output resistance r_0 = |VA|/ I_D	**[L2][CO3]**	**[10M]**
5	**a)**	Define the MOSFET Transconductance g_m with mathematical expression.	**[L1][CO5]**	**[6M]**
	b)	A MOSFET is to operate at I_D = 0.1 mA and is to have g_m = 1 mA/ V. If K'$_n$ = 50 µ A/V^2, Compute the required W/L ratio and the over drive voltage.	**[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	**[L6][CO5]**	**[4M]**

		with its T-Model.		
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)**	Inspect the characteristic Parameters of the Source Follower with figures.	**[L4][CO4]**	**[6M]**
	b)	Illustrate the MOSFET Transconductance gm with graphical construction.	**[L3][CO5]**	**[4M]**

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