SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)
SRM Nagar, Kattankulathur – 603 203.

DEPARTMENT OF

ELECTRONICS AND COMMUNICATION ENGINEERING

QUESTION BANK

III SEMESTER

EC3362 SOLID STATE DEVICES AND CIRCUITS

Regulation – 2023

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SUBJECT : EC3362 SOLID STATE DEVICES AND CIRCUITS

SEM / YEAR : III/ II Year ECE

UNIT-I: SEMICONDUCTOR DEVICES			
PN junction diode –structure, operation and V-I characteristics, diffusion and transition capacitance - Zener diode characteristics – Schottky barrier diode - Varactor diode –Tunnel diode - LED, Laser diodes			
PART - A			
Q.No	**Questions**	**BT Level**	**Course Outcomes**
1.	State the difference between PN junction diode and Zener diode.	BTL 1	CO 1
2.	What are the applications of PN junction diode?	BTL 1	CO 1
3.	Write the diode current equation.	BTL 1	CO 1
4.	Mention the difference between avalanche and Zener breakdown.	BTL 2	CO 1
5.	What is tunnelling?	BTL 2	CO 1
6.	Draw the circuit diagram of zener diode as a voltage regulator.	BTL 1	CO 1
7.	List the applications of LED diode.	BTL 1	CO 1
8.	Mention the applications of schottky barrier diode.	BTL 2	CO 1
9.	Summarize about the diffusion capacitance.	BTL 2	CO 1
10.	Draw the equivalent circuit of tunnel diode.	BTL 1	CO 1
11.	A Ge diode has a saturation current of 10μA at 300 K. Determine the saturation current at 400K.	BTL 2	CO 1
12.	List the applications of Varactor Diode.	BTL 2	CO 1
13.	Mention the difference between LED and Laser Diodes.	BTL 2	CO 1
14.	Draw the V-I characteristics of Schottky barrier diode .	BTL 2	CO 1
15.	Draw the energy band structure of PN junction diode.	BTL 1	CO 1
16.	Write about the working principle of LASER diode.	BTL 1	CO 1
17.	List the advantages and disadvantages of tunnel diode.	BTL 1	CO 1
18.	Write the expression for transition capacitance.	BTL 1	CO 1
19.	What is avalanche breakdown?	BTL 2	CO 1
20.	Write down the applications of varactor diode.	BTL 2	CO 1
21.	Define varactor diode reverse bias operation.	BTL 1	CO 1
22.	Draw the V-I characteristics of tunnel diode with PN junction diode. .	BTL 2	CO 1
23.	Sketch the symbol of Tunnel and LASER diode.	BTL 2	CO 1
24.	Define zener breakdown.	BTL 1	CO 1
PART - B			

1.	Derive the expression for PN junction diode forward and reverse currents with suitable diagram and necessary explanation.	(16)	BTL 3	CO 1
2.	Discuss in detail about transition and diffusion capacitances in semiconductor diode.	(16)	BTL 4	CO 1
3.	Illustrate the switching characteristics of PN junction diode with suitable diagrams.	(16)	BTL 3	CO 1
4.	(i) Obtain the current equations of PN junction diode. (ii)Discuss in detail about energy band diagram of PN diode.	(8) (8)	BTL 3	CO 1
5.	Obtain the drift and diffusion current densities for P type and N type and explain its features.	(16)	BTL 4	CO 1
6.	Explain the working principle of Zener diode with its V-I characteristics.	(16)	BTL 4	CO 1
7.	Differentiate between LED and LASER diode.	(16)	BTL 4	CO 1
8.	Explain the V-I characteristics of tunnel diode with the help of equivalent circuit and its basic structure.	(16)	BTL 3	CO 1
9.	With neat sketch, describe the working principle, operation and characteristics of the tunnel diode.	(16)	BTL 3	CO 1
10.	Describe about schottky diode and its V-I characteristics.	(16)	BTL 3	CO 1
11.	Explain the operation and characteristics of Varactor diode.	(16)	BTL 4	CO 1
12.	(i) Explain the construction and operation of LED diode. (ii) List its merits and applications.	(16)	BTL 3	CO 1
13.	(i) Derive the diode parameters C_D Diffusion capacitance. (ii) Determine the forward resistance of a PN diode, when the forward current is 5mA at T=300k assume silicon diode.	(10) (6)	BTL 3	CO 1
14.	Draw the equivalent circuit of a tunnel diode and explain it.	(16)	BTL 4	CO 1
15.	Explain the principle behind the LASER diode with a neat sketch.	(16)	BTL 3	CO 1
16.	List the application of tunnel diode and mention its advantage and disadvantages.	(16)	BTL 4	CO 1
17.	With the help of neat circuit diagrams, explain the operation of LED diode and its characteristics.	(16)	BTL 4	CO 1

UNIT-II: TRANSISTORS			
BJT- structure, operation, characteristics and Biasing, JFET, MOSFET, UJT, SCR, - Structure and Characteristics.			
PART - A			
Q.No	**Questions**	**BT Level**	**Course Outcomes**
1.	Compare BJT and UJT.	BTL 1	CO 2
2.	List the applications of UJT.	BTL 2	CO 2
3.	List the transistor parameters.	BTL 2	CO 2
4.	Write the relationship between α and β.	BTL 1	CO 2
5.	Express the operation of NPN and PNP Transistor.	BTL 1	CO 2
6.	Why BJT is called as current controlled device?	BTL 1	CO 2
7.	Give the input and output characteristics of a transistor in CE configuration.	BTL 1	CO 2
8.	Sketch the V-I characteristics of UJT.	BTL 1	CO 2
9.	Summarize the concept of operating point.	BTL 1	CO 2
10.	Draw the diode equivalent model of a transistor.	BTL 1	CO 2
11.	Estimate the DC load line for fixed bias amplifier circuit.	BTL 2	CO 2
12.	Give the relationship between currents in NPN transistor.	BTL 2	CO 2
13.	A BJT has a base current of 200μA. Determine the collector current and β.	BTL 2	CO 2
14.	Find the value of β if a transistor has α = 0.97.also find α if β=200.	BTL 2	CO 2
15.	Assess the characteristics of the material used in LED.	BTL 2	CO 2
16.	Mention the different methods of biasing a JFET.	BTL 2	CO 2
17.	Define circuit turn off time of SCR.	BTL 1	CO 2
18.	Why the operating point selected at the center of the active region.	BTL 2	CO 2
19.	How can a FET be used as a uoltage controlled resistor.	BTL 2	CO 2
20.	What are the advantages of FETs ?	BTL 2	CO 2
21.	Mention the three regions that are present in the drain-source characteristics of JFET.	BTL 1	CO 2
22.	Mention the disadvantages of FET compared to BJT	BTL 1	CO 2
23.	Draw I-V characteristic of MOSFET.	BTL 2	CO 2
24.	What is SCR? Mention its applications	BTL 1	CO 2

PART - B				
1.	What is DC load line? How will you select the operating point, explain it using common emitter amplifier characteristics as an example?	(16)	BTL 3	CO 2
2.	(i) Describe the input and output characteristics of a transistor in CC configuration. (ii) Derive the relationship among α, β, γ.	(8) (8)	BTL 4	CO 2
3.	With neat diagram examine the input and output characteristics of a transistor in CE configuration.	(16)	BTL 4	CO 2
4.	(i) The reverse leakage current of a transistor when connected in CB configuration is 0.2 μA and it is 18 μA when the same transistor is connected in CE configuration calculate α, β.	(8)	BTL 3	CO 2

	(ii) Describe early effect with relevant expressions and diagram.	(8)		
5.	Discuss the characteristics and working principle of SCR and list out its applications.	(16)	BTL 3	CO 2
6.	Analyze the input and output characteristics of a transistor in CB configuration.	(16)	BTL 4	CO 2
7.	Explain the configurations and the principle of operation of BJT.	(16)	BTL 3	CO 2
8.	(i) Justify transistor as an amplifier. (ii) Compare and contrast between CE, CB and CC configurations.	(6) (10)	BTL 3	CO 2
9.	Describe the input and output characteristics of a transistor in CB configuration.	(16)	BTL 4	CO 2
10.	Illustrate the construction and operation of n-channel and p-channel JFET with neat diagrams.	(16)	BTL 4	CO 2
11.	Analyze the drain and transfer characteristics of a p channel JFET.	(16)	BTL 4	CO 2
12.	Illustrate the working mechanism of MOSFET with necessary diagram.	(16)	BTL 4	CO 2
13.	Describe the construction and working of a JFET. Derive an expression for pinch off voltage in FET.	(16)	BTL 4	CO 2
14.	Draw the basic structure of UJT and explain V-I characteristics of UJT with the help of equivalent circuit.	(16)	BTL 3	CO 2
15.	Compare and contrast the performance characteristics of SCR and MOSFET.	(16)	BTL 4	CO 2
16.	Describe the operation of UJT relaxation oscillator and R1 value from the conditions for turn-on and turn-off.	(16)	BTL 3	CO 2
17.	Explain the working principle of SCR with V-I characteristics	(16)	BTL 3	CO 2

UNIT III – AMPLIFIERS			
BJT small signal model - Analysis of CE, CB, CC amplifiers- FET small signal model and MOSFET small signal model - Analysis of CS, CG and CD – Gain and frequency response.			
PART – A			
Q.No.	**Question**	**BT Level**	**Course Outcomes**
1.	Define bypass and coupling Capacitor.	BTL1	CO 3
2.	What is an amplifier and AC load line?	BTL1	CO 3
3.	Explain transconductance?	BTL1	CO 3
4.	How would you show Miller effect input capacitance?	BTL1	CO 3
5.	Draw the small signal equivalent of CE configuration.	BTL1	CO 3
6.	Draw the simplified hybrid π equivalent circuit for NPN transistor.	BTL1	CO 3
7.	Construct the small signal AC equivalent circuit of the BJT.	BTL2	CO 3
8.	Why do you choose emitter bypass capacitor in CE amplifier circuit?	BTL2	CO 3
9.	State the advantages of un bypassed R_E in CE configuration.	BTL2	CO 3
10.	Compare AC and DC load lines.	BTL2	CO 3
11.	List the advantages of common drain amplifier.	BTL2	CO 3
12.	Compare the features of three MOSFET amplifier configuration.	BTL2	CO 3
13.	What is meant by voltage swing limitation in JFET?	BTL1	CO 3
14.	How a MOSFET can be used to amplify a time varying voltage?	BTL2	CO 3
15.	Identify the impact of including a source resistor in the FET amplifier.	BTL2	CO 3
16.	What is the relationship between pinch off voltage and drain resistance?	BTL 1	
17.	Write down the small signal parameters of JFET.	BTL1	CO 3
18.	Mention the effect of bypass capacitor on bandwidth of the amplifier.	BTL2	CO 3
19.	Draw a differential pair using FET.	BTL2	CO 3
20.	Discuss the use of MOSFET to amplify a time varying voltage.	BTL1	CO 3
21.	Draw the circuit of JFET common source amplifier.	BTL1	CO 3
22.	The parameters for the transistor below are $K_n = 0.5mA/V^2$, $V_{TN} = 1.2V$, and	BTL2	CO 3
23.	Short note on the transconductance with its expression.	BTL1	CO 3
24.	Compare the three FET configurations (CS, CD and CG).	BTL2	CO 3
PART-B			
1.	Draw the circuit diagram of common emitter amplifier with With the help of small signal equivalent, obtain the expression for current gain, voltage gain, input and output impedance.	(16) BTL3	CO 3

2.	Find the gain, input and output resistance of common collector amplifier with a neat circuit diagram and equivalent circuit.	(16)	BTL3	CO 3
3.	Draw and explain the hybrid π equivalent circuit for NPN transistor.	(16)	BTL3	CO 3
4.	Explain the basic common base amplifier circuit and derive the expressions for its small signal voltage gain, current gain, input impedance and output impedance.	(16)	BTL3	CO 3
5.	Compare CB, CE and CC amplifiers and state their applications.	(16)	BTL4	CO 3
6.	Derive the expression for R_i, A_v and R_o for CE amplifier.	(16)	BTL4	CO 3
7.	(i) How would you describe the expression for the voltage gain of JFET common source amplifier with bypassed R_S. (ii) Derive the expression for the voltage gain of JFET common source amplifier?	(10) (6)	BTL4	CO 3
8.	Explain the expression for common gate circuit of JFET.	(16)	BTL3	CO 3
9.	What is JFET amplifier? Derive gain, input and output impedance of common source JFET amplifier with neat circuit diagram and equivalent circuit.	(16)	BTL4	CO 3
10.	Define the circuit of a basic common source amplifier with voltage divider bias and derive the expressions for voltage gain, input impedance and output impedance using small signal model.	(16)	BTL4	CO 3
11.	Derive the gain, input and output impedance of MOSFET source follower with neat circuit diagram and equivalent circuit.	(16)	BTL3	CO 3
12.	Calculate the voltage gain of the circuit, assuming the following parameters: V_{DD}=3.3V, R_D=10KΩ, R_{G1}=140KΩ, R_{G2}=60KΩ, R_{Si}=4KΩ. The transistors parameters are V_{tn} =0.4V, K_n=0.5mA/V^2 and λ=0.02V^{-1}	(16)	BTL4	CO 3
13.	(i) Explain how JFET can be used as an amplifier. (ii) Describe the small signal low frequency model of JFET.	(10) (6)	BTL3	CO 3
14.	With the equivalent circuit of a common gate MOSFET amplifier, derive for A_v, A_i and R_i .	(16)	BTL4	CO 3
15.	Analyze a simple JFET source-follower amplifier circuit and discuss the general AC circuit characteristics.	(16)	BTL4	CO 3
16.	(i)Mention the small signal parameters of MOSFET. (ii) Explain the configuration of a common-source amplifier with source resistor.	(6) (10)	BTL3	CO 3
17.	Compare the features and small signal equivalent circuits of three MOSFET amplifier configurations.	(16)	BTL3	CO 3

UNIT IV – FEEDBACK AMPLIFIERS AND OSCILLATORS

Feedback – Voltage feedback Amplifiers , Current feedback Amplifiers, Series feedback Amplifiers, Shunt feedback Amplifiers, Differential amplifier – Common mode and Difference mode analysis, CMRR, Cascade amplifier ,Cascode amplifier , Single Tuned amplifiers, Double Tuned amplifiers

PART – A

Q.No.	Question	BT Level	Course Outcomes
1.	What is negative feedback?	BTL1	CO 4
2.	Write the expression of a feedback network.	BTL1	CO 4
3.	List the advantages of negative feedback.	BTL1	CO 4
4.	Compare the frequency response of an open and closed loop gain.	BTL1	CO 4
5.	Outline the loop gain of a feedback amplifier.	BTL1	CO 4
6.	Find the closed loop gain of a negative feedback amplifier if its open loop gain is 100 and the feedback factor is 0.01.	BTL2	CO 4
7.	An amplifier has a voltage gain of 1000. With negative feedback, the voltage gain reduces to 10. Find the fraction of the output feedback to the input.	BTL2	CO 4
8.	A voltage series feedback amplifier has a voltage gain with feedback as 83.33 and feedback ratio as 0.01. Analyze the voltage gain of the amplifier without feedback.	BTL2	CO 4
9.	Draw the block diagram of a voltage-shunt feedback amplifier.	BTL2	CO 4
10.	Write the equation of sensitivity for feedback amplifier.	BTL2	CO 4
11.	Classify the topologies of a negative feedback amplifier.	BTL2	CO 4
12.	Draw the block diagram of a voltage shunt feedback amplifier.	BTL2	CO 4
13.	What is Differential Amplifier?	BTL2	CO 4
14.	What are all the passive elements are used in cascade amplifier?	BTL2	CO 4
15.	Define CMRR of BJT differential amplifier.	BTL2	CO 4
16.	What is tuned amplifier?	BTL2	CO 4
17.	Classify the various types of tuned amplifiers.	BTL2	CO 4
18.	Calculate the bandwidth of a 3 stage cascaded single tuned amplifier if the resonant frequency is 455 KHz and the loaded Q of each stage is 10.	BTL1	CO 4
19.	A tuned amplifier has its maximum gain at a frequency of 2 MHz and has a bandwidth of 50 KHz. Estimate the Q factor.	BTL2	CO 4
20.	Illustrate the gain bandwidth product of a tuned amplifier.	BTL2	CO 4
21.	Compare single tuned and double tuned amplifiers.	BTL1	CO 4
22.	Summarize the applications of tuned amplifiers.	BTL2	CO 4
23.	List out the advantages of double tuned amplifier.	BTL1	CO 4
24.	List out the improvisation methods of CMRR in differential	BTL2	CO 4

PART-B				
1.	Write the expressions of gain for the positive and negative feedback circuit with neat block diagrams.	(16)	BTL3	CO 4
2	Derive the effect of input and output resistance for current shunt feedback by with and without feedback.	(16)	BTL3	CO 4
3.	Illustrate the effect of input and output resistance for the current series feedback by with and without feedback with necessary expressions and diagrams.	(16)	BTL3	CO 4
4.	An amplifier has voltage gain with feedback of 100. If the gain without feedback changes by 20% and the gain with feedback should not vary more than 2%, examine the values of open-loop gain A and feedback ratio β.	(16)	BTL3	CO 4
5.	Explain the effect of input and output resistance for Current-shunt feedback by with and without feedback and derive expressions for the same.	(16)	BTL4	CO 4
6	(i) A voltage-series negative feedback amplifier has a voltage gain without feedback of A = 1000, input resistance Ri = 5 KΩ, output resistance Ro = 25 KΩ and feedback ratio β = 0.01. Find the voltage gain Af, input resistance Rif and output resistance Rof of the amplifier with feedback. (ii) An amplifier has the following parameters Av = 120, Ri = 3.3 KΩ, Ro = 34 KΩ. If a negative feedback 5% is provided in series with the input, choose the values for D, Avf and Rif.	(8) (8)	BTL4	CO 4
7.	Compare four types of feedback amplifiers with respect to gain, input and output impedance, bandwidth and block diagrams.	(16)	BTL4	CO 4
8.	Draw the equivalent circuit diagram for voltage shunt feedback amplifier and derive input and output resistance for with and without feedback.	(16)	BTL3	CO 4
9.	Construct the multistage amplifier with its operation and advantages and also explain its small signal voltage gain and input impedance.	(8) (8)	BTL3	CO 4
10.	What is CMRR? Derive CMRR of differential amplifier with its equivalent circuit.	(10) (6)	BTL4	CO 4
11.	Explain the operation of cascade amplifier and derive voltage gain, overall input resistance, overall current gain and output impedance.	(16)	BTL3	CO 4
12.	Examine the circuit diagram for a differential amplifier using BJT's and find CMRR through small signal analysis.	(16)	BTL4	CO 4
13.	Explain the operation of cascade amplifier and derive voltage gain, overall input resistance, overall current gain and output impedance	(16)	BTL4	CO 4
14.	Describe single tuned amplifier and its frequency response	(16)	BTL4	CO 4
15.	Discuss the double tuned amplifier with neat circuit diagram and derive the expression for 3dB bandwidth.	(16)	BTL4	CO 4
16.	Draw the circuit diagram and the equivalent circuit of a capacitor coupled single tuned amplifier and derive the expression for 3 dB bandwidth. Sketch the frequency response for the same	(16)	BTL4	CO 4

17.	A single tuned transistor amplifier is used to amplify modulated RF carrier of 600 KHz and a bandwidth of 15 KHz. The circuit has total output resistance R_t = 20 KΩ and output capacitance C_o= 50 pF. Select the values of inductance and capacitance of tuned circuit.	(16)	BTL4	CO 4

UNIT-V: OSCILLATORS AND POWER AMPLIFIERS

Condition for oscillations, Principles and Working of Oscillators Phase shift Oscillator Hartley Oscillator , Colpitts Oscillator , Clapp Oscillator , Crystal oscillators , Efficiency and Analysis of Power amplifiers, Class A, Class B, Class AB-Class C .

PART-A

Q.No.	Question	BT Level	Course Outcomes
1.	What is power amplifier?	BTL 1	CO 5
2.	List the different type of power amplifiers.	BTL 1	CO 5
3.	Classify the power amplifiers.	BTL 1	CO 5
4.	Draw the output characteristics of class A amplifier.	BTL 1	CO 5
5.	Compare the voltage and power amplifier.	BTL 1	CO 5
6.	What is the single ended class A amplifier?	BTL 1	CO 5
7.	List out the temperature effects in power amplifier.	BTL 2	CO 5
8.	Express the power relations in Class B amplifier.	BTL 2	CO 5
9.	State the efficiency of a Class C amplifier.	BTL 2	CO 5
10.	Draw the Class B transformer-coupled amplifier circuit and its output waveform.	BTL 2	CO 5
11.	Define an oscillator.	BTL 1	CO 5
12.	What is positive feedback?	BTL 2	CO 5
13.	State the conditions of an oscillator.	BTL 2	CO 5
14.	Draw the Class AB power amplifier using MOSFET.	BTL 2	CO 5
15.	Write about the amplitude stability in an oscillator.	BTL 2	CO 5
16.	Draw the basic block diagram of an oscillator.	BTL 2	CO 5
17.	Draw the circuit diagram of class C amplifier.	BTL 2	CO 5
18.	For a Hartley oscillator, if L1 = 1 mH, L2 = 2 mH and C = 0.1 nF, Determine the frequency of oscillation.	BTL 2	CO 5
19.	Write the merits of crystal oscillator.	BTL 2	CO 5
20.	Sketch the characteristics of Class B amplifier.	BTL 2	CO 5
21.	Examine the applications of a class C power amplifier.	BTL 2	CO 5
22.	List the merits of a RC phase shift oscillator.	BTL 1	CO 5
23.	In a RC phase shift oscillator, if R1 = R2 = R3 = 200 KΩ and C1 =C2 = C3 = 100 pF. Find the frequency of oscillations.	BTL 2	CO 5
24.	Write the frequency equation of oscillation for a Hartley oscillator.	BTL 2	CO 5

PART-B

1.	Explain the transformer-coupled power amplifier in detail.	(16)	**BTL 3**	**CO 5**
2	Write about the Class B transformer coupled power amplifier with necessary derivations.	(16)	**BTL 3**	**CO 5**
3.	Explain the circuit operation and output resistance of class AB power amplifiers.	(16)	**BTL 4**	**CO 5**
4.	Illustrate the transfer characteristic, signal waveforms, power dissipation, and power conversion efficiency of Class A amplifier.	(16)	**BTL 3**	**CO 5**
5.	Summarize the Class C power amplifier in detail with necessary diagrams.	(16)	**BTL 3**	**CO 5**
6	Explain the operation of Class AB power amplifier using MOSFETs.	(16)	**BTL 3**	**CO 5**
7.	(i) Compare feedback amplifier and oscillator. (ii) Classify the oscillators and explain in detail.	(8) (8)	**BTL 3**	**CO 5**
8.	Find the capacitor C and h_{fe} for the transistor to provide a resonating frequency of 10 KHz of a transistorized phase- shift oscillator. Assume R_1 = 25 KΩ, R_2 = 60 KΩ, Rc = 40 KΩ, R = 7.1 KΩ and h_{ie} = 1.8 KΩ.	(16)	**BTL 4**	**CO 5**
9.	Describe the concepts used in the biasing of Class AB circuit.	(16)	**BTL 4**	**CO 5**
10.	Analyze the various biasing methods employed in power amplifiers.	(16)	**BTL 4**	**CO 5**
11.	(i) Elaborate the conditions of oscillation with a neat block diagram. (ii) Write the demerits of a RC phase shift oscillator.	(8) (8)	**BTL 4**	**CO 5**
12.	Write about the working principle of RC phase shift oscillator circuit diagram and also derive the expression for frequency of oscillation and condition for sustained oscillation.	(8) (8)	**BTL 4**	**CO 5**
13.	Explain the working of a Hartley oscillator with a neat circuit diagram and derive the frequency of oscillation.	(8)	**BTL 4**	**CO 5**
14.	Obtain the frequency of oscillation and the condition for sustained oscillation of Colpitts oscillator with a neat circuit diagram.	(16)	**BTL 4**	**CO 5**
15.	Draw the direct coupled class A amplifier and find the maximum efficiency.	(16)	**BTL 3**	**CO 5**
16.	Explain the Class B mode of operation and its advantages and disadvantages in brief.	(16)	**BTL 3**	**CO 5**
17	Explain the working principle of a crystal oscillator in detail with necessary diagrams.	(16)	**BTL 4**	**CO 5**