Code No: RR221401 **Set No. 1**

II B.Tech II Semester Regular Examinations, Apr/May 2006
ELECTRONIC DEVICES AND CIRCUITS
(Mechatronics)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Discuss the various factors that are responsible for the 'Transition Capacitance' C_T of a Semiconductor diode with necessary details.
   (b) The reverse saturation current I_S at T=300^{0}K of a PN junction germanium diode is 50 micro amps. Calculate the forward bias voltage V_f to be applied across the junction to obtain a forward current I_f of 50 ma ?
   (c) Mention the various factors that are to be considered for selecting Zener diodes in voltage regulator circuits?
   (d) Draw the forward and reverse characteristic of a Zener diode [6+4+3+3]

2. (a) What is the significance of the term "ripple factor" in rectifier circuits.
   (b) Draw the circuit diagram of Bridge rectifier using semiconductor diodes.
   (c) Explain the working of Bridge Rectifier Circuit.
   (d) Compare the performance factors of Bridge Rectifier with Full Wave Rectifier circuit using center tapped transformer. [3+3+4+6]

3. (a) Draw a diagram showing the structural details of UJT device.
   (b) Draw a diagram showing the equivalent circuit of an Unijunction Transistor.
   (c) Define Intrinsic stand-off ratio 'η from the equivalent circuit of UJT device
   (d) Obtain the relation between peak-point voltage 'V_P' on the UJT Characteristics, supply voltage 'V_{BB}', Intrinsic stand-off ratio 'η ' and the barrier potential of P-N junction. Explain the significance of peak-point voltage on switching action of UJT device. [3+4+3+6]

4. (a) Why biasing is necessary for a Transistor circuit in a given configuration. Mention the three different types of biasing a Bipolar Junction Transistor.
   (b) Draw the Transistor biasing circuit using fixed bias arrangement and explain its principle with suitable analysis.
   (c) Mention the DC load line equation for CE Transistor fixed bias circuit and describe the method of drawing the DC load line on the CE Transistor output characteristics. [6+6+4]

5. (a) Draw circuit diagram of high input resistance Buffer amplifier using Darlington transistors and explain its operation.
   (b) Derive the expression for the current gain of the Darlington amplifier

(c) Calculate the current gain β_D of Super Beta Transistor having connection of two identical transistors each having current gains β_1=β_2= 150. Assume necessary data. [6+6+4]

6. (a) Draw the potential divider bias circuit for P-Channel JFET and explain the function of each component in the circuit.

   (b) Derive the expression for voltage gain of JFET model for self bias configuration. [8+8]

7. (a) Draw the typical frequency response characteristics of normal amplifier and negative feedback amplifier. Compare and comment on the relevant values of gain, bandwidth and gain-bandwidth product values in both cases with relevant mathematical expressions.

   (b) An amplifier has a gain A_V = 1000 and upper corner frequency W_2= 10^5 rad/sec. With the introduction of negative feedback into the amplifier, calculate the feedback factor β; which will raise the upper corner frequency W_2 to W_{2f} of10^6 rad/sec. Calculate the corresponding gain A_{VF} of the amplifier. Calculate the gain-bandwidth products in each case and comment on the results. [8+5+3]

8. (a) Draw the weinbridge oscillator circuit and explain its working.

   (b) Calculate the value of 'C' used in the weinbridge circuit that determines the oscillator frequency of 10 KHZ. Assume R=50 KΩ in the weinbridge circuit.

   (c) Derive the expression for feedback factor in the weinbridge circuit. [8+4+4]

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Code No: RR221401 **Set No. 2**

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Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
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1. (a) Mention the forward current equation of a semiconductor diode and briefly explain various terms in the equation.
   (b) Draw the forward characteristic of the semiconductor diode and explain the nature of variation with reference to the equation for forward current of the diode.
   (c) The current through silicon diode, I_f =60 ma for a forward bias of V_f =0.6 Volts. Calculate the static resistance.
   (d) Discuss the features that are responsible for maintaining constant voltage across the load in simple voltage regulator circuits using a Zener diodes. [4x4]

2. (a) Explain the working of the following circuit (figure 1). Draw the input and output waveforms.

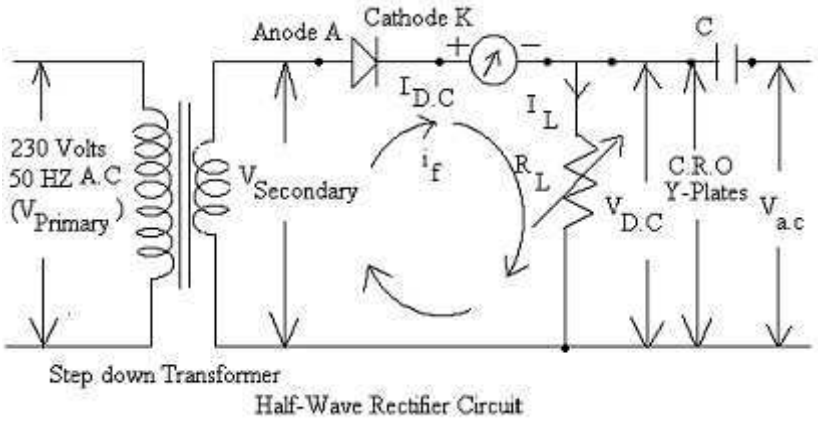

Figure 1:

   (b) Using the above circuit, explain the method of determining regulation and ripple factors practically.
   (c) Calculate the value of V_{DC} for the circuit shown above, if V_{RMS} = 30 volts, across the secondary winding of the mains power Transformer. [8+4+4]

3. (a) Draw the circuit diagram to obtain the UJT characteristics between the Emitter voltage 'V_E' and the Emitter current 'I_E' for a fixed value of 'V_{BB}'.
   (b) What is the reason for getting the negative resistance region in UJT characteristics? Explain.

(c) Determine the peak-point Emitter voltage 'V_P' required for UJT to switch into on state, if the Supply voltage 'V_{BB}' is 20 Volts, Intrinsic stand-off ratio 'η'= 0.75 and 'V_D'= 0.5.

(d) Mention some applications of UJT with suitable explanation [3+5+4+4]

4. (a) Determine the component values of R_C and R_B for a Transistor fixed bias configuration if 'V_{CC} = 12 volts', β =80 and I_{CQ} = 12.5 ma with V_{CEQ} = 6 volts.

(b) Explain 'Quiescent operating point' 'Q' for fixing DC operating conditions of a Transistor amplifier circuit.

(c) Compare the h-parameter and remodels of BJT and explain the advantages and disadvantages of each model. [6+4+6]

5. (a) Draw the hybrid-π model equivalent circuit of CE amlifier. Mention typical values of parameters used in the circuit and explain concepts for such magnitudes of parameters.

(b) For a transistor operated at I_C = 13ma; V_{CE} = 10 V; V_T=26mv at room temperature having h_{fe} = 50; h_{ie} =1.1KΩ ; A_I = 10 at 10MHZ ; and C_C = 3pf. Calculate the values of g_m ,r_{be} ; r_{bb} f_T ; f_β and C_e [10+6]

6. (a) Draw the potential divider bias circuit for P-Channel JFET and explain the function of each component in the circuit.

(b) Derive the expression for voltage gain of JFET model for self bias configuration. [8+8]

7. (a) What is feedback in amplifiers?

(b) Explain the nature of feedback process in an Emitter follower circuit.

(c) An amplifier with a gain of 1000 has output impedance Z_0 of 10KΩ . It is required to modify its output impedance to 1KΩ . Mention the type of feedback that is to be used. Calculate the feedback factor β . Also find the % change in the overall gain; for a 10% Change in the open loop gain of the amplifier. [4+6+6]

8. (a) Explain how oscillations are initiated and later stabilized in an oscillator circuit.

(b) b) Discuss the concept of positive feedback for the production of oscillators.

(c) Discuss the following terms to specify the performance of an oscillator

i. amplitude stability
ii. frequency stability
iii. Frequency range
iv. Output impedance

[4+4+8]

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Answer any FIVE Questions
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1. (a) Draw the Energy Band Diagrams of P-type and N-type Semiconductors.
   (b) Discuss the concept of Forbidden Band Gap Energy and explain its significance in the Energy Band diagrams of P-type and N-type semiconductor materials.
   (c) Explain the Mass-action law.
   (d) Calculate the magnitude of built-in potential at 300^0K for P-N junction with N_A=10^{18} /cm^3 on P-side and N_D=10^{15}/cm^3 on N-side of a Silicon semiconductor diode. Intrinsic carrier concentration n_i = 2.5x10^{13}/cm^3 and. V_T=25 mv at 300^0K [4+6+3+3]

2. (a) Calculate the value of capacitor connected to a half wave rectifier to permit only 5% of ripple. The circuit is connected to an a.c. source with 50Hz line frequency. Assume that the load resistance $R_L = 500\Omega$.
   (b) Mention the necessity of filter circuits and their function in DC power supply circuits.
   (c) Draw a Half Wave rectifier circuit with shunt capacitor filter and explain its working.
   (d) Discuss the nature of output waveforms across the shunt capacitor to load resistor R_L; when used as a filter circuit with a Half wave rectifier circuit. [3+3+6+4]

3. (a) Draw a diagram showing the structural details of N-Channel depletion and enhancement MOSFET device. [4]
   (b) Draw a circuit diagram with biasing voltages to obtain the Drain characteristics and the Transfer characteristics of N-Channel Depletion Enhancement MOSFET device. [4]
   (c) Draw the Drain characteristics of DE MOSFET. Discuss the method of obtaining the output characteristics of the Depletion Enhancement MOSFET device. Show the salient features on the device characteristics [2+2+2]
   (d) Mention the reason for calling MOSFET device as Insulated Gate MOSFET [2]

4. (a) Why biasing is necessary for a Transistor circuit in a given configuration. Mention the three different types of biasing a Bipolar Junction Transistor.
   (b) Draw the Transistor biasing circuit using fixed bias arrangement and explain its principle with suitable analysis.

(c) Mention the DC load line equation for CE Transistor fixed bias circuit and describe the method of drawing the DC load line on the CE Transistor output characteristics. [6+6+4]

5. (a) Draw the block diagram of 'Cascode Amplifier' showing the component blocks of the basic transistor amplifier configurations and explain the working of the circuit.

(b) Discuss basic circuit features of 'Cascode Amplifier' and mention its applications.

(c) If the first stage of a 'Cascode Amplifier' has voltage gain of unity (-1) and the second stage has a gain of 200; calculate the gain of Cascode amplifier in decibels. [8+4+4]

6. (a) Draw the potential divider bias circuit for P-Channel JFET and explain the function of each component in the circuit.

(b) Derive the expression for voltage gain of JFET model for self bias configuration. [8+8]

7. (a) What is feedback in amplifiers?

(b) Explain the nature of feedback process in an Emitter follower circuit.

(c) An amplifier with a gain of 1000 has output impedance Z_0 of 10KΩ . It is required to modify its output impedance to 1KΩ . Mention the type of feedback that is to be used. Calculate the feedback factor β . Also find the % change in the overall gain; for a 10% Change in the open loop gain of the amplifier. [4+6+6]

8. (a) Draw the electrical equivalent circuit of a crystal and draw the frequency versus reactance curve and show the two resonant frequencies f_S and f_P on the graph.

(b) Discuss the importance of resonating the crystal at f_{Series} or $f_{Parallel}$ and illustrate the the locations of the crystal in two crystal oscillator circuits for the two cases of the crystal resonated at f_S and f_P. [6+10]

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Code No: RR221401 **Set No. 4**

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1. (a) Mention the magnitudes of cut in voltages V_γ for silicon and germanium diodes by drawing typical voltage-current characteristics for the devices and explain the reasons for such performance using necessary Energy Band Diagrams.
   (b) In a Germanium diode, find the value of the voltage for which the reverse saturation current 'I_0' will reach 50% saturation value at room temperature.
   (c) How do semiconductors differ from conductors and insulators? Discuss with the help of the relevant Energy Band Diagrams. [6+4+6]

2. The Transformer of a Half Wave rectifier has a secondary voltage of 30 volts (V_{RMS}) with winding resistance 'r_S' of 10 ohms. The semiconductor diode in the circuit has a forward resistance 'r_f' of 100 ohms. Calculate the following: [8]
   (a) No load DC voltage.
   (b) DC output voltage when the load current 'I_L' = 25 ma.
   (c) Percentage regulation at the Load current 'I_L' of 25 ma.
   (d) Ripple voltage across the load
   (e) Ripple frequency 'f_r'
   (f) Ripple factor 'γ'
   (g) D.C. power output and
   (h) Peak Inverse Voltage (PIV) of the semiconductor diode. [2+2+4]

3. (a) Draw a NPN Transistor circuit in common emitter configuration with biasing voltages so that the Transistor can be used as an amplifying device.
   (b) Discuss the flow of various currents in a NPN Transistor in Common Emitter mode.
   (c) Draw the input and output characteristics of a Common Emitter operated Transistor.
   (d) Show the various regions of operation on the output characteristics of a CE Transistor and explain their significance in the use of Transistor as an amplifying device. [3+3+4+6]

4. (a) Compare the relative advantages and disadvantages of the methods of Transistor biasing schemes using fixed biasing and potential divider biasing techniques with illustrations.

(b) Define the stability factors S' and S". Explain the significance of considering the stability factor 'S' in the design of Transistor biasing circuits

(c) Draw the small signal low frequency h-parameter equivalent circuit of a Transistor and specify the importance of each parameter. [6+6+4]

5. (a) Discuss the reasons for the necessity of arriving at hybrid-π model of transistors when used at high frequencies. Draw the hybrid-π model of CE transistor. Explain the parameters that are used in the circuit.

(b) The constants of hybrid-p equivalent circuit of a transistor used in a CE Amplifier are as following: f_T= 100MHZ; $r_{b'e}$= 1KΩ; g_m= 100mmhos. The amplifier uses a load resistance $R_L = 1000$ ohms. Calculate values of β, f_β and mid-band gain of amplifier. [8+8]

6. (a) Draw the three types of JFET biasing circuits and compare them with reference to the stability of the amplifier circuits

(b) Design a fixed bias circuit using JFET for the following specifications: V_{DD}= 12V; V_{DS}= 5V; I_{DSS}= 10mA; V_P= -8V; V_{GS}= -2V. [10+6]

7. (a) Draw a block diagram of a negative feedback amplifier. Explain the functions of each block in the diagram.

(b) Derive an expression for the closed loop gain A_{Vf} of the negative feedback amplifier.

(c) An amplifier with a negative feedback provides an output voltage of 7.5 volts with an input voltage of 0.3 V. If feedback is removed, it needs only 0.1V input signal to get the same output voltage of 7.5V.Calculate the magnitudes of

i. gain without feedback;
ii. gain with feedback and
iii. feedback factor β

[4+4+8]

8. (a) Explain how oscillations are initiated and later stabilized in an oscillator circuit.

(b) b) Discuss the concept of positive feedback for the production of oscillators.

(c) Discuss the following terms to specify the performance of an oscillator

i. amplitude stability
ii. frequency stability
iii. Frequency range
iv. Output impedance

[4+4+8]

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