Printed Pages : 4 TEC-301

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 3073 Roll No.

B. Tech.

(SEM. III) EXAMINATION, 2008-09

SOLID STATE DEVICES & CIRCUITS

Time : 3 Hours] *[Total Marks : 100*

Note : *(1) Attempt **all** the questions.*

*(2) Symbols and notations carry their **usual** meanings unless stated otherwise.*

*(3) Any missing **data** may be assumed **suitably** giving proper justification.*

1 Attempt any **four** parts of the following : **5×4=20**

(a) Explain the operation of a tunnel diode. Draw the I-V characteristics of the diode and list the possible applications of the device.

(b) Explain with a neat sketch the operation of a photodiode. How would you use the device as a (i) Photodetector and (ii) Photo-cell ?

(c) Write down the Ebers-Moll equations for a bipolar junction transistor and sketch the equivalent model. Modify the Ebers-Moll equations when the collector base junction of the transistor is short-circuited.

(d) Compare and contrast the relative performance ratings of CB, CE and CC modes of operation of a BJT in respect of input and output resistances and voltage and current gains.

(e) A bipolar junction transistor is connected in common base mode. Draw the circuit schematic assuming the transistor to be an p-n-p one. Draw a qualitative sketch of the family of output CB characteristics of the transistor and discuss the various modes of operation of the transistor with special reference to amplification and switching operation.

(f) Draw the hybrid π model of a BJT. Define :

(i) h_{fe}

(ii) h_{ie}

(iii) h_{re}

(iv) h_{oe}

2 Attempt any **two** parts of the following : **10×2=20**

(a) Draw a schematic diagram of a MOSFET and explain its mechanism of operation. Sketch the drain current drain voltage characteristics of the device and explain the meaning of threshold voltage.

(b) Explain the meaning of pinch-off voltage in a JFET. How does the current flow in a JFET after pinch-off ? Explain the meaning of the terminologies

(i) transconductance, g_m

(ii) drain resistance, r_d and

(iii) amplification factor, μ of a JFET

(c) Sketch the schematic circuit diagram of a common source MOSFET amplifier. Derive an expression for the voltage gain at low frequencies. What is the maximum value of this gain ?

3 Attempt any **two** parts of the following : **10×2=20**

(a) Draw and explain the small signal high frequency CS model of a JFET. Explain the physical origin of various capacitances that become dominant at high frequency.

(b) Draw the circuit schematic of a common emitter BJT amplifier. Sketch and explain the small signal high frequency model of the amplifier and hence obtain the expression for the input impedance.

(c) Sketch the equivalent circuit of high frequency analysis of an emitter follower stage. Using S-domain analysis obtain the expression for the frequency response of the input admittance of the emitter follower.

4 Attempt any **two** parts of the following : **10×2=20**

(a) Sketch the four possible topologies of a feedback amplifier. Define the feedback factor **(β)** and identify the transfer gain for each topology with appropriate expressions.

(b) Describe the step-by-step procedure for analysis of a feedback amplifier. Apply this procedure to obtain the expression for the voltage gain with feedback for BJT emitter follower using a small signal low frequency model of the transistor.

(c) Sketch the circuit diagram of a feedback pair with current shunt topology. Obtain the expression for the voltage gain with feedback for system.

5 Attempt any **two** parts of the following : **10×2=20**

(a) Draw a neat sketch of a generalized resonant circuit oscillator using three impedances. Explain how this circuit can be used to behave as

(i) Colpitts oscillator

(ii) Hartley oscillator.

(b) Sketch the circuit schematic of a Wien-bridge oscillator and explain its operation. Derive an expression for the frequency of oscillation and suggest a suitable scheme for amplitude stabilization of the oscillator.

(c) What is a piezoelectic crystal ? Sketch the circuit symbol, an electrical equivalent model and the variation of the reactance of the crystal with frequency. Explain how this crystal can be incorporated in an electronic circuit to form a stable oscillator.