Number of Printed Pages — 3   **EC-301**

B.TECH.

THIRD SEMESTER EXAMINATION, 2001-2002

SOLID STATE DEVICES AND CIRCUITS

Time—3 Hours   *Total Marks—100*

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

(2)   All questions carry equal marks.

1.   Attempt any *Two* parts of the following :— 10×2

(*a*)   A full wave rectifier uses shunt filter capacitor of $10\ \mu F$. The voltage between centre tap and one end of the secondary of transformer is $20 \sin (2\ \pi\ 50\ t)$. The angle of conduction has values of 24 and 30 degrees for load resistance of $12\ k\Omega$ and $10\ k\Omega$ respectively. Derive the expression and calculate the ripple factor at the output of the filter for both values of load resistance.

(*b*)   Explain, how the stability of a self bias common emitter amplifier, as compared to the fixed bias circuit, is improved. Does large value of stability factor mean better thermal stability ?

(*c*)   Define Ebers-Moll model. Justify the following statement giving Ebers-Moll model :

There is no essential reason theoretically which constraints us from using a BJT in an inverted mode.

2.   Attempt any *Two* parts of the following :— 10×2

(*a*)   Obtain small signal model of a FET. Compare FET model with the h-parameter model of the BJT.

(b) Describe the steps followed in fabrication of a p-channel enhancement type MOSFET. Explain, why p-channel enhancement FET is popular in MOS systems.

(c) Draw the circuit of a common source FET amplifier. With the help of small signal equivalent circuit, analyse the amplifier for voltage gain and input admittance.

3. Attempt any *Four* parts of the following :— 5×4

(a) (i) Explain Crossover distortion, its causes and remedy.

(ii) What penalty is paid for biasing an amplifier into Class AB operation ?

(b) What type of bias is used in a true Class B push-pull amplifier ? Explain, how it is obtained in a transistor amplifier.

(c) Show that maximum theoretical efficiency of a Class B push-pull amplifier is 78·5%.

(d) Explain, how two complementary transistors in a Class B push-pull amplifier act simultaneously as phase inverters and an output push-pull pair.

(e) Explain the effect of coupling and by-pass capacitors in a circuit.

(f) Draw and explain the emitter follower circuit.

4. Attempt any *Two* parts of the following :— 10×2

(a) Show that cascaded common emitter amplifier stages operating at high frequency have a reduced overall bandwidth given by

$$f_{(n)} = f_2 \sqrt{2^{1/n} - 1}$$

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where, n is the number of stages and f_2 is the bandwidth of each stage.

(b) Define f_α, f_β and f_T and distinguish between f_α and f_β ; f_T and f_α.

(c) What is a cascode pair ? Give the basic circuit characteristic of a cascode amplifier.

5. Attempt any *Two* parts of the following :— 10×2

(a) Specify the input and output signals of various feedback amplifiers in terms of voltage and current signals. Obtain expressions for the input and output resistances and voltage gain with feedback for an *n p n* transistor amplifier with the collector resistance R_L and un-bypassed emitter resistance R_E.

(b) (i) What is Barkhausen criterion for oscillation ?

(ii) Describe the principle of operation of a Wien Bridge Oscillator and give the condition for sustained oscillation.

(iii) What disadvantage does a Phase Shift Oscillator have ? How is this removed in a Wien Bridge Oscillator ?

(c) (i) It is required to stabilize the output amplitude of a Wien Bridge Oscillator against fluctuations caused by ageing of components. Draw a circuit and explain how it can be achieved.

(ii) Draw the electrical equivalent circuit of quartz crystal and describe its electrical characteristics.