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No. of Printed Pages—5 **EC-301**

B.TECH.

THIRD SEMESTER EXAMINATION, 2002-2003

SOLID STATE DEVICES & CIRCUITS

Time : 3 Hours *Total Marks : 100*

Note : (1) Attempt **ALL** the questions.
(2) All questions carry equal marks.
(3) Assume missing data suitably.

1. Attempt any FOUR from the following :— **(5×4)**

(*a*) Draw the circuit diagram of a full-wave rectifier. Derive the expression for —

(*i*) the d.c. load voltage;

(*ii*) the d.c. load current;

(*iii*) the d.c. diode voltage; and

(*iv*) the r.m.s. load current.

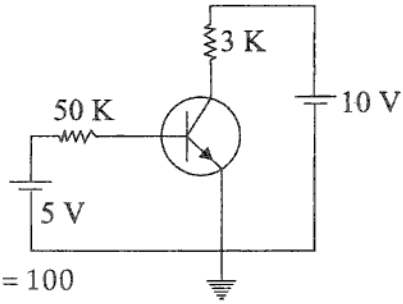
(*b*) What will be the peak inverse voltage in a bridge rectifier with and without capacitor filter ? Explain why mainly capacitor is employed as filter. What will be the effect if large value capacitor is used as filter in a rectifier circuit ?

(*c*) Draw the circuit of transistor in C.E. configuration. Sketch the output characteristic curves. Indicate the cut off, active and saturation regions and explain.

(*d*) Is $|V_{BEsat}|$ greater or less than $|V_{CEsat}|$? Explain.

(*e*) Draw the Ebers-Moll model for a *p-n-p* transistor and explain.

(*f*) Find the region in which the Q point of following transistor circuit will lie :—



$h_{FE} = 100$

$V_{CEsat} = 0{\cdot}2$ V

$V_{BEsat} = 0{\cdot}8$ V

$V_{BEactive} = 0{\cdot}7$ V

2. Attempt any FOUR from the following :— (5×4)

(*a*) Define the pinch off voltage V_p , trans - conductance g_m, drain resistance r_d and amplification factor μ. Find relationship among μ, g_m and r_d.

(*b*) Compare the Bipolar Junction transistor and Junction Field effect transistor. Draw the circuit of a MOFET NOT circuit and explain its working.

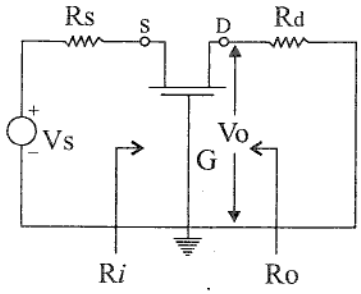
(*c*) Draw the circuit diagram of a common source amplifier. Derive the expression for voltage gain at low frequencies. What is the maximum value of voltage gain A_v ?

(*d*) For the following circuit, find the expressions for

(*i*) voltage gain,

(*ii*) input impedance,

(*iii*) output impedance :—



The power supplies are not shown. Neglect capacitances.

(*e*) Draw the common source drain characteristic of a n-channel field effect transistor and explain the shape of curve.

(*f*) Show that the transconductance g_m of a JFET is related to drain current I_{DS} by

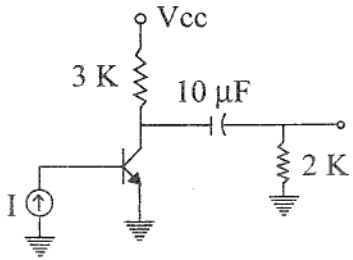
$$g_m = \frac{2}{|V_P|}\sqrt{I_{DSS}\ I_{DS}}$$

3. Attempt any TWO from the following :— (10×2)

(*a*) Why is multistaging done at all ? List the advantages and disadvantages of multistaging. Draw the circuit diagram of a two stage R-C coupled amplifier and explain its operation. What will happen if both bypass capacitors are open circuited simultaneously?

(*b*) How are the power amplifiers classified ? Explain each type. What are advantages of push-pull system ? Draw the circuit diagram of a class B push-pull amplifier and explain its working.

(*c*) For a transistor CE stage, as shown in the following figure with $\frac{1}{h_{oe}} \cong \infty$,



calculate the percentage tilt in the output, if input current I is a 100 Hz square wave. What is the lowest frequency square wave that will suffer less than 1% tilt ?

4. Attempt any TWO from the following :— (10×2)

(*a*) Draw the small signal hybrid π model at high frequency. Explain all the components of your model. Prove that $h_{fe} = g_m r_{b'e}$.

(*b*) Define f_β and f_τ. Derive the expressions for both f_β and f_τ and hence find the mathematical relation between f_β and f_τ.

(*c*) (*i*) Write short note on Cascode Amplifier.

(*ii*) What do you mean by Tuned Amplifier ? Draw the circuit diagram of a tuned amplifier and explain its working. What are the applications of tuned amplifier ?

5. Attempt any TWO of the following :— (10×2)

(*a*) What are the different characteristics of Amplifier that are modified with negative feedback ? Define desensitivity D and discuss the effect of large value of D.

(*b*) What are the Barkhausen conditions

required for sustained sinusoidal oscillation ? Sketch the circuit of a Wien bridge Oscillator. Derive the expressions for frequency of oscillations. Does the oscillation take place with balanced bridge ?

(c) For the following feedback network, find :—

(*i*) the transfer function,

(*ii*) input impedance,

(*iii*) the frequency of oscillation and minimum amplifier voltage gain, if this network is used in a phase shift oscillator. (Assume no loading to take place),