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Total No. of Questions—12] [Total No. of Printed Pages—8

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S.E. (E&TC/Elex.) (First Semester) EXAMINATION, 2011

SOLID STATE DEVICES AND CIRCUITS

(2008 PATTERN)

Time : Three Hours **Maximum Marks : 100**

N.B. :— (*i*) Answers to the two Sections should be written in separate answer-books.

(*ii*) Neat diagrams must be drawn wherever necessary.

(*iii*) Figures to the right indicate full marks.

(*iv*) Use of logarithmic tables, slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.

(*v*) Assume suitable data, if necessary.

SECTION I

1. (*a*) Explain construction, operation and characteristics of photo-diode. [6]

(*b*) Explain the following Non-ideal characteristics of MOSFET :

(*i*) Finite output resistance

(*ii*) Body effect

(*iii*) Subthreshold conduction

(*iv*) Breakdown effect. [8]

(*c*) An ideal Ge-diode at a temperature of 120°C has a reverse saturation current of 30 μA at a temperature of 120°C. Find the dynamic resistance for a 0.2 V bias in :

(*i*) The forward bias direction

(*ii*) Reverse bias direction. [4]

P.T.O.

Or

2. (*a*) Why are MOSFETs used as VLSI device ? [4]

(*b*) While handling CMOS devices, what precautions should be taken ? [6]

(*c*) Analyze the circuit shown in Fig. 1. Assume circuit and diode parameters of V_{ps} = 5 V, R = 5 kΩ, V_r = 0.6 V and V_i = 0.5 sin ω*t* volts. [8]

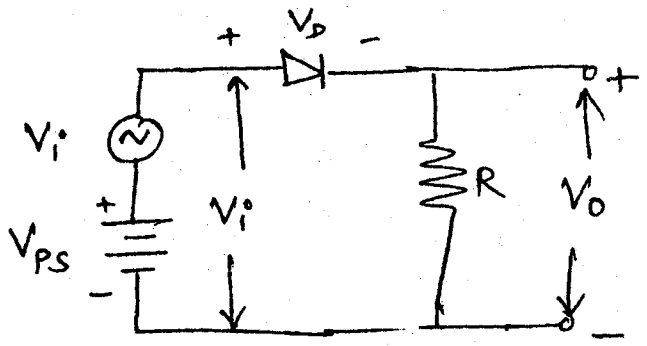

Fig. 1

3. (*a*) Explain with neat diagram BiCMOS inverter. [8]

(*b*) For the circuit shown in Fig. 2, calculate I_D, V_{DS}, V_{Cr}, V_S. For the MOSFET, I_{DSS} = 20 mA, $V_{GS(OFF)}$ = –6 V. [8]

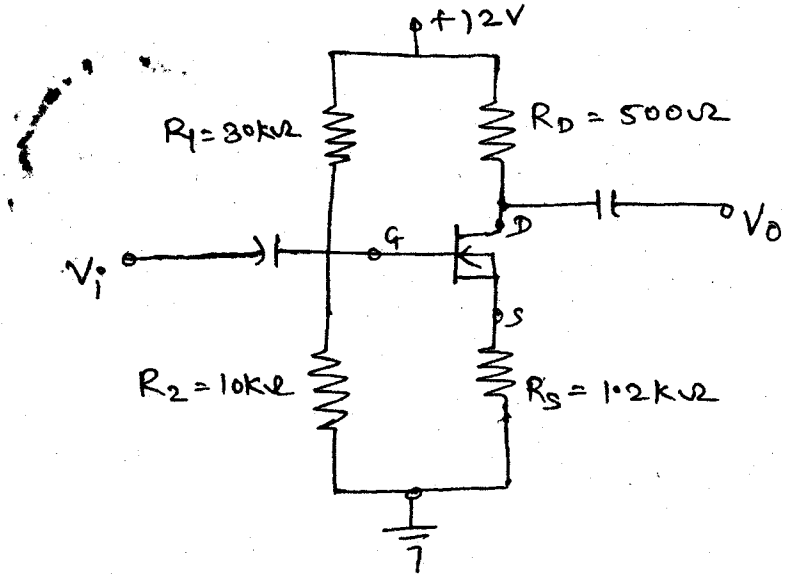

Fig. 2

Or

4. (*a*) Explain MOSFET scaling and small geometry effects. [8]

(*b*) For the circuit shown in Fig. 3, calculate V_G, I_D, V_{GS}, V_{DS}. For MOSFET $V_{GS}(Th) = 5$ V, $I_D(ON) = 3$ mA, $V_{GS}(ON) = 10$ V. [8]

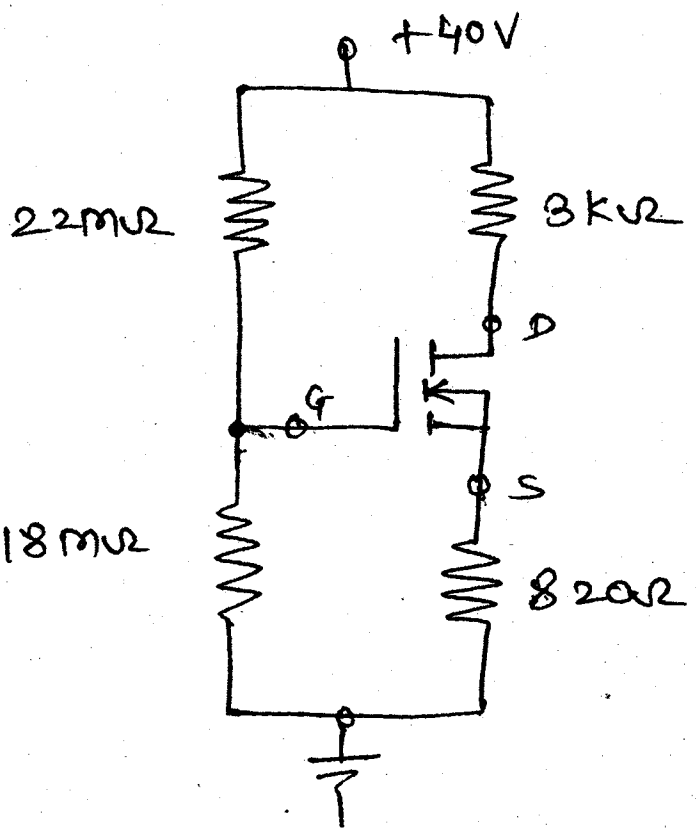

Fig. 3

5. (*a*) Why is bias stabilization in BJT amplifier needed ? Define *three* bias stabilization factors and explain its significance. [8]

(*b*) Derive an expression for current gain, voltage gain, input impedance and output impedance of CE amplifier for small signal *h*-model. [8]

Or

6. (*a*) For the amplifier circuit shown in Fig. 4, calculate :

$$A_{vs} = \frac{V_o}{V_s},\ A_{IS} = \frac{I_o}{I_s},\ R_1', R_o'$$

For the BJT h_{ie} = 1.1 kΩ, h_{fe} = 50,

$h_{re} = 2.4 \times 10^{-4}$, h_{oe} = 25 μA/V. [8]

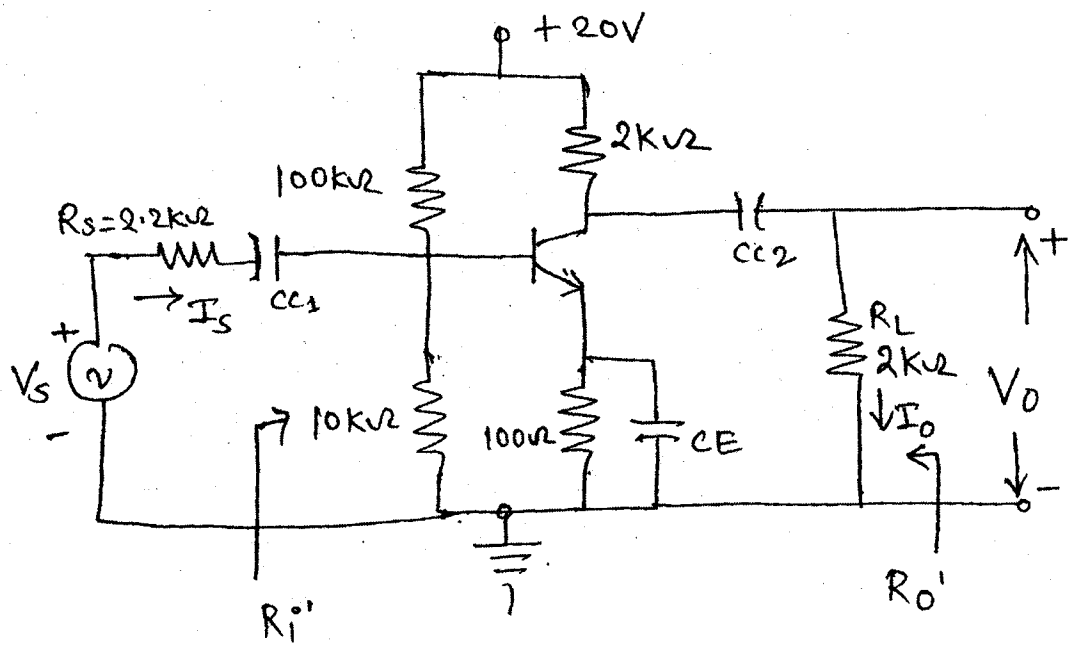

Fig. 4

(*b*) Explain the need of multistaging of amplifiers. What is the selection criterion for transistor configuration in multistage amplifiers. [8]

SECTION II

7. (*a*) What are the advantages of square wave testing over frequency response method ? Explain in brief. [4]

(*b*) Explain the concept of 'Dominant Pole' in BJT amplifier with sketch. [4]

(*c*) A high frequency amplifier uses a transistor which is driven from a source with R_S = 1 Ω, calculate value of f_H, A_{VS}low and A_{VS}high if R_L = 0 and R_L = 1 kΩ.

Assume hybrid –π parameters : $rb'e$ = 1 kΩ, $rb'b$ = 100 Ω, C_e = 100 pF, C_c = 3 pF, 9 m = 50 mA/V. [8]

Or

8. (*a*) Derive the expression for CE short circuit current gain A_i as a function of frequency. [8]

(*b*) An RC-coupled amplifier has $A_V$mid = 80, R_{in} = 10 kΩ, it is fed from ideal voltage source through C_C = 0.1 µF. Calculate lower 3 dB frequency gain at 300 Hz and frequency at which gain is down by 10 dB from its mid frequency value. [8]

9. (*a*) Explain the typical methodology used for feedback amplifier analysis. [6]

(*b*) A Colpitts oscillator shown in Fig. 5. What is the approximate frequency ? What will be the frequency, if the value of L is doubled ? What should be the value of inductance to double the frequency value ? [8]

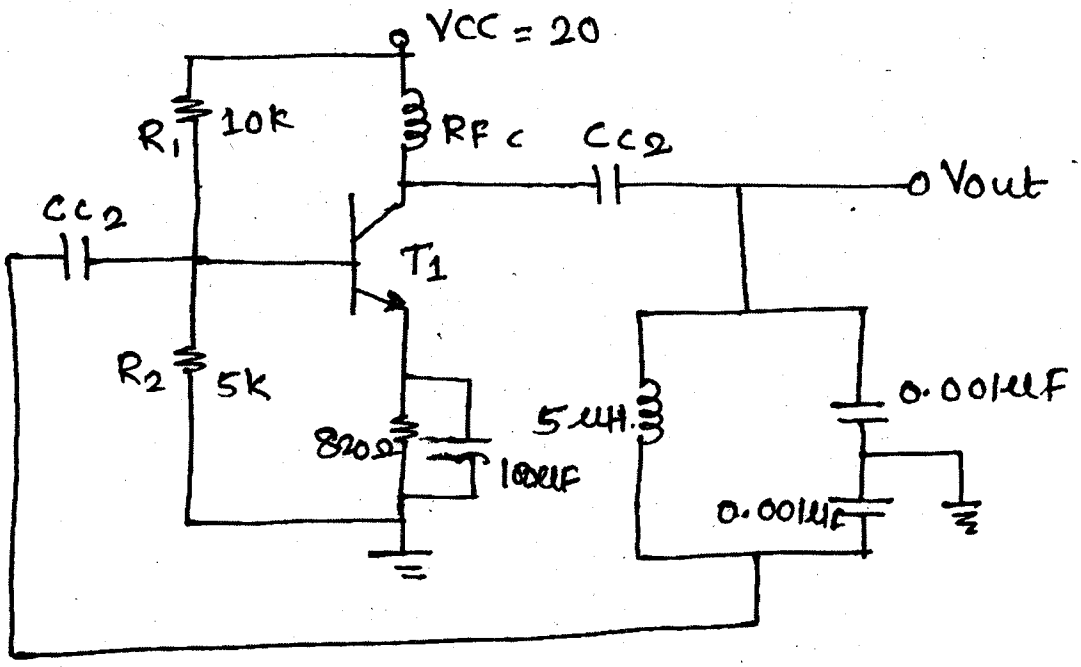

Fig. 5

(*c*) Write a short note on crystal oscillator. [4]

Or

10. (*a*) Define the stability of system. Explain it in terms of Boded plot. [6]

(*b*) For the feedback amplifier shown in Fig. 6,

$R_s = 0$, $h_{fe} = 50$, $h_{ie} = 1.1$ kΩ, $h_{re} = h_{oe} = 0$.

and transistors are identical. Calculate A*vf*, R*of*', R*if*'. [10]

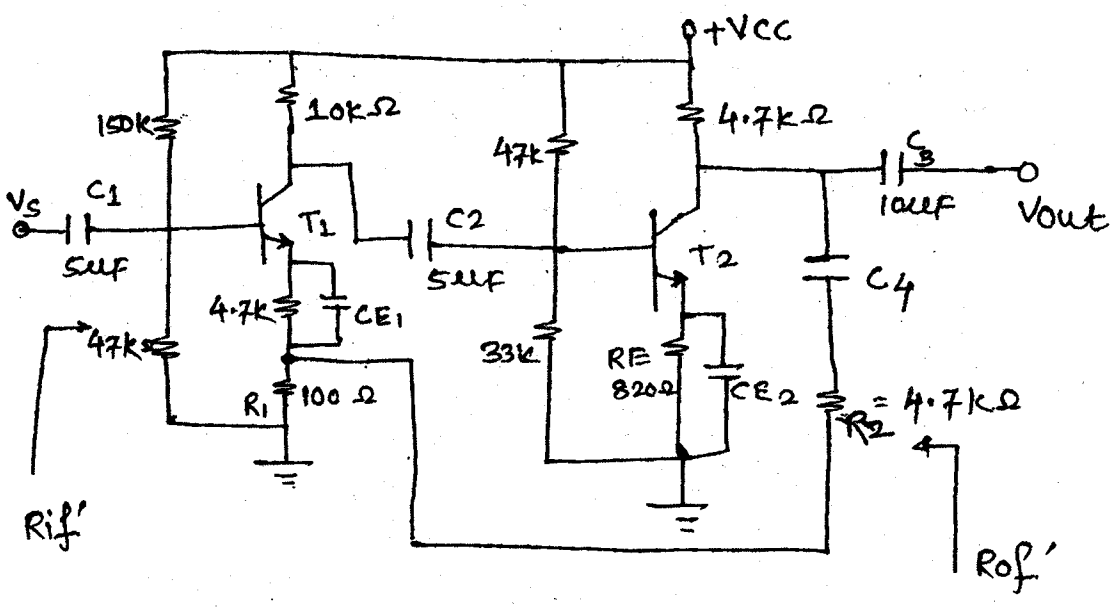

Fig. 6

(*c*) What are the advantages of negative feedback ? [2]

11. (*a*) Discuss the safe operating area of transistor. [4]

(*b*) A complementary symmetry class AB. Audio frequency power amplifier uses two matched BJTs and dual power supply of ± 30 V, and feeds a common load of 8 Ω. If the i/p voltage to the amplifier is 8 V (rms), calculate :

(*i*) DC power input

(*ii*) AC power output

(*iii*) Max. Possible AC power O/P

(*iv*) Efficiency

(*v*) Power dissipation by both transistors. [8]

(*c*) Write a short note on thermal resistance. [4]

Or

12. (*a*) With the help of neat circuit diagram explain the operation of complementary symmetry (class AB) power amplifier. Explain the significance of class AB. [8]

(*b*) A sinusoidal signal $V_S = 1.95 \sin 400t$ is applied to a power amplifier. The resulting current is $I_O = 12 \sin 400t + 1.2 \sin 800\ t + 0.9 \sin 1200t + 0.4 \sin 1600\ t$.

Calculate :

(*i*) Total Harmonic Distortion

(*ii*) Percentage increase in power because of distortion. [8]