Question Paper

Exam Date & Time: 27-Dec-2019 (09:30 AM - 12:30 PM)

MANIPAL ACADEMY OF HIGHER EDUCATION

INTERNATIONAL CENTRE FOR APPLIED SCIENCES
END SEMESTER THEORY EXAMINATIONS NOVEMBER2019
III SEMESTER B.sc. (Applied Sciences) in Engg.
ANALOG ELECTRONIC CIRCUITS [IEC 231 - S2]

Marks: 100 **Duration: 180 mins.**

Answer 5 out of 8 questions.
Missing data may be suitably assumed.

1) A) Draw the circuit diagram of common emitter configuration using NPN transistor. Draw and explain the input and output characteristics. Indicate cut-off, saturation and active regions. (5)

B) Define α_{dc} and β_{dc} of a transistor. Write the expressions for α_{dc} and β_{dc}. Calculate the value of collector current, α_{dc} and β_{dc}, if I_B=200μA, I_{CBO}=20μA and I_{CEO}=0.5mA. (5)

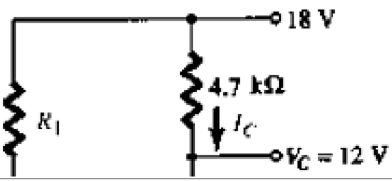
C) A fixed bias circuit with silicon transistor with β=100 is used. Draw the DC load line and determine the operating point. Given R_B=200KΩ, Vcc=10V and R_C=2KΩ. Assume V_{BE}=0.7V.Neglect I_{CO}. Draw the circuit diagram (5)

D) Draw a self-bias circuit using NPN transistor. Illustrate the advantage of a self-bias circuit over a fixed bias circuit by deriving the base and collector currents. (5)

2) A) With the help of a circuit diagram explain how a transistor (BJT) can be used as a switch. Illustrate with the example of a square wave of amplitude 5V applied to the base. (5)

B) An amplifier has a voltage gain of 100, an input resistance of 50KΩ and an output resistance of 100Ω. The amplifier is connected to a sensor input that produces a voltage of 1V and has source resistance of 50Ω, and a load resistance of 100Ω. What will be the output voltage of the amplifier? Also draw the equivalent circuit of an amplifier. (5)

C) Determine I_B, I_C, I_E, V_{CE}, V_B, R_1 and V_E for the voltage divider configuration shown in Fig Q2C given that β=80. Assume V_{BE}=0.7V. What is the region of operation? Neglect I_{CO}. (10)



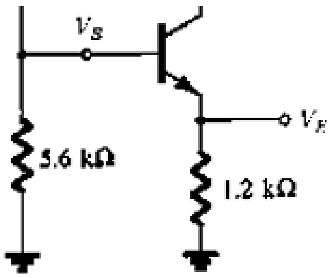


FIG.Q2C

3) (5)

A) Assume $\lambda = 0$, $V_{TH} = 0.4V$ and $\mu_n C_{ox} = 100\ \mu A/V^2$, compute $W/_L$ of M_1 in **Fig. Q3A** such that the device operates at the edge of saturation.

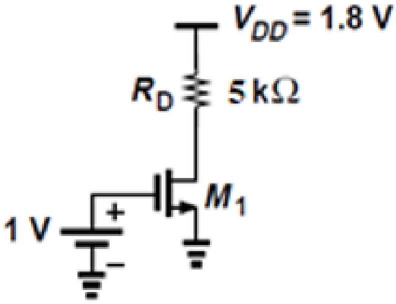


Fig Q3A

B) If $\lambda = 0.2$ / V, $\mu_n C_{ox} = 100\ \mu A/V^2$, $W/_L = {}^{10}/_{0.18}$, V_{TH}=0.4V and I_D=0.25mA, construct the small-signal model of the circuit shown in **Fig. Q3B.** Compute V_{GS}, V_{DS}, I_D, g_m & r_o. (5)

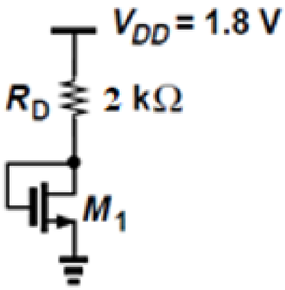


Fig. Q3B

C) An NMOS device with $\lambda = {}^{0.15}/_V$ must provide a voltage gain of 30 with V_{DS} = 1.5V. Determine the required value of $W/_L$ if I_D = 1 mA. and $\mu_n C_{ox} = 100\ \mu A/V^2$ (5)

D) If $W/_L = {}^{20}/_{0.18}$, $\mu_p C_{ox} = 100\ \mu A/V^2$ and $\lambda = 0$, determine V_{GS}, V_{DS} and I_D for the circuit shown in **Fig. Q3D**. Draw the small signal model. (5)

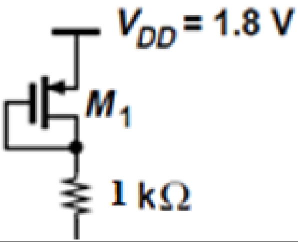
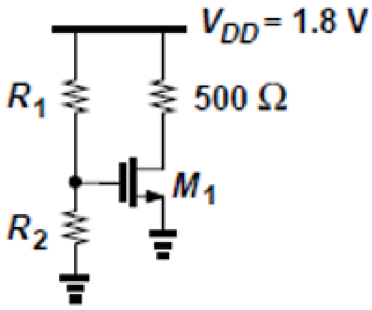


Fig. Q3D

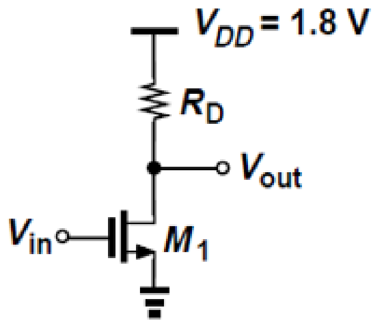
4) (5)

A) Design a circuit of **Fig. Q4A** for a drain current of 2 mA, if $W/_L = 10/_{0.18}$, $\mu_n C_{ox} =$ 100 μA/V² and $V_{TH} = 0.5V$, Compute R1 and R2 such that the input impedance is at least 30 kΩ.



FigQ4A

B) The CS stage of **FigQ4B** carries a bias current of 0.5 mA. If R_D = 500Ω, $V_{TH} = 0.4V$, $\mu_n C_{ox}$ = 200 μA/V², and λ = 0.15/V. Compute the required value of $W/_L$ for a gate voltage of 1 V. (5)



FigQ4B

C) (5)

Design the circuit in **Fig. Q4C** for a drain current of 0.5 mA. If $W/_L = 20/_{0.18}$, $V_{TH} =$ $0.4V$ and $\mu_n C_{ox}$ = 200 μA/V², calculate the values of R1 and R2 such that these resistors carry a current equal to one-tenth of I_D.

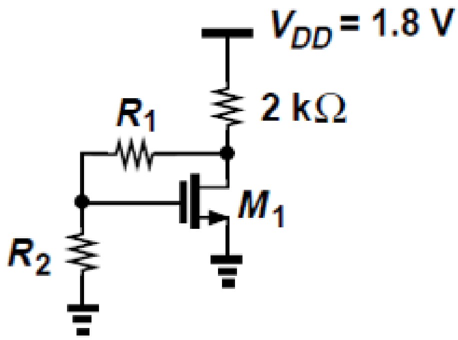


Fig Q4C

D) The degenerated CS stage of **Fig Q4D** must provide a voltage gain of 5 with a bias current of 1.5 mA. Assume a drop of 100 mV across R_S and $\lambda = 0$. If $R_D = 1$ k, determine the required value of W/L. (5)

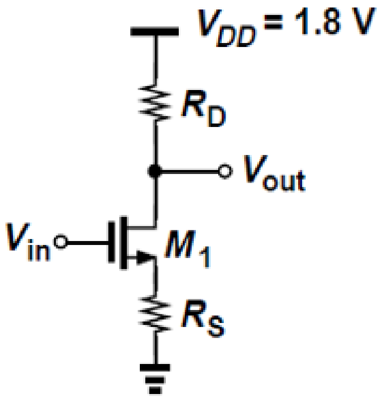


Fig Q4D

5) A) State Barkhausen criteria for sustained oscillations. Draw the circuit diagram of Hartley oscillator and explain its working. Write the expression for frequency of oscillations (5)

B) With the help of a circuit diagram, explain the working of a quasi-complementary Class AB power amplifier. What is the maximum power efficiency achieved using this configuration? Mention one advantage of class AB power amplifier. (5)

C) With the help of a block diagram, explain negative feedback. Derive an expression for gain in a negative feedback amplifier. Mention the application of positive feedback. (5)

D) State and explain Millers theorem with an illustration. Explain any one application of this theorem with necessary circuit (5)

6) A) Draw the circuit diagram of Low Frequency Model of MOSFET and explain. Write the expressions for the cutoff frequency of the amplifier. (5)

B) Draw the electrical equivalent circuit of crystal. A crystal has the following parameters: L=0.33 H, Cseries=0.065 pF, Cshunt=1 pF and R=5.5 KΩ.Find the series resonant frequency. With the help of a circuit diagram, explain how crystal can be used in an oscillator circuit? (5)

C) With suitable diagrams, explain how power amplifiers are classified based on the operating point. (5)

D) Determine the voltage gain, input and output impedance with feedback for voltage Series feedback having A= 200, Ri=50KΩ & R_0 =10KΩ for feedback of i) $\beta = 0.1$ ii) $\beta = 0.5$ (5)

7) A) Draw the block schematic of i) Current shunt ii) Current series feedback amplifiers. What is the effect of series and shunt feedback on the input and output resistance of an amplifier? (5)

B) Plot the frequency response of an amplifier with and without feedback. Discuss the effect of feedback on bandwidth and gain. An amplifier has a mid-band gain of 1500 and a bandwidth of 4 MHz The mid-band gain reduces to 150 when a negative feedback is applied. Determine the value of feedback factor and the bandwidth. (5)

C) Explain the construction, working and characteristics of MOSFET. Sketch output and transfer characteristics. (5)

D) With necessary current equation explain Triode and Saturation region in MOSFET. Explain how current varies when width, length is varied with necessary plot. (5)

8) Explain the following: (20)

i) Emitter follower

ii) Channel length modulation in MOSFET

iii) MOS trans conductance

iv) Piezoelectric effect in crystals
(5X4=20)

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