Bengal Engineering and Science University, Deptt. Of E&T.C.
Final Sem Examination 3rd Sem E&T.C.
Subject: Analog Electronics F.M. 70 Time: 3 Hours.
(ET-304)

Answer any FIVE questions. Answer all questions in a single answer script.

1. a) Draw the structure of MOS device and explain its operation in cut off saturation and active region.
b) Draw the basic small signal model of MOS and explain it.

2. a) Derive expression for $g_m r_o$ in terms of I_D and W / L.
b) Consider a semiconductor bar carrying a current I. If the charge density along the direction of current is Q_d coulombs per meter and the velocity of the charge is v meters per second. With that consideration obtain the relationship between the drain current of a MOSFET and its terminal voltages.

3. a) Draw the circuit diagram of common source stage with diode load and compute its voltage gain.

b) Draw the circuit diagram of common source stage with source degeneration and its small signal equivalent circuit and compute equivalent tran conductance $G_m = \frac{\partial I_D}{\partial V_{in}}$.

4. a) Consider the circuit shown in Fig. 1 and determine its characteristics. Also compute power and current gain of the circuit.

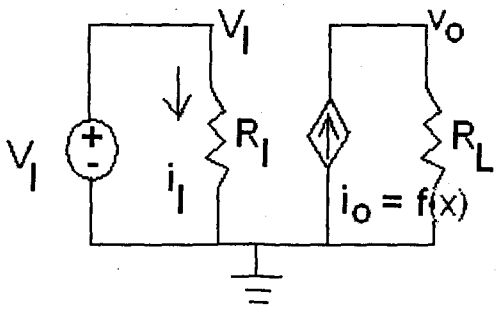

Fig. 1

b) What do you mean by differential amplifier. Explain the advantages of differential amplifier over single ended amplifier.

5. a) The amplifier in Fig.2 has two input voltages, V_{IN1} and V_{IN2}, and one output voltage V_{out}. Determine V_{out} as a function of V_{IN1} and V_{IN2}. The V_S, and I_S serve only to bias the amplifier, and are assumed to be constant.

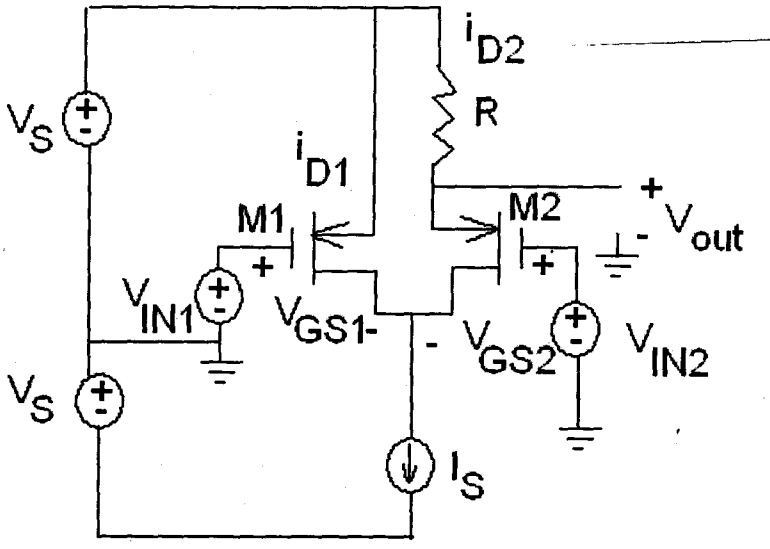

Fig. 2

b) Define and explain common mode rejection ratio.

6. a) With necessary diagram explain the operation of (i) BJT and MOS current source and current sink. Draw the V-I characteristic.

b) The transit frequency is defined as the frequency at which the small signal current gain of a MOS device drops to unity while the source and drain terminals are held at ground. . Then prove that $f_T = \frac{g_m}{2.\pi(C_{GD} + C_{GS})}$. Note that transit frequency does not include the effect of the S/D junction capacitance.

7. a) How many types of inverting amplifiers are there ? With necessary circuit and input output characteristic diagram explain the operation of each type of amplifier.

b) Explain how the gain of an amplifier can be improved by cascading.

8. a) Define and explain the differences between class A and class AB amplifier.
b) Draw circuit diagram of BJT and MOS class A amplifier and explain their operation.

9. a) Define current mirror.

b) In Fig. 3 assume $(\frac{W}{L})_1 = 50/5$, $\lambda = 0$, $I_{out} = 0.5mA$, and M1 is saturated.

(i) Determine $\frac{R_2}{R_1}$

(ii) Calculate sensitivity of I_{out} to V_{DD},, defined as $\frac{\partial I_{out}}{\partial V_{DD}}$ and normalized to I_{out} .

(iii) How much does I_{out} change if V_{TH} change by 50 mV.

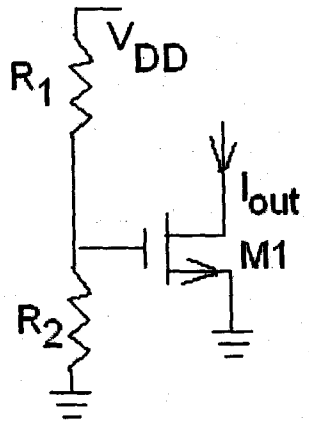

Fig. 3

c) State and explain the condition of oscillation of an analog amplifier.

10 Write short notes on:

a) Second order effect of MOS transistor.
b) Source follower
c) Matching principle