Assiut University
Faculty of Engineering

EE0513-ELECTRONIC CIRCUITS
First Term Final Exam
January 2015

Mechatronics Program

Attempt all questions, full mark: 40 Points **Time: 3 Hours**

Question #1: (10 Points)

Choose the right answer:

1) If a sinusoidal voltage is applied to the base of a biased npn transistor and the resulting sinusoidal collector voltage is clipped near zero volts, the transistor is

A

(A) being driven into saturation (B) being driven into cutoff
(C) operating nonlinearly

2) The input resistance of a common-base amplifier is

A

(A) very low (B) very high
(C) the same as a CE (D) the same as a CC

3) The voltage gain of a common-base amplifier is

C

(A) very low (B) very high
(C) the same as a CE (D) the same as a CC

4) The input resistance at the base of a biased transistor depends mainly on

D

(A) β (B) R_E
(C) R_B (D) β and R_E

5) A differential amplifier

D

(A) is used in op-amps (B) has one input and one output
(C) has two outputs (D) answers (A) and (C)

6) The maximum efficiency of a class A power amplifier is

A

(A) 25% (B) 50%
(C) 75% (D) 78.5%

7) Crossover distortion is a problem for

C

(A) class A amplifiers (B) class AB amplifiers
(C) class B amplifiers (D) all of these amplifiers

8) For V_{GS}= 0, the drain current in a JFET becomes constant when V_{DS} exceeds

C

(A) cutoff (B) V_{DD}
(C) V_P (D) 0 V

9) A certain n-channel E-MOSFET has a $V_{GS(th)}$= 2V. If V_{GS}= 0 V, the drain current is

A

(A) 0 A (B) $I_{D(ON)}$
(C) maximum (D) I_{DSS}

10) Which of the following characteristics does not necessarily apply to an op-amp?

B

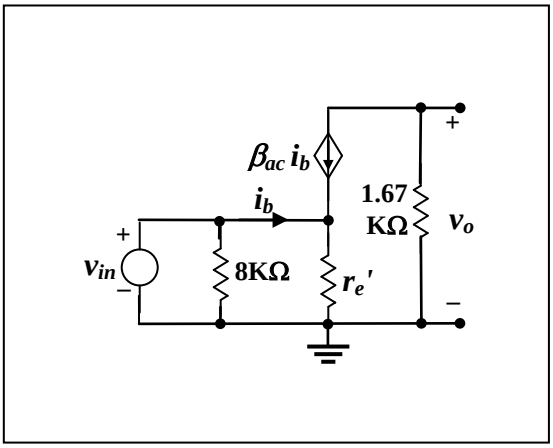
(A) High gain (B) Low power
(C) High input impedance (D) Low output impedance

Question #2: (5 Points)

a) A certain transistor has α_{DC}= 0.99. If the dc base current is 10 μA, determine r_e'.

$\beta = \alpha/(1-\alpha) = 99$
$I_E = (\beta + 1)I_B = 1$ mA
$r_e' = 25/I_E = 25\ \Omega$

b) Draw the ac equivalent circuit for the amplifier in Fig.b



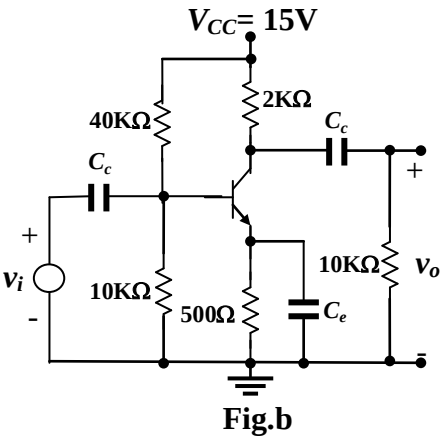


Fig.b

c) An n-channel JFET has I_{DSS} = 5 mA and $V_{GS(off)}$ = -8 V. What value of V_{GS} is required to set up a drain current of 2.25 mA.

$I_D = 5[1 - V_{GS}/(-8)]^2 = 2.25$

$V_{GS} = -2.63$ V

d) A certain class A power amplifier has V_{CEQ}= 12 V and I_{CQ}= 1A. Find the maximum signal power output.

$P_{out(max)} = V_{CEQ}I_{CQ}/2$
$= 6$W

e) Find V_o in the circuit of Fig.(e).

$V_o = -18$ V

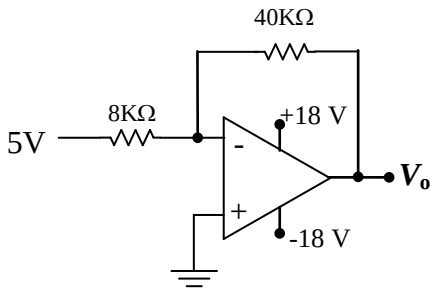


Fig.(e)

Question #3: (5 Points)

The silicon npn transistor used in the swamped amplifier shown in Fig.3 has $\beta_{dc} = \beta_{ac} = 100$.

a) Find I_{CQ} and V_{CEQ}.
b) Find r_e'.
c) Find the voltage gain and input impedance of the amplifier.

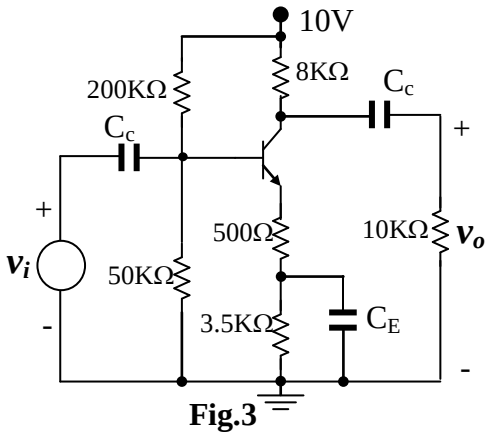


Fig.3

I_{CQ}= 0.295 mA	V_{CEQ}= 6.45 V	r_e'= 84.6 Ω
A_v= -7.6	Z_{in}= 23.75 KΩ	

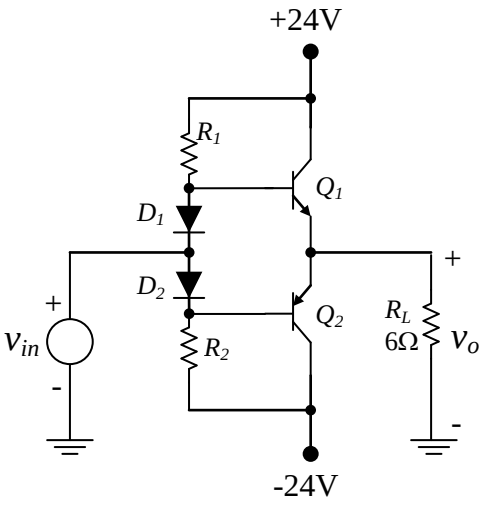
Question #4: (5 Points)

A class-*AB* complementary-symmetry push-pull power amplifier is connected to a 6 Ω load. The supply voltages are ±24 V.

a) Draw the amplifier circuit diagram. (1 Point)
b) Find the peak value of the collector current, the DC power delivered by the source, and the amplifier efficiency if the ac power delivered to the load is 27 W. (3 Points)
c) What would be the maximum allowable output power? (1 Point)

I_{Cp} = 3 A	
P_{DC} = 45.83 W	
Efficiency = 58.9%	
$P_{out(max)}$ = 48 W	

The Circuit Diagram



Question #5: (5 Points)

The JFET used in the common source amplifier of Fig.5 has $V_{GS(off)}$ = -5V and I_{DSS} = 10 mA.

a) Determine the operating point I_{DQ}, V_{GSQ} and V_{DSQ}. (3 Points)

b) Calculate the value of the transconductance g_m at the *Q*-point. (1 Point)

c) Determine the amplifier voltage gain. (1 Point)

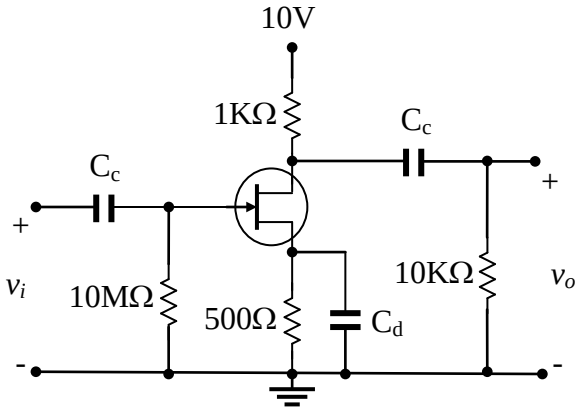


Fig.5

I_{DQ}= 3.82 mA	V_{GSQ}= -1.91 V	V_{DSQ}= 4.27 V
g_m= 2.47 mS	A_v= -2.247	

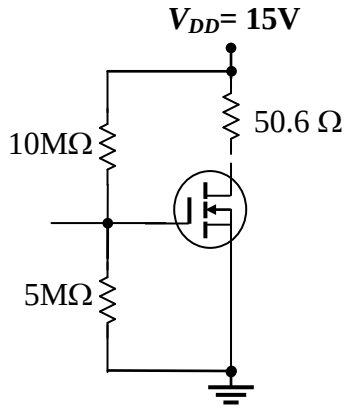
Question #6: (3 Points)

a) The data sheet for a 2N7008 E-MOSFET gives $I_{D(on)}$ = 500 mA at V_{GS} = 10 V and $V_{GS(th)}$ = 1 V. Determine the drain current for V_{GS} = 5 V. (1 Point)

b) The transistor is to operate at: V_{GSQ} = 5 V, V_{DSQ} = 10V. Draw a suitable circuit to bias this transistor giving suitable resistances values, assuming that V_{DD} =15 V. (2 Points)

I_D = 98.765 mA

The Circuit Diagram



Question #7: (3 Points)

a) Find the output voltage when the indicated input voltages are applied to the scaling adder of Fig.7. (2 Points)

b) What is the value of the current through R_f? (1 Point)

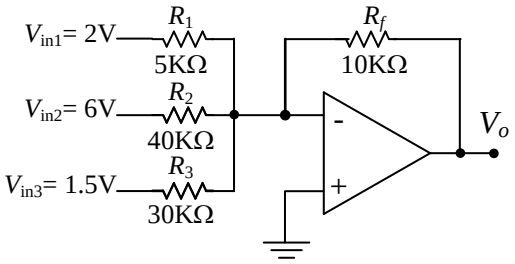


Fig.7

V_o= -6 V	I_f = 0.6 mA

Question #8: (4 Points)

The voltage waveform v_g shown in Fig.(8-a) is applied to the circuit of Fig.(8-b). Sketch v_o versus t, assuming ideal op-amp.

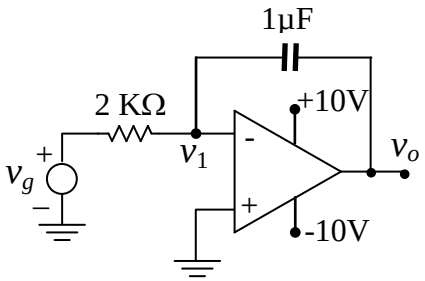


Fig. (8-b)

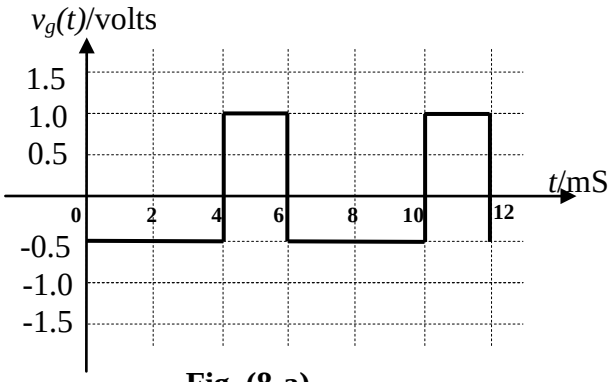


Fig. (8-a)