Basic Electronics

ECC01

Full Marks = 60 Duration = 2 Hours

(Answer ALL questions)

Question No. 1 (Multiple Choice Types) (15 × 1 = 15)

1.1) FET is a
- (a) voltage controlled current source
- (b) voltage controlled voltage source
- (c) current controlled current source
- (d) current controlled voltage source

1.2) A MOSFET works as an amplifier when biased in
- (a) Cut-off region
- (b) Triode/Linear region
- (c) Saturation region
- (d) Ohmic region

1.3) Threshold voltage of a MOSFET is the minimum gate voltage to invert the channel such that
- (a) channel carrier concentration is equal to the carrier concentration in the body
- (b) channel carrier concentration is double to the carrier concentration in the body
- (c) channel carrier concentration is half of the carrier concentration in the body
- (d) channel carrier concentration is very small compared to the carrier concentration in the body

1.4) Pinch-off in a FET occurs towards the
- (a) drain end of the channel
- (b) source end of the channel
- (c) at the middle of the channel
- (d) gate end of the device

1.5) Which of the following device is most widely used in modern electronics industry?
- (a) JFET
- (b) BJT
- (c) MOSFET
- (d) All of these

1.6) _____ number of transistor/s are required to design a single-stage amplifier
- (a) 1
- (b) 2
- (c) 3
- (d) 4

1.7) Based on the input signals, when the fluctuations in collector current are large i.e. beyond the linear portion of the characteristics, the amplifier is known as
- (a) small signal amplifier
- (b) large signal amplifier
- (c) power amplifier
- (d) audio amplifier

1.8) Voltage gain of an amplifier without feedback and with negative feedback respectively are 100 and 20. The percentage of negative feedback would be
- (a) 4%

(b) 5%
(c) 20%
(d) 80%

1.9) About negative feedback which of the following statements are correct.
1. In negative feedback, the effective input voltage to the basic amplifier is reduced because the feedback voltage is mixed out of phase with the input signal.
2. In negative feedback, the effective input voltage to the basic amplifier is reduced because the overall input impedance is decreased due to the shunt configuration of the feedback network and the basic amplifier.
3. Negative feedback reduces overall gain and distortion, while increases noise and bandwidth.

(a) 1 and 2
(b) 1 and 3
(c) 2 and 3
(d) 1, 2 and 3

1.10) For sustaining oscillations in an oscillator
(a) Loop gain should be unity
(b) phase shift between input and feedback should be 0^0
(c) feedback should be positive
(d) all of these

1.11) This gate is said to be the universal building block of all digital circuits-
(a) AND
(b) OR
(c) NAND
(d) NOT

1.12) This is the heart of an oscilloscope-
(a) Delay time
(b) CRT
(c) Vertical Amplifier
(d) Time Base Generator

1.13) The unit of deflection sensitivity of a CRT is-
(a) V/mm
(b) mm/V
(c) A/V
(d) V/A

1.14) An emitter or source follower circuit exhibits
(a) low input impedance and high output impedance
(b) high input impedance and high output impedance
(c) low input impedance and low output impedance
(d) high input impedance and low output impedance

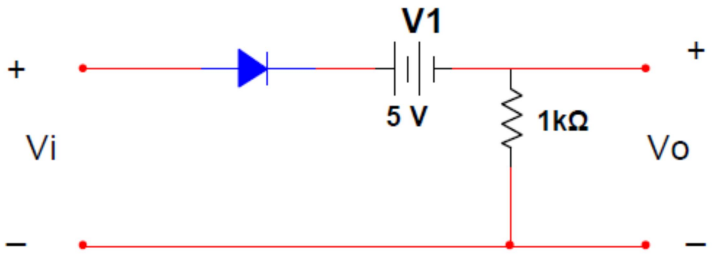
1.15) The loop gain of a feedback amplifier designed as an oscillator got to be
(a) slightly greater than 1 with 180 degrees phase difference w.r.t effective input
(b) slightly less than 1 with 180 degrees phase difference w.r.t effective input
(c) slightly greater than 1 with same phase w.r.t effective input
(d) slightly less than 1 with same phase w.r.t effective input

Question No. 2 (5+5+5 = 15)

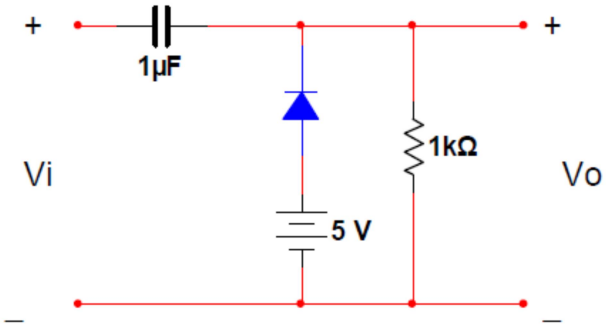
2.1) A 230V, 50Hz AC voltage is applied to the primary of a 5:1 step down transformer which is used in a bridge rectifier having a load resistor of value 500Ω. Assuming the diodes to be ideal, determine the following:
(1) DC output voltage (2) DC power delivered to load (3) PIV of each diode.

2.2) Determine output waveform of the following circuits considering an input of 20V peak to peak, 10kHz sine wave and ideal diode in *each case*.

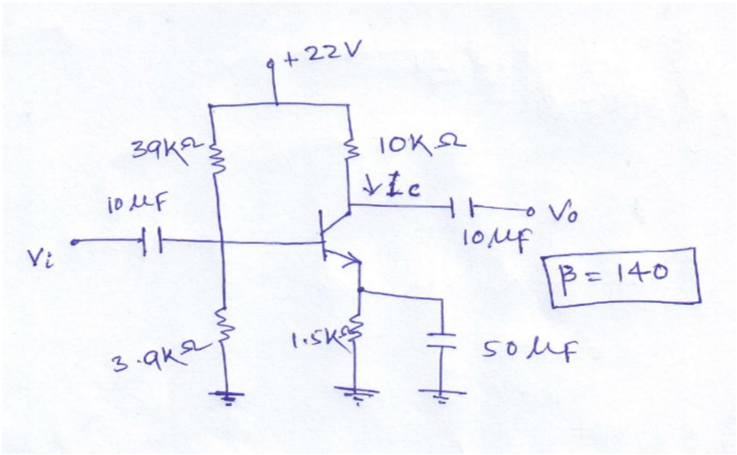
Case 1:



Case 2:

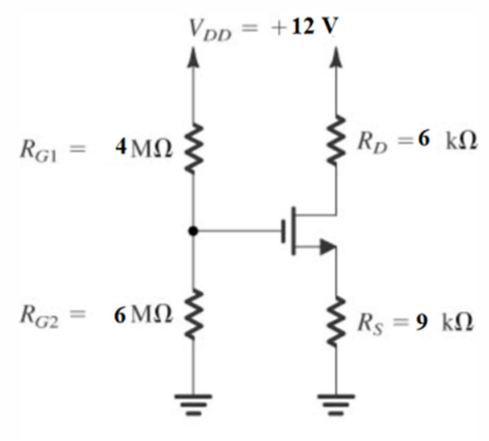


2.3) Determine the dc bias voltage V_{CE} and the current I_C for the voltage-divider configuration given in figure below. Assume β = 140.



Question No. 3 (5+5+5 = 15)

3.1) How to operate the NMOS as an amplifier? State the corresponding Current-Voltage (I/V) relation. Now determine the drain current of the MOS circuit shown in the figure below. Assume V_T = 1 V and $k'_N(W/L)$ = 1 mA/V^2. Will the transistor conduct, if V_{DD} is changed to -12 V?



3.2) An amplifier, when loaded by 3 kΩ resistor, has a voltage gain of 70 and a current gain of 120. Determine the necessary signal voltage and current to give an output voltage of 1V. What is the power gain of the amplifier?

3.3) Discuss the effect of negative feedback on the non-linear distortion and stability of an amplifier. The change in gain of an amplifier without feedback is ±10%. Find the percent change in gain when 20dB negative feedback is introduced. If the gain of the internal amplifier is 1000, find the feedback ratio and the overall gain of the feedback amplifier.

Question No. 4 (5+5+5 = 15)

4.1) State Barkhausen's criterion for oscillation. In the positive feedback circuit of a Wein bridge oscillator, R = 5.1 KΩ ($R_1 = R_2 = R$) and C = 0.001 μF ($C_1 = C_2 = C$). In the negative feedback circuit, R_3 = 6 KΩ and R_4 = 2 KΩ. Determine whether the circuit will oscillate or not. If yes, find the frequency of oscillation. (All symbols have their usual meanings)

4.2) To design an inverting amplifier using op-amp, gain is chosen as – 5.5 and R_i = 10 KΩ, what value of R_f is to be chosen? How can you extend the above design to build up a voltage summer.

4.3) State De-Morgan's Theorems and also give Truth Table for verification of the said theorem.

In this regard, simplify the following Boolean Expressions

(1) A.(A+B) (2) (X+Y) (X+Z)

& realize the Boolean Function f = $\bar{x}z + x\bar{y}$ using logic gate.

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