



**DHARMSINH DESAI UNIVERSITY, NADIAD**  
**FACULTY OF TECHNOLOGY**  
**THIRD SESSIONAL**  
**SUBJECT: PHYSICS (BSC 202)**

**Examination** : B.Tech. Semester- II (CE/IT/EC)  
**Date** : 30/05/2023  
**Time** : 10:30AM to 11:45AM

**Seat No.** : 31  
**Day** : Tuesday  
**Max. Marks** : 36

**INSTRUCTIONS:**

1. Figures to the right indicate maximum marks for that question.
2. The symbols used carry their usual meanings.
3. Assume suitable data, if required & mention them clearly. ( $K = 1.380649 \times 10^{-23}$  joule per kelvin, Temp.  $T = 300$  K,  $h = 6.626 \times 10^{-34}$  J Hz<sup>-1</sup>,  $q = 1.602176634 \times 10^{-19}$  coulomb,  $\epsilon_0 = 8.854 \times 10^{-14}$  F/cm)
4. Draw neat sketches wherever necessary.

**Q.1 Do as directed.**

- |     |   |     |                                                                                                                                                                                                                                                      |      |
|-----|---|-----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| CO3 | U | (a) | Draw the schematic diagram of CMOS inverter.                                                                                                                                                                                                         | [12] |
| CO3 | U | (b) | For an Oscillator from where does the starting voltage come from?                                                                                                                                                                                    | [1]  |
| CO2 | N | (c) | Consider a voltage divider circuit with the following specifications: $V_{CC} = 10V$ , $R_1 = 15k\Omega$ , $R_2 = 5k\Omega$ , $R_C = 3.6k\Omega$ , $R_E = 2k\Omega$ , $\beta_{dc} = 200$ . Is this voltage divider stiff? Show your calculation.     | [1]  |
| CO3 | N | (d) | MOSFET shown in Fig.-1 has following characteristics: $V_{GS(on)} = 4.5V$ , $I_{D(on)} = 75mA$ and $R_{DS(on)} = 6\Omega$ . Is MOSFET biased in the ohmic region when $V_{in} = V_{GS} = +4.5V$ ? Show your calculation. What is the output voltage? | [2]  |
| CO5 | A | (e) | Estimate the critical angle when the core refractive index is 1.48 and the relative refractive index is 2%.                                                                                                                                          | [2]  |
| CO5 | E | (f) | Why the refractive index of core and cladding are different? Which one has greater refractive index? Justify.                                                                                                                                        | [2]  |
| CO5 | U | (g) | What are the causes of absorption in optical fiber cable?                                                                                                                                                                                            | [2]  |

**Q.2 Attempt Any TWO from the following questions.**

- |     |   |     |                                                                                                                                                                                                                                                                                                                                                                                                               |      |
|-----|---|-----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| CO3 | E | (a) | An nFET has the following characteristics: $W = 10\mu m$ , $L = 0.35\mu m$ , $\epsilon_{ox} = 3.9\epsilon_0$ , $t_{ox} = 15nm$ , $\mu_n = 478 cm^2/(V \cdot sec)$ , $V_{Tn} = 0.7 V$ . Determine the oxide capacitance, process transconductance and the device transconductance. Find the drain current if the voltages are set to 1) $V_{GSn} = 2 V$ , $V_{DSn} = 1 V$ 2) $V_{GSn} = 2 V$ , $V_{DSn} = 2 V$ | [12] |
| CO3 | U | (b) | Draw the schematic diagram of 1-Transistor Dynamic RAM. Explain Write and Hold operations in detail with necessary diagrams and equations. Also, discuss the charge leakage and its impact on voltage across storage capacitor in a DRAM cell with necessary graph.                                                                                                                                           | [6]  |
| CO3 | U | (c) | Draw the structure of an n-channel D-MOSFET and label the diagram properly. Explain operation of n-channel D-MOSFET using drain curves and transconductance curve. If an n-channel D MOSFET has the specifications $V_{GS(off)} = -2V$ , $I_{DSS} = 4mA$ . Determine the $I_D$ if $V_{GS}$ values are :1) $-0.5V$ 2) $+1V$ . Determine mode of operation (Depletion mode, Enhancement mode) for each case.    | [6]  |

**Q.3 Attempt the following questions.**

- |     |   |     |                                                                                                                                                                                                                                                                                                                                                                       |      |
|-----|---|-----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| CO2 | C | (a) | The DC load line and Q-point of a voltage divider biased (VDB) circuit is shown in Fig.-2. Consider $R_1 = 10 k\Omega$ and $R_2 = 2.2 k\Omega$ for this VDB circuit. Design this VDB circuit by determining 1) $V_{CC}$ 2) $V_{BB}$ 3) $V_E$ 4) $R_E$ and 5) $R_C$ . Draw the schematic of this designed circuit. Consider silicon NPN BJT with second approximation. | [12] |
|     |   |     |                                                                                                                                                                                                                                                                                                                                                                       | [6]  |

- CO6 A (b) A carrier wave of frequency 10 MHz and peak value 10V is amplitude modulated by a 5-kHz sine wave of amplitude 6V. Determine (i) modulation index (ii) sideband frequencies and (iii) amplitude of sideband components. Draw the frequency spectrum. [4]
- CO6 E (c) "Carrier signal with amplitude 4V is modulated with modulating signal with Amplitude 5V, at the receiver side an envelope detector can detect modulating signal without distortion." State true/false. Justify your answer [2]
- OR**
- Q.3 Attempt the following questions. [12]
- CO2 C (a) Design a common emitter voltage divider bias(VDB) circuit with following parameters:  $V_{CC}=24V$ ,  $I_C=5mA$ ,  $V_E=0.1V_{CC}$ ,  $V_C=0.5V_{CC}$ ,  $\beta_{dc}=135$ . Draw the schematic of this designed circuit. Consider silicon NPN BJT with second approximation. [6]
- CO6 A (b) An FM wave is given by  $s(t)=10 \cos(8\pi \times 10^6 t + 3\sin(4\pi \times 10^3 t))$ . Consider the frequency sensitivity of 1kHz/volt. Calculate the frequency deviation, modulation index, carrier frequency (in Hertz), bandwidth and amplitude of modulating signal. [4]
- CO6 E (c) A carrier wave of 2 MHz is amplitude modulated by a modulating wave of 2KHz. Which frequencies will be present in an AM wave? [2]

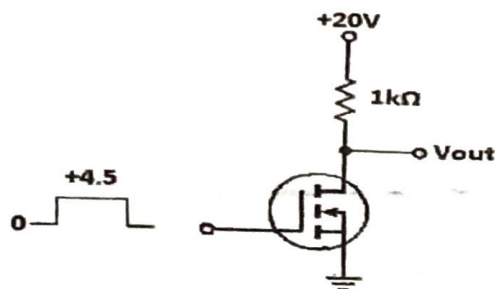


Fig.-1 (Q.1(d))

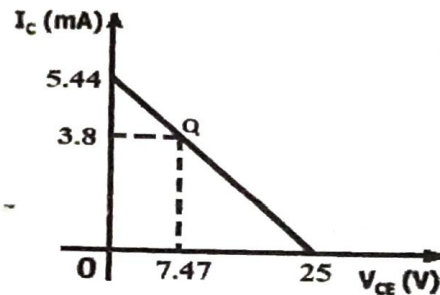


Fig.-2 (Q.3 (a))

Blooms Taxonomy levels : R-Remembering, U- Understanding, A-Applying, N-Analyzing, E- Evaluating, C-Creating