DHARMSINH DESAI UNIVERSITY, NADIAD
FACULTY OF TECHNOLOGY
B.TECH. SEMESTER II [CE/IT/EC]
SUBJECT: (BS202) PHYSICS

Examination : Regular
Date : 20/06/2023
Time : 10.00 to 1.00 pm

Seat No : 51
Day : Tuesday
Max. Marks : 60

INSTRUCTIONS:

1. Answer each section in separate answer book.
2. Figures to the right indicate maximum marks for that question.
3. The symbols used carry their usual meanings.
4. Assume suitable data, if required & mention them clearly ($h=6.626\times10^{-34}$ J Hz^{-1} $q=1.60217\times10^{-19}C$, $c = 3\times10^{8}$ m/s, $\varepsilon_0=8.854\times10^{-14}$ F/cm)
5. Draw neat sketches wherever necessary.

SECTION – I

Q.1 **Do as directed.** **[10]**

CO1 N (a) A silicon diode has a saturation current of 6 nA at 25°C. What is the saturation current at 100°C? [2]

CO2 A (b) State true or false: [2]
1. In an n-p-n transistor, the collector has higher degree of doping compared to that of emitter.
2. Base, emitter, and collector regions have similar size.
3. Oscillators operate on negative feedback.
4. The start-up gain of an oscillator must be greater than 1.

CO4 E (c) A given silicon APD has a quantum efficiency of 65% at a wavelength of 900 nm. If 0.5 μW of optical power produces a multiplied photocurrent of 10μA, find the multiplication factor M. [2]

CO2 R (d) In a BJT, if $\beta_{dc}= 50$ and collector current is 1 mA, then determine I_E. [2]

CO4 E (e) Calculate the modulation bandwidth of a GaAs-based LED with $\tau = 400$ ps. [2]

Q.2 **Attempt *Any TWO* from the following questions.** **[10]**

CO1 E (a) Draw schematic diagram of a Zener regulator with a supply voltage of 24 V, a series resistance of 470Ω, a Zener voltage of 15V, and a load resistance of 1.5kΩ. Is the Zener diode operating in breakdown region? Determine (I) current through series resistor (II) the load voltage (III) Zener current [5]

CO1 E (b) Draw a schematic of Centre-tapped full wave rectifier circuit for the following specifications: supply voltage 120Vrms 60Hz, RL= 2.2KΩ. Transformer turns ratio is 7:1. Calculate (I) Average Output Voltage, (II) Peak Load Current (III) Average Load Current. (IV) Output Frequency (Note: Consider Germanium Diode with ideal approximation) [5]

CO1 E (c) Draw a schematic of bridge rectifier circuit with capacitor input filter for the following specifications: supply voltage 140Vrms 60Hz, RL= 1kΩ and C=470μF. Transformer turns ratio is 9:1. Calculate (I) Average Output Voltage, (II) Peak Load Current (III) Peak to Peak Ripple Voltage (IV) What is the rms voltage of secondary winding of the transformer? (Note: Consider Silicon Diode with Second approximation) [5]

Q.3 **Answer the following questions.** **[10]**

CO6 U (a) Assume $m(t) = A_m \cos(2\pi f_m t)$(modulating signal) and $c(t) = A_c \cos(2\pi f_c t)$ (carrier signal). Derive expression of amplitude modulated wave AM(t). Derive the equation of modulation index in terms of maximum and minimum amplitude of the modulated waves. Also show the frequency spectrum for the modulated wave. [5]

CO5 R (b) Explain various losses you come across in optical fibers. [5]

OR

Q.3 **Answer the following questions.** **[10]**

CO6 U (a) (I) Draw the waveforms of the modulated digital signal 110010100 using ASK,FSK and PSK. [5]

U (II) Discuss types of Amplitude modulation.

CO5 E (b) State the difference between step index and graded index fiber. A continuous 12 km long optical fiber link has a loss of 1.5dB/km. What is the minimum optical power level that must be launched into the fiber to maintain an optical power level of 0.3 μW at the receiving end? What is the required input power if the fiber has a loss of 5 dB/km? [5]

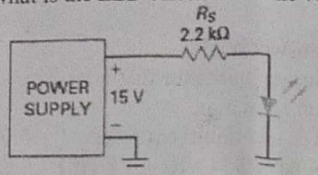
SECTION – II

Q.4 **Do as directed.** [10]

CO6 E (a) Consider the signal frequency be f1=1 KHz and f2=100 MHz. Calculate the size of antenna for both of the cases. Comment on the results.(**Note:Antenna Size α λ/2**) [2]

CO5 E (b) Calculate the angle of acceptance of a given optical fiber, if the refractive indices of the core and cladding are 1.563 and 1.498 respectively. [2]

CO4 A (c) Find the current through the LED of the figure. If the resistor is decreased to 1kΩ what is the LED current. Assume voltage drop across LED is1V. [2]



CO3 E (d) A particular MOSFET for which $V_{Tn} = 0.5\ V$ and $\beta_n = 1.6\ mA/V^2$is to be operated in the saturation region. If I_D is to be 50μA, find the required V_{GS} and the minimum required V_{DS}. [2]

CO3 R (e) Draw the schematic diagram of 1-Transistor Dynamic RAM. [2]

Q.5 **Attempt *Any TWO* from the following questions.** [10]

CO3 E (a) An nFET has the following characteristics: $W/L = 10, \varepsilon_{ox} = 3.9\varepsilon_o,\ t_{ox} = 6nm,$ $\mu_n = 460\,cm^2/(V.\sec)$, $V_{Tn} = 0.5\ V$. Determine the oxide capacitance, process transconductance and the device transconductance. Find the drain current if the voltages are set to **1)** $V_{GSn} = 2.5\ V$, $V_{DSn} = 1\ V$ **2)** $V_{GSn} = 2.5\ V$, $V_{DSn} = 2.5\ V$ [5]

CO3 U (b) Draw the structure of an n-channel E-MOSFET and label the diagram properly. Explain operation of n-channel E-MOSFET using drain curves and transconductance curve. Also, draw schematic symbol of n-channel E-MOSFET. [5]

CO3 E (c) What is the advantage of active load switching over passive load switching? Draw the n-channel E-MOSFET active switching load circuit having VDD = + 10 V and source terminal of lower MOSFET is connected to ground. Gate voltage of lower MOSFET is 5V and the upper MOSFET offers drain-source resistance of 5 kΩ. Is lower MOSFET operating in ohmic region? Determine the drain voltage of lower MOSFET. Assume $V_{GS(TH)}$ = + 1.5 V, $V_{GS(ON)}$ = 5V, $V_{DS(ON)}$ =2V , $ID_{(ON)}$ = 3 mA [5]

Q.6 **Answer the following questions** [10]

CO2 E (a) Consider a base biased BJT circuit with V_{BB} =V_{CC} =12V, R_B =565kΩ, R_C =2 kΩ. Determine Q-point values assuming a) β_{dc} =150, and b) β_{dc} = 100. Comment on stability of Q point. Consider *npn* silicon transistor with second approximation. [5]

CO2 E **(b)** Draw an emitter biased BJT circuit with the base supply voltage 2V, the collector supply voltage 10V, collector resistance (R_C) 910Ω and emitter resistance (R_E) 180Ω. Assume silicon transistor with second approximation and determine the following: (I) Emitter voltage (II) Emitter current (III) Collector voltage (IV) Collector emitter voltage. (Note: Consider npn transistor) [5]

OR

Q.6 **Answer the following questions** [10]

CO2 E (a) Consider a base biased BJT circuit with V_{BB}=10V, V_{CC}=20V, R_B=33kΩ, R_C=3.3kΩ, βdc =100. Determine whether the transistor is saturated? Use (1) Saturation current method and (2) Collector–Voltage method to recognize the saturation. Also, calculate the saturated current gain. Consider the silicon NPN transistor with second approximation. [5]

CO2 E (b) Consider a voltage divider bias BJT circuit having the following specifications. R_1=10kΩ, R_2=2.2kΩ, R_C=3.6kΩ, R_E=1kΩ, V_{CC}=+25V. Sketch the DC Load line. Determine (i) Emitter voltage (ii) Emitter current (iii) Collector to ground voltage (iv) Collector-Emitter voltage. Consider silicon NPN transistor with ideal approximation. [5]

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