Shahjalal University of Science and Technology

Department of nameOfTheDepartment

B.Sc. Honours Fourth Year, Second Semester Final Examination-20**

Course Code: ABC ******** Session:** 20**-20**

Course Title: theCourseTitle

Total Marks: 60 **Credits: 3.0** **Total Time: 3 Hours**

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*[Answer **all** the questions. The figure in the right margin indicate full marks.]*

1. (a) What are luminescent and photo-luminescent processes? 2

   (b) How is the concept of quasi-Fermi level useful in semiconductors? 2

   (c) If you want the marks to be displayed as $2+2$, use the command `\bdpart[2+2]` instead of the regular `\part[]` command. As for example: What is molecular orbital? Explain bonding and anti-bonding in molecular orbital. 2+2

   (d) If you want the subparts of the question to be appeared inline the use the command `\begin{inlinesubparts} \item, \item, etc.---\end{inlinesubparts}`. As for example: Draw schematic diagrams to show splitting of two molecular orbitals due to resonance interactions with the orbitals: (i) having same energy, and (ii) having different energies. 2+2

2. (a) For units, you can use SI unit, as for example 2 µm can be achieved by using the command `\SI{2}{\micro\meter}`. In case you need to use the unit for an expression as for example $20sin(\omega t)$ mA, right after the expression, you can use the command `\si{\milli\ampere}`. 2

   (b) Two resistors of values 1 kΩ and 4 kΩ are connected in series across a constant voltage supply of 100 V. A voltmeter having an internal resistance of 12 kΩ is connected across the 4 kΩ resistor. Draw the circuit and calculate: 4

   (i) True voltage across 4 kΩ resistor before the voltmeter was connected.

   (ii) Actual voltage across 4 kΩ resistor after the voltmeter is connected and voltage recorded by the voltmeter.

   (iii) change in supply current when voltmeter is connected.

   (iv) Percentage error in voltage across 4 kΩ resistor.

   (c) If you want to insert a Figure(pdf, png, etc) then you can use the `\includegraphics{nameOfFigure}` command as shown below. : Find the rms value of the current waveform of Fig.1. If the current flows through a 9 Ω resistor, calculate the average power absorbed by the resistor. 5

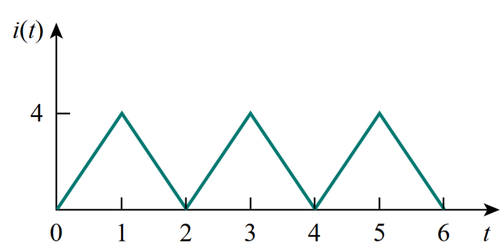


Fig. 1

3. (a) If you want to place two figures side by side then use minipage environment. As for example: Using nodal analysis, determine the potential across the 4 Ω resistor in Fig. 2 4

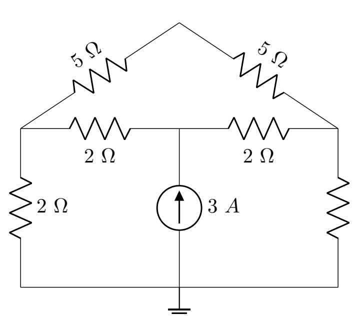


Fig. 2

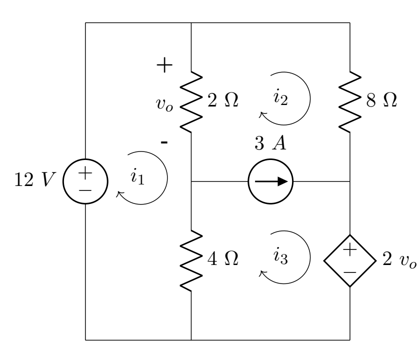


Fig. 3

   (b) Use mess analysis to find currents and voltage v_o in the circuit of Fig. 3. 4

(c) If a table is needed to insert, then you can use either tabular or tabulrx. In the table as shown in Table 1, the data are given for a general purpose Silicon diode, draw the I-V characteristic curve. 2

Table 1: Your Table Title Here

SL.no	Forward bias voltage (V)	Forward bias current(mA)
1	0	0
2	0.2	0.0
3	0.4	0.1
4	0.5	0.5
5	0.53	1.0
6	0.6	8.2
7	0.66	19.5
8	0.7	53.5
9	0.71	83.1
10	0.73	112.7

OR

(a) What is photovoltaic device? What is air mass zero (AM0)? What is its value? 2

(b) Suppose a household consumes 500 W of electric power daily over a year. If annual average solar intensity incident per day is about 6 kW h m^{-2} and a photovoltaic device that converts solar energy to electrical energy has efficiency of 15%, what is required device area? 3

(c) Draw $I-V$ characteristics for a photovoltaic device. Define fill factor FF. 4+1

(d) Draw schematic $I-V$ characteristic of a Si-solar Cell. 2

4. (a) State Fermi's golden rule using molecular wave function and perturbing Hamiltonian. 2

(b) How does a spin-forbidden transition acquire a finite transition rate? 5

(c) What do you mean by non-radiative transition? Briefly explain internal conversion and intersystem crossing. 1+4

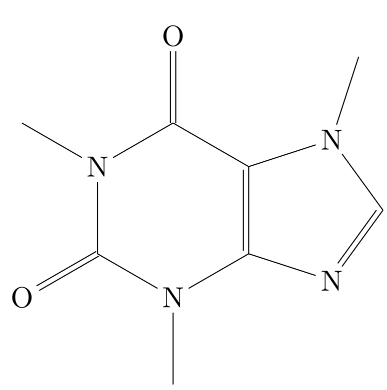
5. (a) Using the command `\ce{..}` you can typeset the chemical formula and equations. As for example: Write down whether the given chemical formulas are organic or inorganic. 2

- Water: `\ce{H2O}`, H_2O
- Benzene: `\ce{C6H6}`, C_6H_6
- Hydrogen peroxide: `\ce{H2O2}`, H_2O_2
- Acetic acid: `\ce{C2H4O2}`, $C_2H_4O_2$
- Glucose: `\ce{C6H12O6}`, $C_6H_{12}O_6$

(b) The chemical equation can also be written using the command `\ce{}`. As for example: Explain the following two chemical equations. 2+2

- `\ce{2H2 + O2 -> 2H2O}` typesets $2\,H_2 + O_2 \longrightarrow 2\,H_2O$
- `\ce{CO2 + C -> 2 CO}` typesets $CO_2 + C \longrightarrow 2\,CO$

(c) Drawing a molecule consists mainly of connecting groups of atoms with lines. Simple linear formulae can be easily drawn using the chemfig package and using the command `\chemfig{*6((=O)-N(-)-(*5(-N=-N(-)-))=-(=O)-N(-)-)}`, as shown in the following example: Identify the given chemical formula. 1+4



6. (a) Simplify the Boolean function $F(w, x, y, z) = \sum(1, 3, 7, 11, 15)$. Which has don't-care condition: $d(w, x, y, z) = \sum(0, 2, 5)$. 4

(b) Simplify $F(A, B, C, D) = \sum(0, 1, 2, 5, 8, 9, 10)$ in product of sums. 4

(c) Define Minterms and Maxterms and briefly explain De Morgan's law. 2

OR

(a) Simplify the Boolean function $F(w, x, y, z) = \sum(0, 1, 2, 4, 5, 6, 8, 9, 12, 13, 14)$. 4

(b) Suppose you have 3 friends. Design an alarm which will ring when more than one friend come. 4

(c) Draw the symbol and truth table of EX-OR gate & EX-NOR gate. 2½

List of the relevant equations:

$$\begin{bmatrix} A_r \\ A_\theta \\ A_\phi \end{bmatrix} = \begin{bmatrix} \sin\theta\cos\phi & \sin\theta\sin\phi & \cos\theta \\ \cos\theta\cos\phi & \cos\theta\sin\phi & -\sin\theta \\ -\sin\phi & \cos\phi & 0 \end{bmatrix} \begin{bmatrix} A_x \\ A_y \\ A_z \end{bmatrix}$$

$$\nabla \times \mathbf{A} = \frac{1}{r\sin\theta} \begin{vmatrix} \hat{r} & r\hat{\theta} & r\sin\theta\hat{\phi} \\ \dfrac{\partial}{\partial r} & \dfrac{\partial}{\partial \theta} & \dfrac{\partial}{\partial \phi} \\ A_r & rA_\theta & r\sin\theta A_\phi \end{vmatrix}$$

$$= \frac{1}{r\sin\theta} \left[\hat{r}\left(\frac{\partial}{\partial\theta}(\sin\theta A_\phi) - \frac{\partial A_\theta}{\partial\phi}\right) + \hat{\theta}\left(\frac{1}{\sin\theta}\frac{\partial A_r}{\partial\phi} - \frac{\partial}{\partial r}(rA_\phi)\right) \right.$$
$$\left. + \hat{\phi}\left(\frac{\partial}{\partial r}(rA_\theta) - \frac{\partial A_r}{\partial\theta}\right) \right]$$

$$\begin{bmatrix} a_x \\ a_y \\ a_z \end{bmatrix} = \begin{bmatrix} \sin\theta\cos\phi & \cos\theta\cos\phi & -\sin\phi \\ \sin\theta\sin\phi & \cos\theta\sin\phi & \cos\phi \\ \cos\theta & -\sin\theta & 0 \end{bmatrix} \begin{bmatrix} a_r \\ a_\theta \\ a_\phi \end{bmatrix}.$$