

Shahjalal University of Science and Technology
Department of Electrical and Electronic Engineering
B.Sc. (Engg.) First Year, First Semester Final Examination-2022
Course Code: EEE 07131121 Session: 2020-2021
Course Title: Basic Electrical and Electronic Circuit

Total Marks: 60

Credits: 3.0

Total Time: 3 Hours

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

Part-A

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 $2\text{ }\mu\text{m}$ 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 $20\sin(\omega t)\text{ mA}$, right after the expression, you can use the command `\si{\milli\ampere}`. 2
 (b) Two resistors of values $1\text{ k}\Omega$ and $4\text{ k}\Omega$ are connected in series across a constant voltage supply of 100 V . A voltmeter having an internal resistance of $12\text{ k}\Omega$ is connected across the $4\text{ k}\Omega$ resistor. Draw the circuit and calculate: 4
 (i) True voltage across $4\text{ k}\Omega$ resistor before the voltmeter was connected.
 (ii) Actual voltage across $4\text{ k}\Omega$ 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 $4\text{ k}\Omega$ resistor.
 (c) Figure(pdf, png, etc) can be inserted using the `\includegraphics{nameOfFigure}` command as shown below. : Find the rms value of the current waveform of Fig.1. If the current flows through a $9\text{ }\Omega$ resistor, calculate the average power absorbed by the resistor. 5

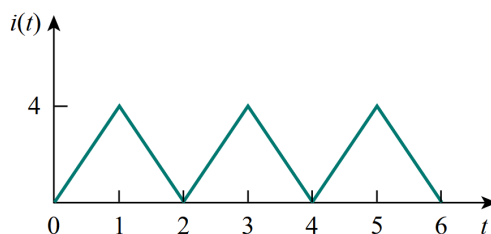


Fig. 1

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 $4\text{ }\Omega$ resistor in Fig. 2 4

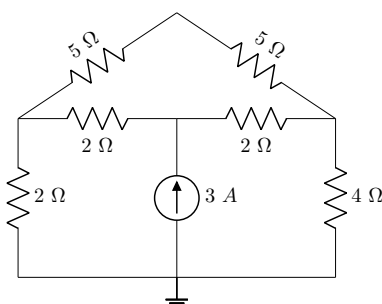


Fig. 2

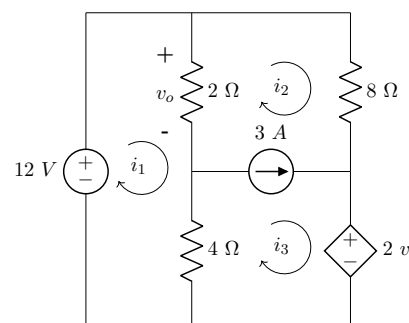


Fig. 3

- (b) Use mesh 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) Find the Thevenin’s equivalent circuit of Fig. 4 to the left of the terminal.
- 4

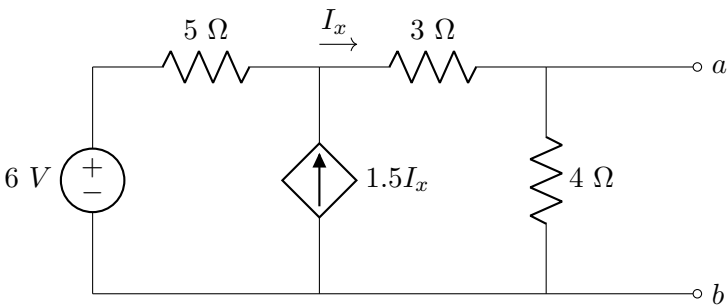


Fig. 4

- (b) Find the magnitude R_L for the maximum power transfer in the circuit shown in Fig. 5. Also find out the maximum power.
- 4

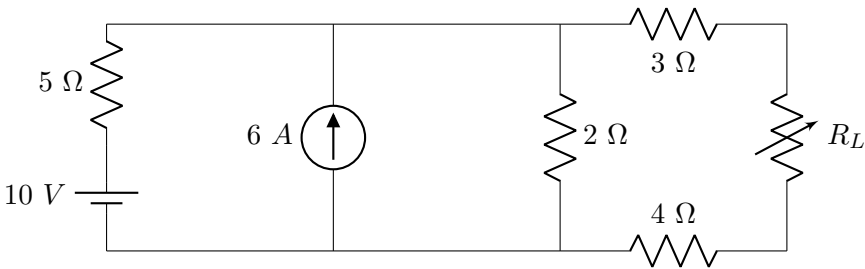


Fig. 5

- (c) Write short notes on Real power and Reactive power.
- 2

Part-B

4. (a) Determine I_{BQ} , I_{CQ} , V_{CEQ} , V_B , V_C and V_{BC} for the fixed-bias configuration shown in Fig. 6. 4

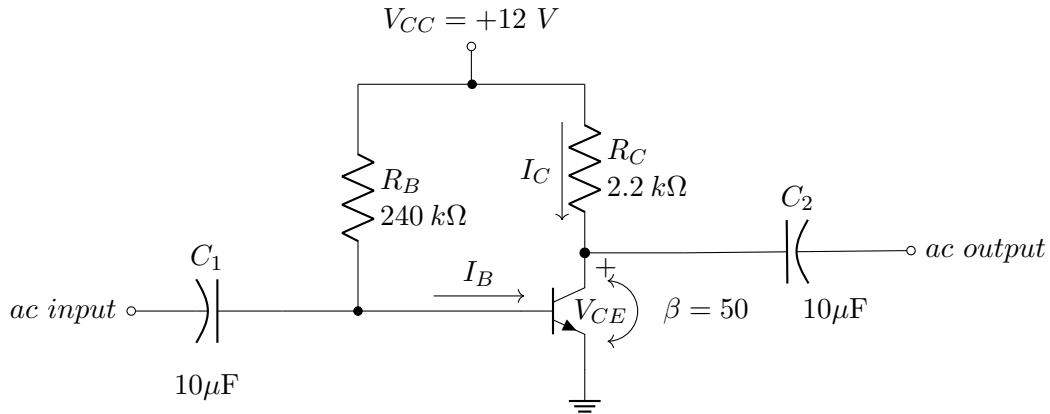


Fig. 6

- (b) Determine the saturation level for the network of Fig. 6. 2
 (c) For the emitter bias network of Fig. 7 determine I_B , I_C , V_{CE} , V_C , V_E and V_B for the fixed-bias configuration shown in 4

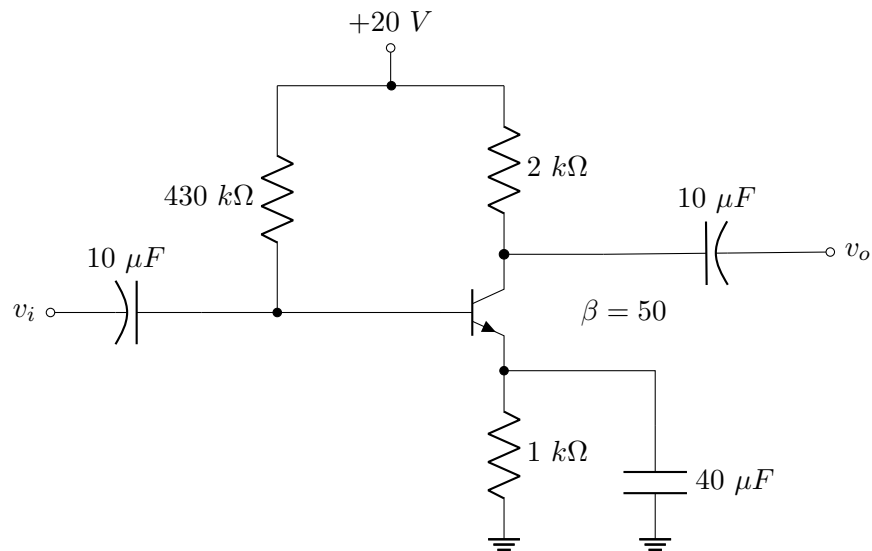


Fig. 7

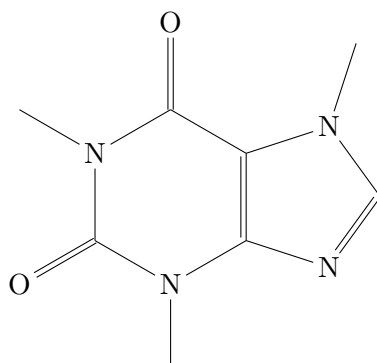
5. (a) Using the command `\ce{...}` you can typeset the chemical formula and equations. As for example: Write down whether the given chemical formulas are organic or inorganic. 2

- Water: `\ce{H2O}`, H_2O
- Benzene: `\ce{C6H6}`, C_6H_6
- Hydrogen peroxide: `\ce{H2O2}`, H_2O_2
- Acetic acid: `\ce{C2H4O2}`, $\text{C}_2\text{H}_4\text{O}_2$
- Glucose: `\ce{C6H12O6}`, $\text{C}_6\text{H}_{12}\text{O}_6$

- (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 $2\text{H}_2 + \text{O}_2 \longrightarrow 2\text{H}_2\text{O}$
- `\ce{CO2 + C -> 2 CO}` typesets $\text{CO}_2 + \text{C} \longrightarrow 2\text{CO}$

- (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) A transmission line has the following per-unit length parameters: $L = 0.5 \mu\text{H m}^{-1}$, $C = 200 \text{ pF m}^{-1}$, $R = 4 \Omega \text{ m}^{-1}$ and $G = 0.02 \text{ S m}^{-1}$. Calculate the propagation constant and characteristics impedance of this line. If the line is 30 cm long, what is the attenuation in dB. 4
- (c) If you only want the unit as symbol mode like $R = 4 \Omega/\text{m}$ instead of the conventional unit $R = 4 \Omega \text{ m}^{-1}$, wrap the unit in braces: as shown below. 2½

```
{
\sisetup{per-mode = symbol}
\si{\milli\volt\per\pico\second}
}
```

List of the relevant equations:

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

$$\begin{aligned} \nabla \times \mathbf{A} &= \frac{1}{r \sin \theta} \begin{vmatrix} \hat{r} & r\hat{\theta} & r \sin \theta \hat{\phi} \\ \frac{\partial}{\partial r} & \frac{\partial}{\partial \theta} & \frac{\partial}{\partial \phi} \\ A_r & rA_\theta & r \sin \theta A_\phi \end{vmatrix} \\ &= \frac{1}{r \sin \theta} \left[\hat{r} \left(\frac{\partial}{\partial \theta} (\sin \theta A_\phi) - \frac{\partial A_\theta}{\partial \phi} \right) + \hat{\theta} \left(\frac{1}{\sin \theta} \frac{\partial A_r}{\partial \phi} - \frac{\partial}{\partial r} (r A_\phi) \right) \right. \\ &\quad \left. + \hat{\phi} \left(\frac{\partial}{\partial r} (r A_\theta) - \frac{\partial A_r}{\partial \theta} \right) \right] \end{aligned}$$

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