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Mid Term Examinations - October 2026

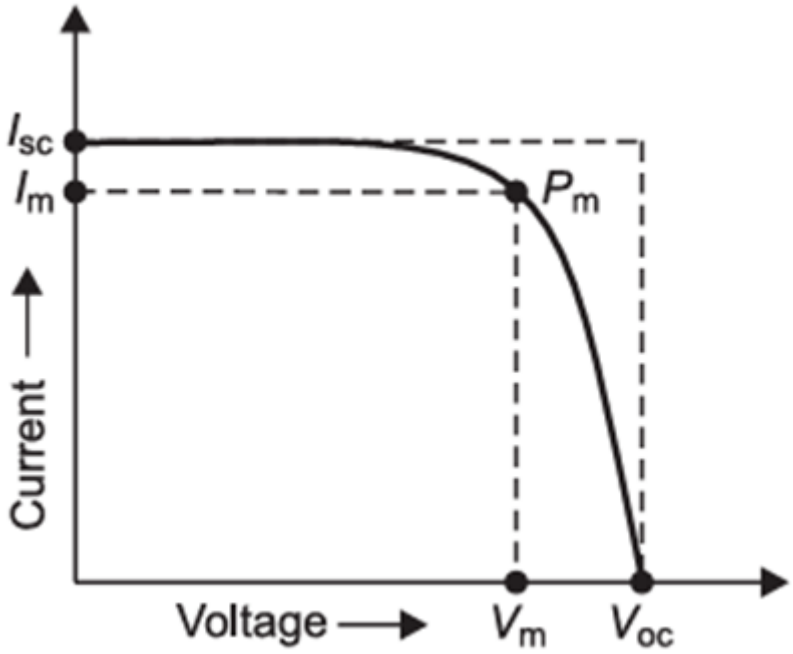
Date: 05/10/2026 **Time:** 09:30 AM - 11:00 AM

Course Code: EEE3008 **Course Name:** Materials in Electrical Systems

Semester: Fourth Semester **Max. Marks:** 50 **Weightage:** 50%

CO - Levels	CO1	CO2
Marks	46	44

PART A: Answer Following Questions. 10 M

Q.N.	Questions	M	CO	BT
1	Explain "Drude Model of Conductivity"?	2	CO1	BT2
2	List out the applications of organic semiconductors.	2	CO1	BT1
3	List the advantages of conjugated semiconductors (organic semiconductors).	2	CO1	BT1
4	Define the fill factor for the schematic of the solar cell I-V curve shown below. 	2	CO2	BT1
5	A PV module is required to provide a terminal voltage of 21.76 V. If the terminal voltage of each solar cell under operating conditions is 0.68 V, determine the number of identical solar cells that must be connected in series to achieve the required module voltage.	2	CO2	BT3

PTO (Please Turn Over)

PART B : Answer Any 1 Following Questions. 10 M				
Q.N.	**Questions**	**M**	**CO**	**BT**
6	Explain the electrical conductivity in metals and also its dependency on temperature.	10	CO1	BT2
7	Explain the following, a) intrinsic and extrinsic semiconductor conduction. b) donor and acceptor doping and explain the formation of n-type and p-type semiconductors. c) law of mass action for semiconductors and write its mathematical expression.	10	CO1	BT2

PART C: Answer Any 1 Following Questions. 10 M				
Q.N.	**Questions**	**M**	**CO**	**BT**
8	A semiconductor has an electron concentration 4×10^{21} m^{-3} of and an electron mobility of 0.45 $m^2/(V.S)$ a) Calculate its electrical conductivity. b) Determine its resistivity. c) Explain how the conductivity of a semiconductor changes with temperature.	10	CO1	BT3
9	A copper conductor is used in an electrical heating circuit. The conductor has a resistance of 12 Ω at 25°C. Its temperature coefficient of resistance at 25°C is 0.004/°C. The conductor is connected to a 240 V supply and, during operation, its temperature rises to 125°C. **Calculate:** **a) Resistance of the conductor at 125°C.** **b) Current drawn by the conductor at 25°C.** **c) Current drawn by the conductor at 125°C.** **d) Percentage decrease in current due to the rise in temperature.**	10	CO1	BT3

PART D: Answer Any 1 Following Questions. 10 M				
Q.N.	**Questions**	**M**	**CO**	**BT**
10	Explain the following with respect to Light-Emitting Diode (LED) w a) Explain how electron-hole recombination in a forward-biased p-n junction results in the emission of light. [3 Marks] b) Explain the relationship between the energy band gap of the semiconductor material and the wavelength/colour of light emitted by an LED. [3 Marks] c) Explain why different semiconductor materials are used to produce LEDs of different colours. Give suitable examples. [2 Marks] d) Explain any two advantages and two applications of LEDs compared with conventional light sources. [2 Marks]	10	CO2	BT2

11	Explain the following with refrence to a solar PV module. characterize the performance of a solar cell. a) Explain any four factors affecting the electrical power generated by a solar PV module. [4 Marks] b) Describe the following important parameters of a solar cell: short-circuit current, open-circuit voltage, maximum-power-point voltage, and maximum-power-point current. [4 Marks] c) State the expressions for maximum power and fill factor (FF) of a solar cell. [2 Marks]	10	CO2	BT2

PART E: Answer Any 1 Following Questions. 10 M

Q.N.	Questions	M	CO	BT
12	A solar PV module is to be designed for charging a 24 V battery under Standard Test Conditions (STC). A silicon solar cell has the following specifications: Parameter | Value at STC Open-circuit voltage, V_{OC} | 0.64 V Short-circuit current, I_{SC} | 5.5 A Voltage at maximum power point, V_{MPP} | 0.504 V Current at maximum power point, I_{MPP} | 4.8 A Cell area | 160 cm^2 Solar irradiance | 1000 W/m^2 The required battery charging voltage is 28.8 V. A practical voltage margin of 5% above the required charging voltage is to be provided to account for practical operating conditions. a) Determine the minimum number of solar cells required in series to provide the required charging voltage with the specified voltage margin. [2 Marks] b) Calculate the maximum power output of one series string of the PV module. [1 Mark] c) If the required module output power is 250 W, determine the number of parallel strings required. [2 Marks] d) Determine the overall PV module configuration in terms of series × parallel cells and calculate the actual module power output. [2 Marks] e) Calculate the fill factor (FF) of the individual solar cell. [1 Mark] f) Calculate the conversion efficiency of the individual solar cell under STC. [1 Mark] g) Determine the total active area of the designed PV module. [1 Mark]	10	CO2	BT3

13	A student has purchased a silicon solar cell with an active area of 30 cm^2. According to the datasheet, the cell operates under Standard Test Conditions (STC) with the following specifications: Parameter | Value Voltage at maximum power point, V_{mpp} | 0.52 V Current at maximum power point, I_{mpp} | 0.82 A Short-circuit current, I_s | 0.88 A Open-circuit voltage, V_o | 0.66 V Solar irradiance | 1000 W/m^2 Cell area | 30 cm^2 Using the given data, calculate the following: a) Calculate the maximum power output of the solar cell. [2 Marks] b) Calculate the fill factor (FF) of the solar cell. [2 Marks] c) Calculate the input solar power incident on the cell under STC. [2 Marks] d) Determine the conversion efficiency of the solar cell. [2 Marks] e) Briefly explain the significance of fill factor and conversion efficiency in evaluating the performance of a solar cell. [2 Marks]	10	CO2	BT3