

FE Sem-II (NEP-2020) May 2026

20/05/26

(1 Hours 30 Minutes)

[Total Marks: 45]

N.B.:

- (1) Question No. 1 is compulsory.
- (2) Attempt any two questions from Q.2 to Q.5.
- (3) Assume suitable data wherever required.
- (4) Figures to the right indicate marks.

Q.1 Attempt any Five

(15 Marks)

- (i) Explain the concept of series and parallel connections of solar cells. How do these affect the output voltage and current?
- (ii) Differentiate between micro sensors and micro actuators with examples.
- (iii) What are fuel cells? What are their advantages over internal Combustion Engines
- (iv) What is a nanocomputer? Mention two key differences between nanocomputers and conventional computers.
- (v) Given the tristimulus values $X = 40$, $Y = 30$, $Z = 30$,
Calculate the chromaticity coordinates (x, y)
- (iv) Give three real-life examples where piezoelectric energy harvesting is used in practical applications.

Q2.

- (i) A solar cell having an area of 40 cm^2 gives a current of 1.35 A and voltage 0.6 V at maximum power point. The short circuit current is 1.5 A and open circuit voltage is 0.65 V . What is the Fill Factor, maximum power point and efficiency of the solar cell? (5 marks)
- (ii) Describe how color image formation takes place using RGB colours. Include a suitable diagram. (5 marks)
- (iii) Describe the working principle of a piezoelectric electricity generator. Include a labeled diagram in your explanation. (5 marks)

Q3

- (i) What is Chemically Assembled Electronic Nanotechnology (CAEN)? State advantages and disadvantages in using CAEN. (5 marks)
- (ii) Describe the construction and working of an Solid Oxide Fuel Cell* with a neat labeled diagram. (5 marks)
- (iii) A solar PV module is fabricated using 45 solar cells of 155 cm^2 each, connected in series. The cells have a uniform 45 mA/cm^2 current density at Standard Test Condition (STC). Estimate the maximum current produced by the module. If all 45 cells are connected in 5 branches of parallel combination of 9 cells. Estimate the maximum current produced by the arrangement. If each cell produces 0.6 Volts at STC, Estimate voltage produced in Series combination of 45 cells and by parallel combination of 45 cells in 5 branches of 9 Cell each. (5 marks)

Q4

- (i) Explain the intrinsic characteristics of MEMS devices in detail (such as miniaturization, multifunctionality, and integration). (5 marks)
- (ii) Explain Wright & Guild Experiment and Its significance (5 marks)
- (iii) Explain the significance of nanocomputing in modern electronics. What are the advantages and limitations of using nanoscale components? (5 marks)

Q5

- (i) A PV module of new solar cell technology is to be designed to charge a battery of 24 V. The V_{oc} (open circuit) and V_m (maximum) of the cell of new technology under STC are 0.96 and 0.80 respectively. The cell's voltage decreases by 2.2 mV every degree centigrade rise in temperature. How many cells should be connected in series in this PV module, if cell temperature under operation is 70°C . (5marks)
- (ii) Explain the direct and inverse piezoelectric effects with diagrams. How are these effects useful in energy harvesting? (5marks)
- (iii) Compare the following four types of fuel cells: AFC, MCFC, PEMFC, and SOFC in terms of: Operating temperature, Electrolyte, Applications, Efficiency (5 marks)
