25B TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2074 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL, BEX	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

Subject: - Applied Photovoltaic Engineering *(Elective II) (EX76502)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. a) Define altitude and azimuth angle. Find the altitude angle and azimuth angle for the sun at 3:00 P.M. solar time in Kathmandu, Nepal (latitude 27.67°) on March 1(n=60). [8]
   b) With the aid of IV curve of a typical PV cell, explain how the internal losses affect the performance of a PV cell. Also explain the impacts of temperature and insolation on its performance. [8]

2. a) Differentiate between MPPT and PWM charge controllers. Discuss also the effect of temperature on their performance. [8]
   b) What are thin film and thick film solar cells? Differentiate between conventional and thin film technology in the fabrication of solar cells. [8]

3. a) What are the different power electronic topologies implement in PV system? Explain the main features of each of them. [8]
   b) Draw a neat diagram of bidirectional dc to dc converter and explain its operational features. Briefly explain about its application in PV system. [8]

4. a) Draw a suitable control block diagram of a PV water pumping system and explain briefly about each components involved. [6]
   b) Estimate the size of solar array, battery bank, inverter and other components needed to electrify a remotely located public school with following loads operated by 220V/ 50 Hz ac supply. Also provide a realistic estimate of the cost based on current market prices in Nepal to install such system. Assume suitable data where necessary. [10]

SN	Load	Quantity	Watts/unit	Hours of use
1	Fluorescent lamp	20	40	7
2	Desktop computers	10	100	5
3	Printer/photocopy	2	800	2
4	Fan	8	60	4
5	Projector Units	3	150	3
6	Refrigerator	2	600	24
7	Water pump	1	746(1hp)	2
8	Microwave	1	1000	1

5. a) What are the codes and standards applicable to PV system? Discuss about the IEEE 1547 standards that addresses the issues associated with grid connected PV system. [8]
   b) Discuss the technical issues related to high penetration level on grid connected PV system. [8]

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15 B TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

Subject: - Applied Photovoltaic Engineering *(Elective II) (EX76502)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. a) Describe the spectral distribution of the blackbody radiation from Sun. How are direct and diffuse solar radiations measured? [5+3]

   b) How does shading affect the performance of a PV cell? How can these effects be mitigated? [5]

   c) A PV module is made up of 36 identical cells, all wired in series. With 1-sun insolation (1 kW/m^2), each cell has short-circuit current I_{SC} = 3.4A and at 25°C its reverse saturation current is $I_0 = 6\times10^{-10}$ A. Parallel resistance R_P = 6.6 Ω and series resistance R_S = 0.005.
   Find the voltage, current and power delivered when the junction voltage of each cell is 0.50 V. [3]

2. a) What are Epitaxial thin films? Describe the structure of GaAs cell and its characteristics. [3+5]

   b) Why are inverters considered a major component in a PV system? What are their major performance parameters? Describe square wave inverters with diagrams. [2+2+4]

3. a) What is the concept of Maximum Power Point (MPP) tracking? Compare 'Perturb and Observe (P&O)' and 'Incremental Conductance' algorithms employed for MPP tracking. [4+4]

   b) What is the effect of PV integration on the voltage profile of a feeder? How is the short circuit analysis done after the PV integration? [4+4]

4. a) Estimate the sizes of solar array, battery bank, inverter and other components needed to operate an academic block with 220 V/ 50 Hz loads as listed below. Also provide a realistic estimate of the cost based on current market prices in Nepal to install such a system. Assume suitable data if required. [10]

S.No.	Load	Quantity	Watts	Hours of Use
1	LED Bulbs	13	9	4
2	Laptops	3	40	3
3	Desktop Computer	1	120	4
4	Printer	1	1000	2
5	Projectors	3	200	3
6	Wi-Fi Router	1	10	16
7	Communication Equipment	1	20	12
8	Fans	4	60	4

   b) How can PV be employed in UPS system? Describe different charging schemes of UPS by PV and grid. [6]

5. a) What are the major aspects of IEEE 1547 standard for grid connected PV? [8]

   b) In the current context of energy crunch in Nepal, how can solar PV utilized as an alternative? What policy changes are needed to realize its utilization effectively? [8]

25 B TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

Subject: - Applied Photovoltaic Engineering *(Elective II) (EX76502)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. a) What is solar constant? How does the solar spectrum get changed before reaching the surface of the earth? How are direct and diffuse solar radiations measured? [2+3+3]

   b) With the aid of IV curve of a typical PV cell, explain how the internal losses affect the performance of a PV cell. Also explain the impacts of temperature and isolation on its performance. [8]

2. a) Make comparison of monocrystalline and polycrystalline silicon solar cells regarding their production processes and performance. [8]

   b) Compare the performance of PV-Battery system with and without utilizing intermediate dc-dc converter. [2+2+4]

3. a) Develop two-stages power electronic interface schemes associated with grid-connected solar PV system. Explain the control feature of the PV side converter. [8]

   b) What is the effects of PV integration on the voltage profile and short circuit level of the distribution network? Explain with suitable examples. [8]

4. a) Draw a suitable control block diagram of a PV water pumping system and explain briefly about each components involved. [6]

   b) Estimate the sizes of solar array, battery bank, inverter and other components needed to operate an academic block with 220 V/50 Hz loads as listed below. Also provide a realistic estimate of the cost based on current market prices in Nepal to install such a system. Assume suitable data if required. [10]

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6	Wi-Fi Router	1	10	16
7	Communication Equipment	1	20	12
8	Fans	4	60	4

5. a) What is the significance of interconnection standards? Discuss relevant standards applicable for grid connected PV systems. [8]

   b) Discuss the technical issues related to high penetration level on grid connected PV system. [8]

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