KINGS

COLLEGE OF ENGINEERING

(NAAC Accredited Institution)

(Approved by AICTE, New Delhi, Affiliated to Anna University, Chennai)

TÜVRheinland CERT ISO 9001

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Acadamic year 2020-21 Odd

VALUE ADDED COURSE

SUBJECT: EVA002 - ADVANCES IN SOLAR ENERGY TECHNOLOGIES

YEAR / SEMESTER - III / V

FACULTY IN-CHARGE: Mr.J.Arokiaraj, AP/EEE, KCE

TABLE OF CONTENT

Off: 22357077 / 73
22357074
Fax / Dir : 22352272

CENTRE FOR ACADEMIC COURSES
ANNA UNIVERSITY
CHENNAI – 600 025

Dr. R. RAJU
DIRECTOR
Letter No:2518/AU/EVA/CAC/2019

13.06.2019

To
The Controller of Examinations
Anna University
Chennai - 25.

Sir,

Sub : A.U. - CAC – Kings College of Engineering - Value Added Course - Reg.

Ref. : Letter No. KCE/PRL/VAC/113/18-19, from Kings College of Engineering. Dated: 22.05.2019 & 07.06.2019.

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With reference to the letter cited above, the following Value Added Course offered by Kings College of Engineering, Affiliated Institutions is allotted the course code as detailed below

S.No	Code Allotted	Title
1.	EVA002	Advances in Solar Energy Technologies

This is for your kind information and necessary action at your end.

Yours faithfully

DIRECTOR

Copy to:
1. The Chairperson, Faculty of Electrical Engineering, Anna University, Chennai - 25.
2. The Principal, Kings College of Engineering, Punalkulam, Gandarvakottai Taluk, Pudukkottai District, Tamilnadu – 613 303.
3. The Stock File

kv

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

SUBJECT: ADVANCES IN SOLAR ENERGY TECHNOLOGIES

SEMESTER: V

COURSE PLAN (EVA 002)
(Version: 2)

PREPARED BY

Mr. J. AROKIARAJ AP/EEE

SYLLABUS

EVA002 ADVANCES IN SOLAR ENERGY TECHNOLOGIES

L	T	P	C
2	0	0	2

UNIT I ADVANCES IN SOLAR PV MATERIALS 6

Semiconductor Materials and Modelling - Crystalline silicon solar cells - Thin film technologies - Space and concentrator cells - Organic and dye sensitized cells - Evaluating a Site for Solar PV Potential.

UNIT II MPPT CRITERIA FOR PV SYSTEMS 6

Testing, Monitoring and Calibration - Photovoltaic System Components - Maximum Power Point Tracking Algorithms - Different MPPT techniques - Implementation of MPPT using a boost converter.

UNIT III STAND ALONE PV SYSTEM 6

Solar modules – storage systems – power conditioning and regulation - MPPT- protection – Stand-alone PV systems design – sizing.

UNIT IV GRID CONNECTED PV SYSTEMS 6

PV systems in buildings – design issues for central power stations – safety – Economic aspect – Efficiency and performance - International PV programs.

UNIT V MODELLING AND SIMULATION OF PV SYSTEMS USING MATLAB 6

Introduction to Systems - Systems Modeling - Formulation of State Space Model of Systems - Model Order Reduction - Interpretive Structural Modeling - System Dynamics Techniques – Simulation.

TOTAL: 30 PERIODS

Mr.J.Arokiaraj
Faculty in-charge

HOD/ EEE

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE PLAN

Sub. Code	: EVA002	**Branch / Year / Sem**	: B.E EEE / III /V
Sub. Name	: Advances In Solar Energy Technologies	**Batch**	: 2018-2022
Staff Name	: Mr.J.Arokiaraj	**Academic Year**	: 2020 - 21 (ODD)

COURSE OBJECTIVE

1. To get an overview of different types of photovoltaic semiconductor devices and their characteristics.
2. To analyze the operation and performance parameters MPPT criteria for PV systems.
3. To study the operation techniques and basics topologies standalone operation of PV system.
4. To learn the different techniques of grid connected PV system.
5. To study the modelling and simulation of PV systems using MATLAB.

TEXT BOOKS

T1. Solar Cells: Materials, Manufacture and Operation, Tom Markvart University of Southampton, UK and Luis Castafier Universidad Politecnica de Catalunya, Barcelona, Spain, First edition 2005 Reprinted 2005, 2006, Elsevier Ltd.

T2. Study of maximum power point tracking (MPPT) techniques in a solar photovoltaic array, Arjav Harjai, Abhishek Bhardwaj, Mrutyunjaya Sandhibigraha, nit, Rourkela.

T3. Solanki C.S., "Solar Photovoltaics: Fundamentals, Technologies And Applications", PHI Learning Pvt. Ltd.,2015.

T4. Modeling and Simulation of Systems Using MATLAB and Simulink, Devendra K. Chaturvedi, CRC Press, 2010 by Taylor and Francis Group, LLC.

REFERENCE BOOKS

R1. "Power Electronics for Renewable Energy Systems". C.R.Bala Murugan, D.Periyaazhagar, N.Suresh, Sruthi Publishers, Jan – 2017.

R2. "Solar Photovoltaic Technology and systems", Chetan Singh Solanki, PHI Publications. 2017.

WEB RESOURCES

W1. http://www.energy.wsu.edu/Documents/SolarPVforBuildersOct2009.pdf **(Topic No. 06)**

W2. https://pdfs.semanticscholar.org/1db7/435215cb2d9895bc29e0358a9b23300988f5.pdf **(Topic No. 12)**

W3. https://www.sciencedirect.com/science/article/pii/S0960148105002831 **(Topic No. 22)**

W4. http://www.os.ucg.ac.me//MS_kn.pdf **(Topic No. 27)**

Topic No	Topic	Books for Reference	Page No.	Teaching Methodology	No. of Hours Required	Cumulative No. of periods
UNIT I	**ADVANCES IN SOLAR PV MATERIALS**					**(6)**
1.	Semiconductor Materials and Modelling	T1	30-52	BB	1	1
2.	Crystalline silicon solar cells.	T1	72-86	BB	1	2
3.	Thin film technologies.	T1	218-337	PPT	1	3
4.	Space and concentrator cells.	T1	354-388 393-442	BB	2	5
5.	Organic and dye sensitized cells.					
6.	Evaluating a Site for Solar PV Potential.	W1	-	PPT	1	6

LEARNING OUTCOME

At the end of unit, students should be able to

- Describe the basic materials of PV cells.
- Understand the concepts of PV Power Generation semiconductor devices.

Topic No	Topic	Books for Reference	Page No.	Teaching Methodology	No. of Hours Required	Cumulative No. of periods
UNIT II	**TESTING, CALIBRATION AND MPPT CRITERIA FOR PV SYSTEMS**					**(6)**
7.	Testing.	T1	452-497	PPT	2	8
8.	Monitoring and Calibration.					
9.	Photovoltaic System Components.	T2	17-25	BB	1	9
10.	Maximum Power Point Tracking Algorithms.	T2	25 -29	BB	2	11
11.	Different MPPT techniques.					
12.	Implementation of MPPT using a boost converter.	W2	-	BB	1	12

LEARNING OUTCOME

At the end of unit, students should be able to

- Study and analyze the Solar Photovoltaic System Components.
- To develop the different maximum power point tracking algorithms.
- To implement the various techniques of MPPT.

Topic No	Topic	Books for Reference	Page No.	Teaching Methodology	No. of Hours Required	Cumulative No. of periods
UNIT III	**STAND ALONE PV SYSTEM**					**(6)**
13.	Solar modules.	T3	352-370	PPT	1	13
14.	Storage systems.	R2	120-142	BB	1	14
15.	Power conditioning and regulation.	R1	3.28-3.47	BB	1	15
16.	Protection.	R1	3.13-3.14	BB	1	16
17.	Stand-alone PV systems design.	T3	420-423	Sem	1	17
18.	Sizing.	T3	437-440	BB	1	18

LEARNING OUTCOME

At the end of unit, students should be able to

- Study and analyze the Solar Modules and Storage systems.
- Getting detailed operating for Standalone PV systems and Sizing.

UNIT IV	GRID CONNECTED PV SYSTEMS					(6)
Topic No	**Topic**	**Books for Reference**	**Page No.**	**Teaching Methodology**	**No. of Hours Required**	**Cumulative No. of periods**
19.	PV systems in buildings.	T1	446-450	BB	1	19
20.	Design issues for central power stations.	R1	4.28-4.36	BB	1	20
21.	Safety.	T1	299-300	BB	1	21
22.	Economic aspect.	W3	-	PPT	1	22
23.	Efficiency and performance.	T1	173-177	BB	1	23
24.	International PV programs.	R1	5.31-5.32	BB	1	24

LEARNING OUTCOME

At the end of unit, students should be able to

- Study the Design issues for central power stations.
- Understand the Economic aspect, Efficiency and performance.

UNIT V	MODELLING AND SIMULATION OF PV SYSTEMS USING MATLAB					(6)
25.	Introduction to Systems.	T4	1-98	BB	1	25
26.	Systems Modeling.					
27.	Formulation of State Space Model of Systems.	W4	-	PPT	1	26
28.	Model Order Reduction.	T4	219-263	BB	1	27
29.	Interpretive Structural Modeling.	T4	300-325	BB	1	28
30.	System Dynamics Techniques	T4	327-344	BB	1	29
31.	Simulation.	T4	401-420	PPT	1	30

LEARNING OUTCOME

At the end of unit, students should be able to

- Understand the Impact of Simulation.
- Analyze of the techniques used for simulation tools.

COURSE OUTCOME

At the end of the course, the students will be able to

- Use different materials used for photovoltaic cells manufacturing.
- Understand the principles and operation techniques used for MMPT.
- Analyze and design standalone operation of PV power generation.
- Describe the various grid connecting techniques for PV system.
- Understand the simulation tools used for photovoltaic power generation.

INTERNAL ASSESSMENT DETAILS

ASST. NO.	I	II
Topic Nos.	1 - 14	15-31
Date		

Prepared by
Mr.J.Arokiaraj

Verified by
HOD/EEE

Approved by

Principal

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Acadamic year 2020-21 Odd Sem

VALUE ADDED COURSE DETAILS

SUBJECT: EVA002 - ADVANCES IN SOLAR ENERGY TECHNOLOGIES
SEMESTER - V / III - Year EEE

COURSE CREDIT DETAIL

L	T	P	C
2	0	0	2

STUDENTS DETAILS

Roll No.	Register Number	Name of the Students
1.	821118105001	ABIRAMI U
2.	821118105002	AKESH SATHIYA A
3.	821118105003	BAVANA K
4.	821118105005	CHANDRAKUMAR S
5.	821118105006	CHANDRAPRIYA S
6.	821118105009	JAGADESHWARAN S
7.	821118105010	JAYAPRAKASH R
8.	821118105011	KARTHIKEYAN K
9.	821118105013	KAVIYA M
10.	821118105015	MOHAMEDHALITH S
11.	821118105017	PRIYADHARSHINI S
12.	821118105019	SANTHOSH G
13.	821118105020	SANTHOSH G
14.	821118105023	VASANTH K
15.	821118105301	PREMALATHA N

COMMITTEE MEMBERS

COURSE IN CHARGES	Mr. J. AROKIARAJ	AP/EEE
SENIOR FACULTY MEMBER	Mr. R.SUNDARAMOORTHI	AP/EEE
HEAD OF THE DEPARTMENT	Dr. A. ALBERT MARTIN RUBAN	Asso. Prof/EEE
PRINCIPAL	Dr. J. ARPUTHA VIJAYA SELVI	Professor

6/8/20 — Course in Charges

Academic Coordinator

12/8/20 — Head of the Department

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

ACADEMIC YEAR 2020-2021 / ODD SEMESTER

TIME TABLE for VALUE ADDED COURSES

III EEE **Class Strength : 15**

Session	1	11.30a.m - 11.45a.m	2	12.45p.m - 1.30p.m	3
Day	10.30 a.m - 11.30 a.m		11.45 a.m - 12.45 p.m		1.30 p.m - 2.30 p.m
SAT	EVA002	BREAK	EVA002	LUNCH BREAK	EVA002

SUB. CODE	NAME OF THE SUBJECT	NAME OF THE STAFF	DEPT.	PERIODS/WEEK
EVA002	Advances in solar energy technologies	Mr. J. Arokiaraj	EEE	3

DEPT. VACC HEAD OF THE DEPARTMENT 12/8/20 PRINCIPAL 12/8/2020

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING
Acadamic year 2020-21 Odd Sem

VALUE ADDED COURSE DETAILS

SUBJECT: EVA002 - ADVANCES IN SOLAR ENERGY TECHNOLOGIES
SEMESTER - V / III - Year EEE

COURSE CREDIT DETAIL

L	T	P	C
2	0	0	2

Total No. of Course hours conducted = 30

Assessment test conduct on 30-09-2020 & 26-10-2020

13/11/20 13/11/20

COURSE IN CHARGE — **ACADEMIC COORDINATOR** — **HEAD OF THE DEPARTMENT**

Mr. J. Arokiaraj

KINGS COLLEGE OF ENGINEERING

CONTINUES ASSESSMENT TEST - I (Sep-2020)

EVA 002 - ADVANCES IN SOLAR ENERGY TECHNOLOGIES

Class: III EEE | Date & Session: 30-09-2020 & FN

Maximum marks: 100 | Time: 9.30 AM -12.30 PM

Answer all the questions

PART - A (10x2=20)

1. List the Basic components grid connected solar systems.
2. Recall the three Steps involved in Cell processing.
3. Differentiate the solar modules types.
4. Rewrite the module efficiency (watts per Area).
5. Classify the different MPPT techniques.
6. Write the Procedure for testing for solar panels.
7. Draw the calibration system for solar PV systems.
8. Define solar PV regulation.
9. What is array arching? How it can be prevented?
10. What are super capacitors? State its advantages and uses.

PART - B (5x13=65)

11. (a) How is light absorbed in a semiconductor? Also write notes on recombination of e-h pairs. (13)

(OR)

(b) How a pn junction is formed? And explain its characteristics. (13)

12. (a) Discuses about the optical and recombination losses. (13)

(OR)

(b) What is the effect of light, temperature and parasitic resistance on a solar cell? (13)

13. (a) With neat diagram explain the protection techniques used for solar PV system. (13)

(OR)

(b) Estimate the power conditioning in PV system. (13)

14. (a) Explain in detail about the different types of energy storage system. (13)

(OR)

(b) What are the design issues for a central PV power station? Discuss in detail. (13)

15. (a) Summarize the working of the pumped hydro electric energy storage system. (13)

(OR)

(b) Illustrate the sensible heat storage system in details. (13)

PART - C (1x15=15)

16. (a) With a neat diagram explain grid tied solar PV system. (15)

(OR)

(b) Explain about any three international PV programs in existence and its development. (15)

EVA002 - ADVANCE IN SOLAR ENERGY TECHNOLOGIES

CAT-1

K. KARTHIKEYAN.
821118105011
30/09/2020

94/100

PART-A

1) List the Basic components grid connected solar systems.

* Solar photovoltaic Modules.
* Combiner box.
* Inverter.
* Array Mounting racks.
* Surge Protection.
* Meters.

2

2) Recall the three steps involved in cell processing.

* Standard process.
* Limitation of the Screen Printing.
* Buried contact cells.

1½

3) Differentiate the solar modules types.

* Single-crystalline.
* Poly-crystalline.
* Amorphous.
* Other cell material used in solar modules are Cadmium telluride.
* Copper indium diselenide. (CIS).

2

4) Rewrite the Module efficiency (Watts Per Area).

* Modules with higher efficiency will have higher ratio of watts to area.

1½

* The higher the efficiency, the smaller area will be required to achieve the same Power output of an array.

5) Classify the different MPPT techniques.

* Incremental Conductance method.
* Fractional Short Circuit Current.
* Fractional open Circuit Voltage.
* Neural networks.
* Fuzzy logic.
* Perturb and observe.

2

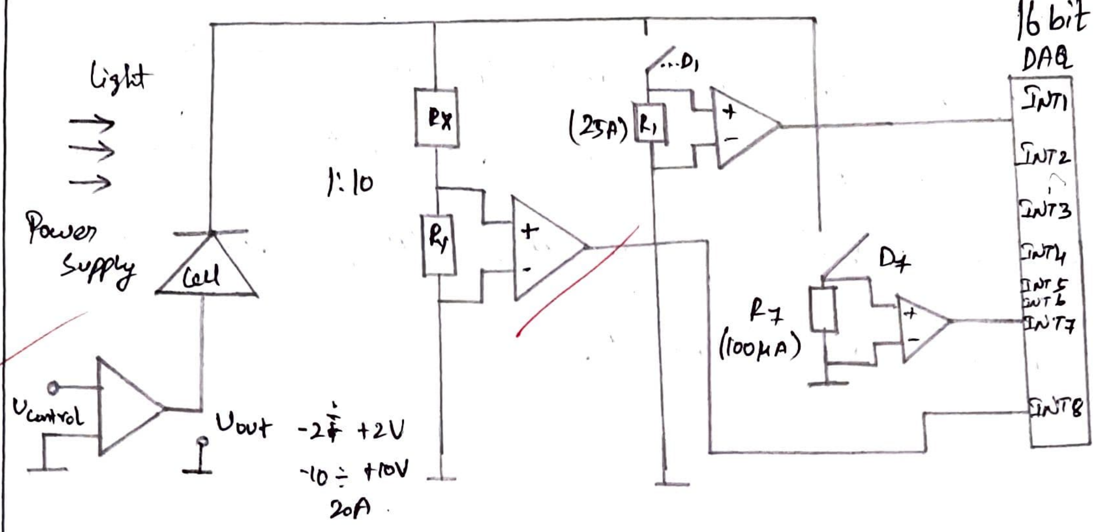
6) Write the Procedure for testing for Solar Panels

* Propely testing your solar panels is a very important but often overlooked procedure.

1½

* We wouldn't believe how many People completely skip testing solar Panels and forget to Confirm their solar Power output before installing them.

7) Draw the Calibration system for solar PV systems.



8) Define Solar PV regulation.

* A Photovoltaic system, also PV system or solar Power System, is a power system designed to supply usable solar power system, by means of photovoltaics.

* Due to the exponential growth of photovoltaics, prices for PV Systems have rapidly declined in recent years.

* However, they vary by market and the size of the system.

9) What is array arching? How it can be prevented?

* A review on satellite Solar array Phenomenon. It has been observed that if the satellite bus voltage is increased a certain voltages, arcing is observed which gradually damages the solar array partially or completely.

2

10) What are Super Capacitors? State its advantages and uses.

* Super Capacitors store more energy than ordinary capacitors by creating a very thin, "double layer" of charge between two plates, which are made from porous, typically carbon-based materials soaked in an electrolyte.

2

ADVANTAGES:

* Super Capacitors combine the energy storage properties of batteries with the powerdischarge characteristics of capacitors.

USES:

* In applications requiring many rapid charge/discharge cycles rather than long term compact storage.

PART-B

11) (b) How a Pn junction is formed? And explain its characteristics.

The Principal Parameters of a P-n junction is in equilibrium along the spatial coordinate perpendicular to the junction.

In operation. the Fermi level E_F split into two Quasi-Fermi levels E_{Fn} and E_{FP}, one each for the electrons and holes.

With the corresponding potentials $\phi_n = -q/E_{Fn}$ and $\phi_p = -q/E_p$.

Near the open circuit, the quasi-Fermi levels are Parallel in the junction.

$$qV_{b_1} = K_BT \ln\left(\frac{N_D N_A}{n_i^2}\right) \longrightarrow ①$$

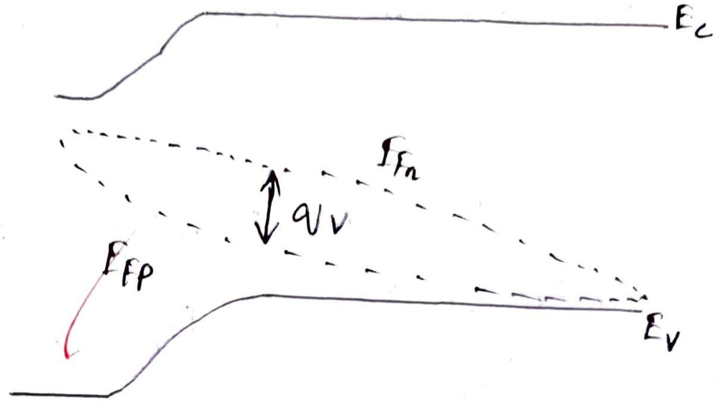
$$W_j = L_D\sqrt{\frac{2q\Delta\psi}{K_BT}} \longrightarrow ②$$

$$L_D = \frac{\sqrt{\epsilon K_BT}}{q^2 N_B} \longrightarrow ③$$

$$N_B = \frac{N_A N_D}{N_A + N_D}$$

$$n(\text{base}) = n_0(\text{base}) e^{qV/k_BT} = n_0(\text{emitter}) e^{q(V - V_{b1})/k_BT} \rightarrow (4)$$

$$P(\text{emitter}) = P_0(\text{emitter}) e^{qV/k_BT} = P_0(\text{base}) e^{q(V - V_{b1})/k_BT} \rightarrow (5)$$



$$I_{ph} = I_{phb} + I_{phe}$$

$$I_0 = I_{ob} + I_{oe} \longrightarrow (6)$$

$$EQE(\lambda) = a_1(\lambda) v_1(\lambda) \longrightarrow (7)$$

$$I_{02}\left(e^{\frac{qV}{2k_BT}} - 1\right) \longrightarrow (8)$$

$$\xi = \frac{SL}{D}$$

$$\gamma_+ = (\xi + 1) e^{W/L} + (\xi - 1) e^{-W/L} \longrightarrow (9)$$

$$J_0 = \frac{qD}{L} \frac{n_i^2}{N_{dop}} \frac{\gamma^+}{\gamma^-} \rightarrow (10)$$

ADVANTAGES:

* Pn junction diode is the simplest form of all the semiconductor devices.

* However, diodes plays a major role in many electronic devices.

DISADVANTAGES:

* It overstressed during breakdown in voltage referencing.

12) (b)

EFFECT OF LIGHT:

* Changing the light intensity incident on a solar cell changes all solar cell parameters, including the short-circuit current, the open circuit voltage, the efficiency and the impact of series and shunt resistances.

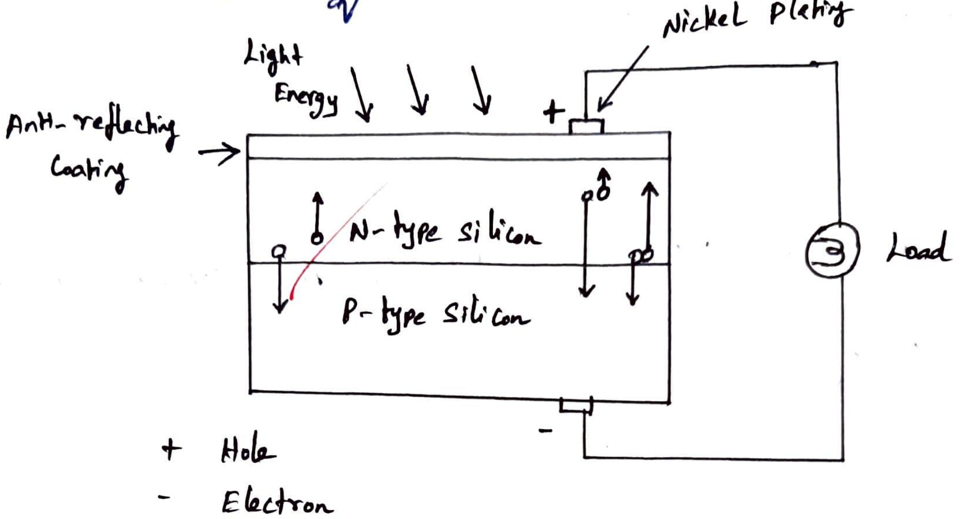
* The light intensity on a solar cell is called the number of suns, where 1 sun corresponds to standard illumination at AM1.5, or $1 KW/m^2$.

* For example a system with $10 KW/m^2$ incident on the solar cell would be operating at 10 suns, or at 10X.

$$V'_{oc} = \frac{nkT}{q} \ln\left(\frac{X I_{sc}}{I_o}\right)$$

$$= \frac{nkT}{q}\left[\ln\left(\frac{I_{sc}}{I_o}\right) + \ln X\right]$$

$$V'_{oc} = V_{oc} + \frac{nkT}{q} \ln X$$



ADVANTAGES:

* It does not generate emissions or radiations.
* It does not require fuels or water to produce electricity.

DISADVANTAGES:

* It cannot be used in absence of the light from any source.

EFFECT OF TEMPERATURE

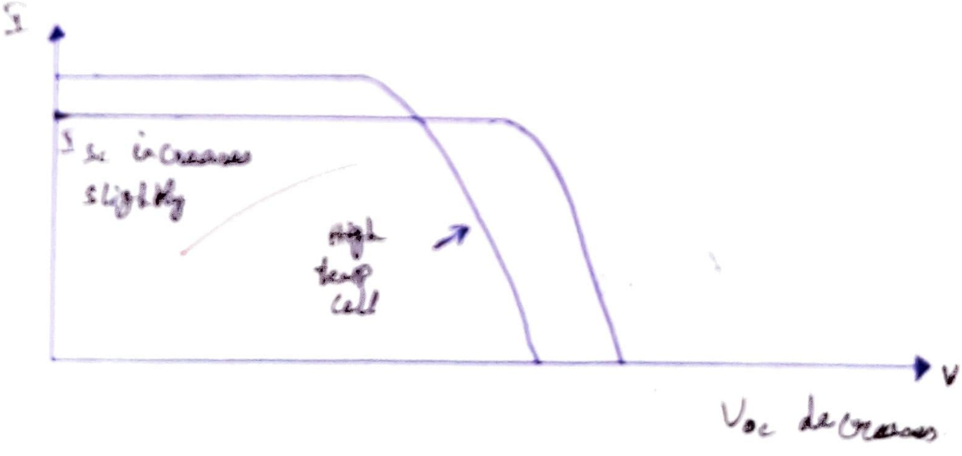
- Solar cells are sensitive to temperature changes. An increase in temperature reduces the band gap of the semiconductor material.

- The decrease in the band gap of semiconductor with increase in temperature is an increase in the energy of electrons in the material.

$$I_0 = qA \frac{D n_i^2}{L N_D}$$

$$n_i^2 = 4 \left(\frac{2\pi kT}{h^2}\right)^3 (m_e^* m_h^*)^{3/2} \exp\left(-\frac{E_{G0}}{kT}\right) = BT^3 \exp\left(-\frac{E_{G0}}{kT}\right)$$

$$\frac{dV_{oc}}{dT} = \frac{V_{oc} - V_{G0}}{T} - \gamma \frac{k}{q}$$



EFFECT OF PARASITIC RESISTANCES

- The key impact of parasitic resistance is reducing the fill factor in the majority of cases and for usual values of series and shunt resistance.

* Both the impact and the magnitude of series and Shunt resistance is dependent on the geometry and Shape of the solar cell, at the point of operation of the solar cell.

13) (b) Estimate the Power Conditioning in PV system.

* Photovoltaic energy is currently considered as one of the most useful renewable natural energy sources in the world because it is clean, free, abundant, pollution free and inexhaustible.

* PV energy has received increasing interest in electric power application.

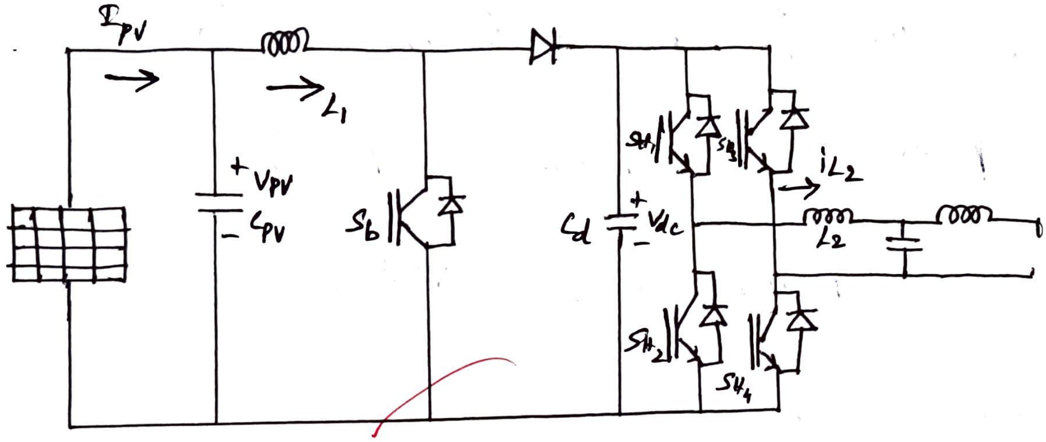
* Photovoltaic system circuit conditioning system 33kW transformerless PCS with grid connection.

* The transformer less PCS is composed of a PV array. ~~Dcto~~

* DC/DC boost converter dc line and AC/AC inverter L-C filter PV voltage V_{PV} is set in wide range variation (150 – 450V).

* In the operation voltage of PV array changes the duty ratio in order to local variations in directions of maximizing PV array current.

* If power increases, the operating voltage is in the same direction if it decreases the direction of the perturbation.



* This disadvantage of the Perturbation and observation Method can be minimized by comparing the incremental instantaneous conductance of PV array. this Method is More accurate and can Provide good performance under rapid changing conditions.

* The current circle is increased linearly by PV array characteristics from 0 to 1 at the fixed temperature of to show the relative values between the voltage and current.

14) (a) Explain in detail about the different types of energy storage system?

- The different types of energy storage can be grouped into five broad technology categories.

(i) Batteries (ii) Thermal (iii) Mechanical

(iv) Pumped hydro (v) Hydrogen.

12

BATTERY STORAGE:

- Batteries are the most common and widely accessible form of storage, ~~one~~ an electrochemical technology comprised of one or more cells with a positive terminal named a cathode and negative terminal or anode.

THERMAL STORAGE:

- Thermal storage is essencial involves the capture and release of heat or cold in a solid, liquid or air and potentially involving changes of state of the storage medium.

MECHANICAL STORAGE:

Mechanical storage system are the simplest drawing on the kinetic energy of rotation or gravitation to store energy.

* Technologies include energy storage with salt and liquid air or storage solar power.

* But this storage options may limited by the need for large underground storage.

PUMPED HYDRO:

* Energy storage with pumped hydro system based on large water resorvoirs has been based on large water reservoir has been widely implemented over much of the past to become the most common form of utility scale storage globally.

HYDROGEN:

* Energy storage with hydrogen which is still involve its ~~conser~~ conversion from electricity via electrolysis for storage in tanks from it can heat undergo either electrification or supply to energing application as transport industry or residential as a supplement or replacement to gas.

15) (b) Illustrate the sensible heat storage system in details.

SENSIBLE HEAT STORAGE:

* The most direct way is the storage of sensible heat.

* Sensible heat storage is based on raising the temperature of a liquid or solid to store heat and releasing it with the decrease of temperature when it is required.

* The volumes needed to store energy in the scale that world needs are extremely large.

12

* Materials used in sensible heat storage must have high heat capacity and also high boiling or melting point.

* Although this method of heat storage is currently less efficient for heat storage, it is least complicated compared with latent or chemical heat and it is inexpensive.

* From thermodynamics point of view, the storage of sensible heat is based on the increase of enthalpy of the material in the store,

either a liquid or a solid in most cases.

* The sensible effect is a change in temperature.

* Heat stored can be obtained by the equation:

$$\Delta Q = m . \int_{T_1}^{T_2} c_p (T) . dT$$

Where,

ΔQ is the energy stored (J)

m is the mass of an object (kg)

c_p is the specific heat capacity ($J . kg^{-1} . k^{-1}$)

dT is the temperature difference.

* Different substances are affected to different magnitudes by the addition of heat.

* When a given amount of heat is added to different substances, their temperatures increase by different amounts.

* This proportionality constant between the heat Q that the object absorbs or losses and the resulting temperature change T of the object is known as the heat capacity C of an object.

$$C = Q / \Delta T$$

* Heat capacity is an extensive property of matter, meaning it is proportional to the size of the system.

* Heat capacity C has the unit of energy per degree or energy per kelvin.

* When expressing the same phenomenon as an intensive property, the heat capacity is divided by the amount of substance, mass, or volume, thus the quantity is independent of the size or extent of the sample.

16) (a) **Grid-Tied Solar photovoltaic system:**

* Most PV systems are grid-tied systems that work in conjunction with the power supplied by the electric Company.

* A grid-tied solar system has a special inverter that can receive power from the grid or send grid-quality AC power to the utility grid when there is an excess of energy from the solar system.

* In addition, the utility company can produce power from solar farms and send power to the grid directly.

* Grid-tied PV systems can be set up with or without a battery backup.

* The simplest grid-tied PV systems does not use battery backup but offers a way to supplement some fraction of the utility power.

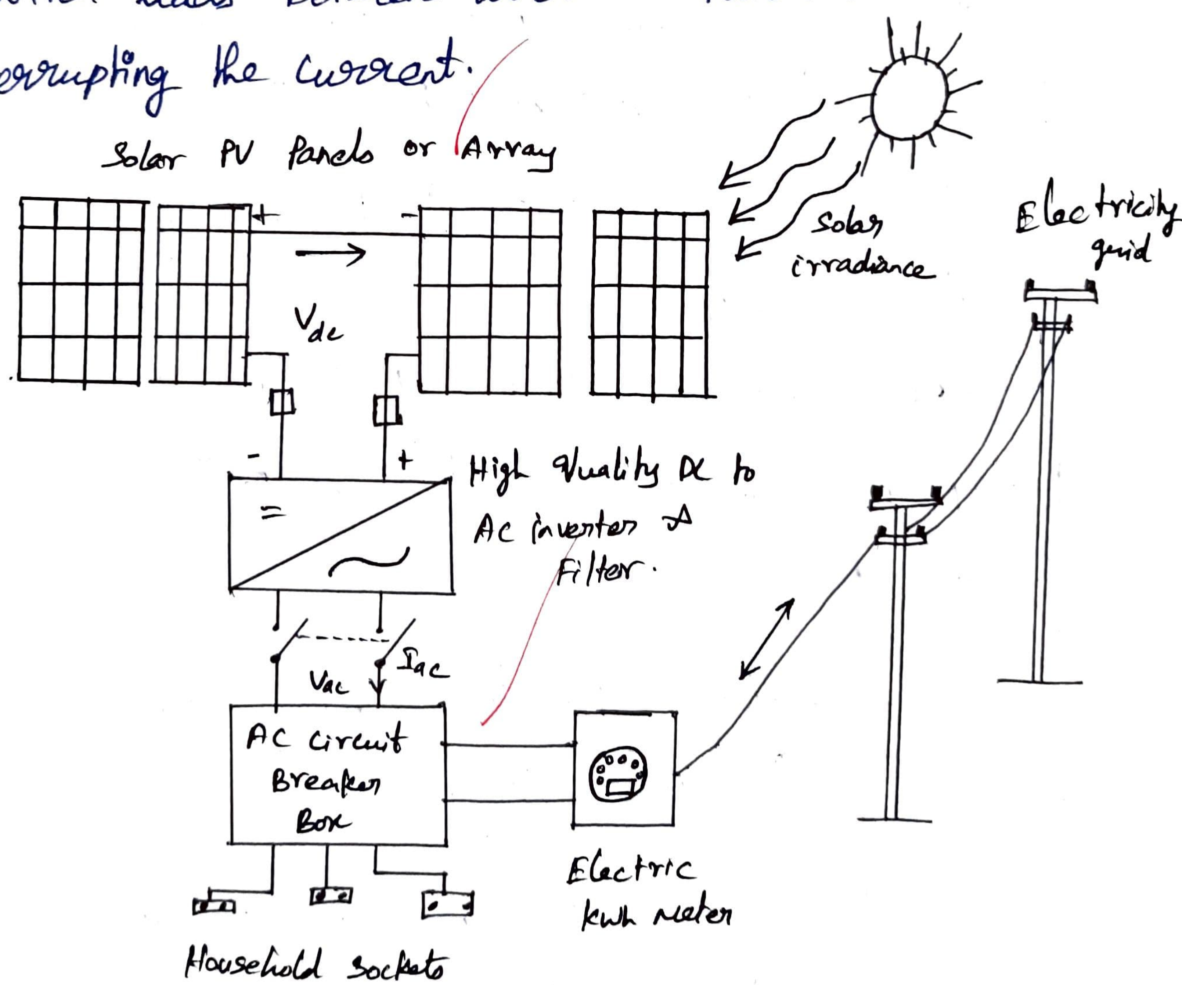
* The major components of this system are the PV modules and an inverter.

* The modules may be connected in series to the inverter if voltage limits are not exceeded, or a separate combiner box may be used to combine the outputs of various modules in parallel.

* The inverter must be a special type that can be connected directly to the ac breaker box, so it needs to convert the DC from the PV modules into grid-compatible AC and match the phase of the utility sine wave.

* It must also be able to disconnect the PV system when the grid is down, so it must be an approved inverter that meets UL standard 1741.

* A transfer switch is an automatic switch that can switch loads between alternate power sources without interrupting the current.



GRID-TIED SOLAR PV SYSTEM.

* Compared to a system with a battery backup, a battery-free system like this is less expensive, easier to install, and almast Maintanance free.

* It has the advantage of not having to supply all of the power needed for the home or business it can offset any fraction of the power and make the utility make up the difference.

DISADVANTAGES:

* No electricity when grid is absent.

* Cannot guarantee 24×7 Electricity.

* Limitations while using with Diesel-Generator.

* Poor DG utilisation.

ADVANTAGES:

* Saves more money with net metering.

* The utility grid is a virtual battery.

KINGS COLLEGE OF ENGINEERING

CONTINUES ASSESSMENT TEST - II (Oct - 2020)

EVA 002 - ADVANCES IN SOLAR ENERGY TECHNOLOGIES

Class: III EEE
Maximum marks: 100

Date & Session: 26-10-2020 & FN
Time: 9.30 AM -12.30 PM

Answer all the questions

PART - A (10x2=20)

1. Recall the use of blocking Diode.
2. Why regulator is needed in a PV system?
3. Compare the materials used in mounting structures.
4. Define depth-of-discharge.
5. List the economic issues involved in large, central-generating PV plant.
6. Compute the various approaches to rooftop mounted PV arrays.
7. Differentiate Capacity and energy credit.
8. Compute array arching. How it can prevent?
9. What are the situations based requirement in Modeling simulation?
10. Write the Classification of Models.

PART - B (5x13=65)

11. (a) With neat diagram explain the protection techniques used for solar PV system. (13)

(OR)

(b) Estimate the power conditioning in PV system. (13)

12. (a) Explain in detail about the different types of energy storage system. (13)

(OR)

(b) What are the design issues for a central PV power station? Discuss in detail. (13)

13. (a) Describe in detail on: (13)

(i) Inverters used in PV system.

(ii) Sizing of PV system.

(OR)

(b) Discuss about the issues addressed during grid tied solar power. (13)

14. (a) Explain the economical aspects of PV system. Also explain how PV system is usually rated? (13)

(OR)

(b) Illuminate about the safety and islanding issues of central power stations. (13)

15. (a) Write the Formulation of State Space Model of Systems. (13)

(OR)

(b) Construct and Arrange the Techniques of System Analysis. (13)

PART - C (1x15=15)

16. (a) Construct the any one Modeling and Simulation of Systems Using MATLAB and Simulink. (15)

(OR)

(b) Discuss the Basics of Linear Graph Theoretic Approach in modeling of the System. (15)

EVA002 - ADVANCE IN SOLAR ENERGY TECHNOLOGIES

CAT - 2

R. JAYAPRAKASH
821118105010
26.10.2020

94/100

PART - A

1. Recall the use of blocking diode.

* A blocking diode should be used between the battery and the cell array to prevent the battery from discharging through the cells when the light intensity is low.

2

2. Why regulator is needed in a PV system?

* The voltage regulator ensures that the voltage from the solar panel never exceeds the safe value required by the battery for charging. Generally, there is no need for a charge controller with small maintenance.

2

3. Compare the materials used in mounting structures.

* Stainless steel, aluminium and galvalume are the primary materials used in solar mounting structures in India. While steel and aluminium have been in use for a long time, galvalume is a more recent addition. The type of material used for mounting structures is dependent on the location and the life cycle of the plant. Earlier, wood and polymer were used as mounting structures materials. However, they have been replaced with more durable materials and are no longer actively used.

2

4. Define depth-of-discharge.

* Depth of discharge is the fraction or percentage of the capacity which has been removed from the fully charged battery. It is an alternative method to indicate a battery's state of charge. It is the complement of state of charge: as one increases, the other decreases.

5. List the economic issues involved in the large, central-generating PV plant.

* The vast majority of the electricity that these facilities are generated by centralized generation is distributed through the electric power grid to multiple-end users.

6. Compute the various approaches to rooftop mounted PV rays?

* A rooftop photovoltaic power station or rooftop PV system is a photovoltaic (PV) system that has its electricity-generating solar panels mounted on the rooftop of a residential or commercial building or structure.

* The various components of such a system include

(i) photovoltaic modules
(ii) mounting systems
(iii) solar inverters and
(iv) other electrical accessories.

7. Differentiate Capacity and energy credit.

Capacity credit :

* Capacity is the maximum output an electricity generator can physically produce, measured in megawatts (MW).

Energy credit :

2 * Energy is the amount of electricity a generator produces over a specific period of time.

* Many generators do not operate at their full capacity all the time.

8. Compute array arching. How it can prevent?

* A review on satellite solar array phenomenon,

It has been observed a certain voltages,

12 arcing in observed which gradually damages the solar array partially or completely.

9. What are the situations based requirement in Modelling simulation?

* Abstract specifications of the essential features of a system : When a system does not exist and a designer wants to design a new system like a missile or an airplane. The model will help in knowing, prior to the

development of the system, how that system will work for different environmental conditions and inputs.

* Modeling forces us to think clearly before making a physical model: One has to be clear about the structure and the essentials of the situation.

* To guide the thought process: It helps in refining ideas or decisions before implementing it in the real world.

* It is a tool that improves the understanding about a system, and allows us to demonstrate and interact with what we design and not just describe it.

* **To improve system performance**: Models will help in changing the system structure to improve its performance.

* To explore the multiple solutions economically: It also allows us to find many alternate solutions for the improvement in system performance.

10. Write the classification of Models.

* Physical vs. Abstract Model
* Mathematical vs. Descriptive Model
* Static vs. Dynamic Model
* Steady state vs. Transient Model
* Open vs. Feedback Model
* Deterministic vs. Stochastic Models
* Continuous vs. Discrete Models.

PART - B

11. b) Estimate the power conditioning in PV system.

* Photovoltaic energy is currently considered as one of the most useful renewable natural energy sources in the world because it is clean, free, abundant, pollution free and inexhaustible.

* PV energy has received increasing interest in electric power application.

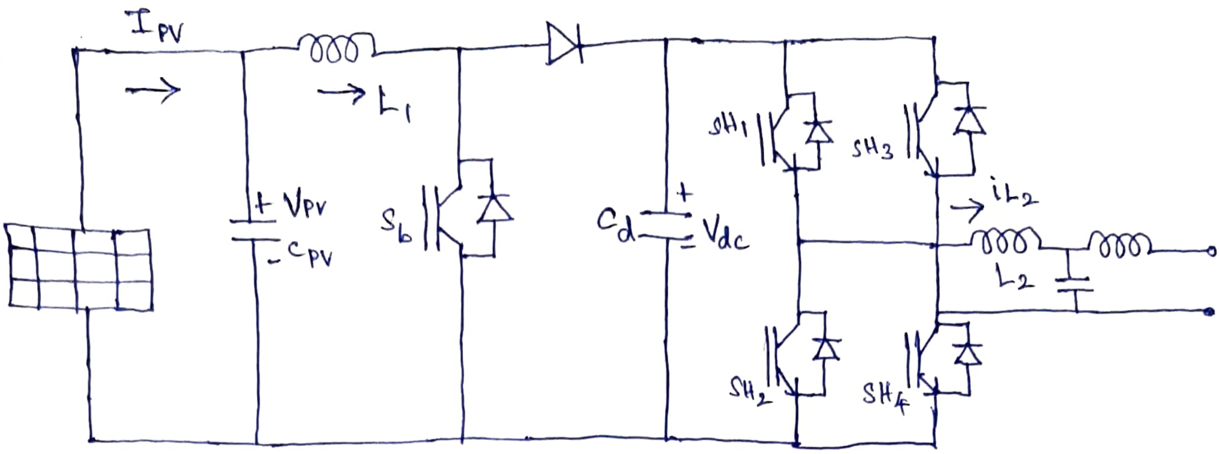
* Photovoltaic system circuit conditioning system 33 KW transformless PCS with grid connection.

* The transformer less PCS is composed of a PV array.

* DC/DC boost converter dc line and AC/AC inverter L-C filter PV voltage V_{PV} is set in wide range variation (150 - 450 V).

* In the operation voltage of PV array changes the duty ratio in order to total variations in directions of maximizing PV array current.

* If power increases, the operating voltage is in the same direction if it decreases the direction of the perturbation.



* This disadvantage of the perturbation and Observation method can be minimized by comparing the incremental instantaneous conductance of PV array this method is more accurate and can provide good performance under rapid changing conditions.

* The current curve is increased linearly by PV array characteristics from 0 to 1 at the fixed temperature of to show the relative values between the voltage and current.

12. a) Explain in detail about the different types of energy storage system.

The different types of energy storage can be grouped into five broad technologies categories.

* Batteries
* Thermal
* Mechanical
* Pumped hydro
* Hydrogen.

(i) Battery storage :

* Batteries are the most common and widely accessible form of storage are an electrochemical technology comprised of one or more cells with a positive terminal named a cathode and negative terminal or anode.

(ii) Thermal storage :

* Thermal storage is essential involves the capture and release of heat or cold in a solid liquid, or air and potentially involving changes of state of the storage medium.

(iii) Mechanical storage :

* Mechanical storage system are the simplest drawing on the kinetic energy of rotation or gravitation to store energy.

* Technologies include energy storage with salt and liquid air or storage solar power.

* But this storage options may limited by the need for large underground storage.

(iv) Pumped hydro :

* Energy storage with pumped hydro system based on large water reservoirs has been based on large water reservoir has been widely implemented over much of the past to become the most common form of utility scale storage globally.

(v) Hydrogen :

* Energy storage with hydrogen which is still involve it conversion on from electricity via electrolysis for storage in tanks from it can heat undergo either electrification or supply to energing application as transport industry or residential as a supplement or replacement to gas.

13. b) Discuss about the issues addressed during grid tied solar power.

* There are several technical issues associated with grid connected systems like Power Quality issues, Power and voltage fluctuations, storage, protection issues, Islanding.

(i) Power Quality Issues :

* Power Quality issues are harmonics and voltage and frequency fluctuations.

Harmonics :

* Harmonics are currents or voltages with frequencies that are integer multiples of the fundamental power frequency.

* Electrical appliances and generators all produce harmonics and in large volumes can cause interference that results in a number of power quality problems.

Frequency and Voltage fluctuations :

Frequency and voltage fluctuation again classified as,

* Grid - derived voltage fluctuations
* Voltage imbalance
* voltage rise and reverse power flow
* power factor Correction

a) Grid - Derived voltage fluctuations :

Inverters are generally configured to operate in grid 'voltage - following' mode and to disconnect DG when the grid voltage moves outside set parameters, This is both to help ensure they contribute suitable power quality as well as help to protect against unintentional islanding.

b) Voltage imbalance :

* Voltage imbalance is when the amplitude of each phase voltage is different in a three - phase system or the phase difference is not exactly 120°.

12

c) Voltage Rise and Reverse Power flow :

* Traditional centralized power networks involve power flow in one direction only ; from power plant to transmission network, to distribution network, to load.

d) Power factor correction:

* Because of poor power factor line losses increases and voltage regulation become difficult.

* Inverters configured to be voltage - following have unity power factor, while inverters in voltage - following mode provide current that is out of phase with the grid voltage and so provide power factor correction.

14. b) Illuminate about the safety and islanding issues of central power stations.

Islanding : Islanding is a critical and unsafe condition in which a distributed generator, such as a solar system, continues to supply power to the grid while the electric utility is down.

Islanding and distributed power generation :

* Islanding is a critical and unsafe condition, which may occur in a power system. This condition is caused due to an excessive use of distributed generators in the electrical grid.

Anti - islanding or islanding protection :

* To avoid this problem, it is recommended that all distributed generators shall be equipped which devices to prevent islanding. The act of preventing islanding from happening is also called anti-islanding.

Problems caused by islanding :

* Islanding causes many problems, some of which are listed below :

1. Safety concern :

* Safety is the main concern, as the grid may still be powered in the event of a power outage due to electricity supplied by

distributed generators, as explained earlier.

* This may confuse the utility workers and expose them to hazards such as shocks.

2. Damage to customer's appliances :

* Due to islanding and distributed generation, there may a bi-directional flow of electricity.

* This may cause severe damage to electrical equipment, appliances and devices.

3. Inverter damage :

* In the case of large solar systems, severe inverters are installed with the distributed generators. islanding could cause problems in proper functioning of the inverters.

12

Ways to detects and resolve islanding :

* Active islanding detection method
* Passive islanding detection method.

Active islanding detection :

* Active detection methods involve the technique of constantly sending a signal back & forth between the distributed generator and the grid to ensure the status of electrical supply.

Passive islanding detection :

* It makes use of transients in the electricity for detection. The quickest and easy way to prevent any problems is to shut off the distributed generator when requested by the utility.

15. a) Write the formulation of State Space Model of Systems.

* In control engineering, a state - space representation is a mathematical model of a physical system as a set of input, output and state variables related by first order differential equations or differential equations.

* state variables are variables whose values evolve over time in a way that depends on the values they have at any given time and on the externally imposed values of input variables. Output variables' values depend on the values of the state variables.

* State space model (SSM) refers to a class of probabilistic graphical model that describes the probabilistic dependance between the latent state variable and the observed measurement.

* The SSM framework has been successfully applied in engineering, statistics, computer science and economics to solve a broad range of dynamical system problems.

$$P(x(t) \mid y(0:t)) = \frac{P(x(t), y(0:t))}{P(y(0:t))} = \frac{P(x(t) \mid y(0:t-1)) \, P(y(0:t) \mid x(t), y(0:t-1))}{P(y(t) \mid y(0:t-1))}$$

$$= \frac{P(x(t) \mid y(0:t-1)) \, P(y(t) \mid x(t), y(0:t-1))}{P(y(t) \mid y(0:t-1))} \rightarrow (1)$$

13

$$p(x(t)\mid y(0:t-1)) = \int p(x(t)\mid x(t-1))\, p(x(t-1)\mid y(0:t-1))\, dx(t-1) \quad \text{(2)}$$

$$x(t+1) = A\, x(t) + n(t) \quad \text{(3)}$$

$$y(t) = Bx(t) + V(t) \quad \text{(4)}$$

$$x(t+1) = \rho\, x(t) + n(t) \quad \text{(5)}$$

$$\log \lambda(t) = \mu + \alpha x(t) + \beta u(t) \quad \text{(6)}$$

$$p(Y\mid x,\theta) = \exp\left\{ \int_0^{T_0} \log \lambda(\tau)\, dy(\tau) - \int_0^{T_0} \lambda(\tau)\, d\tau \right\} \quad \text{(7)}$$

$$P(X, Y\mid\theta) = \prod_{t=1}^{T_0} p(x(t)\mid x(t-1), \theta) \prod_{c=1}^{C} p(y_c(t)\mid x(t), \theta) \quad \text{(8)}$$

12

$$x(t+1\mid t) = \rho\, x(t\mid t) \quad \text{(one step mean prediction)} \quad \text{(9)}$$

$$\sigma_x^2(t+1\mid t) = \rho^2 \sigma_x^2(t\mid t) + \sigma^2 \quad \text{(one step variance prediction)} \quad \text{(10)}$$

$$x(t+1\mid t+1) = x(t+1\mid t) + \sigma_x^2(t+1\mid t)\, \alpha \left[dy(t+1) - \exp(\mu + \alpha x(t+1\mid t+1) + \beta u(t+1))\Delta \right]$$

posterior mode (11)

$$\sigma_x^2(t+1\mid t+1) = \left[(\sigma_x^2(t+1\mid t))^{-1} + \alpha^2 \exp(\mu + \alpha x(t+1\mid t+1) + \beta u(t+1))\Delta \right]^{-1}$$

posterior mode (12)

PART - C

16. b) Discuss the Basics of Linear Graph Theoretic Approach in modelling of the system.

State Variable System representation:

* Linear graph system models provide a graphical representation of a system model and the interconnection of the elements.

* A set of differential and algebraic equations which completly define the system may be derived from the linear graph model.

* In this handout, we develop a procedure for deriving a specific set of differential equations, known as the state equations, from the system linear graph.

State Equation based modeling procedure:

The complete system model for a linear time-invariant system consists of

(i) a set of n state equations, defined in terms of the matrices A and B,

(ii) a set of output equations that relate any output variables of interest to the state variables and inputs, and expressed in terms of the C and D matrices.

$x = Ax + Bu \rightarrow (1)$

$y = Cx + Du \rightarrow (2)$

The overall modeling procedure developed in this chapter is based on the following steps :

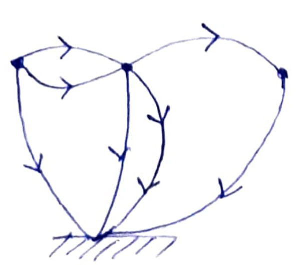
* Determination of the system order n and selection of a set of state variables from the linear graph system representation.

* Generation of a set of state equations and the system A and B matrices using a well defined methodology.

* Determination of a suitable set of output equations and derivation of the appropriate C and D matrices.

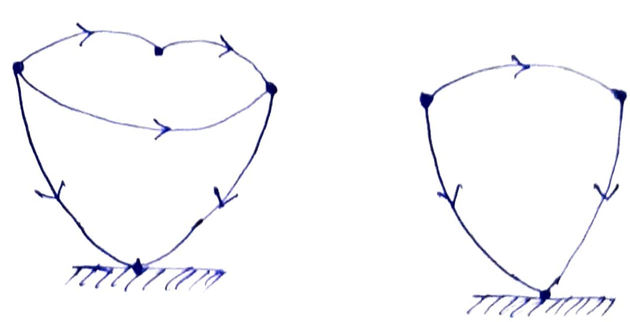
Linear Graph properties :

* The derivation of the state equations in this chapter is based on the use of the system linear graph model.



(a)

Connected system graph



(b)

Unconnected system graph.

* A linear graph with B branches represent B system elements, each with a known elemental equation or source function.

* The graph also represents the structure of the element interconnections, in terms of the continuity and compatibility constraint equations.

* In the following sections we use the properties of linear graphs to

(i) derive the system structural constraints

(ii) define the set of state variables

(iii) provide a system structural technique for deriving the system state equations [4-8].

System Graph:

* The oriented linear graph model of system.

Connected Graph:

* A system graph in which a path exists between all pairs of nodes.

* A path is said to exist if the node pair is joined by a series of branches.

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Acadamic year 2020-21 Odd Sem

VALUE ADDED COURSE

WEBPORTAL ENTRY-1

SUBJECT: EVA002 - ADVANCES IN SOLAR ENERGY TECHNOLOGIES

SEMESTER - V / III - Year EEE

TOTAL HOUR: 18

Roll No.	Register Number	Name of the Students	Attended Hour	Mark
1.	821118105001	ABIRAMI U	17	96
2.	821118105002	AKESH SATHIYA A	17	95
3.	821118105003	BAVANA K	16	84
4.	821118105005	CHANDRAKUMAR S	16	85
5.	821118105006	CHANDRAPRIYA S	16	86
6.	821118105009	JAGADESHWARAN S	16	85
7.	821118105010	JAYAPRAKASH R	17	96
8.	821118105011	KARTHIKEYAN K	17	94
9.	821118105013	KAVIYA M	17	87
10.	821118105015	MOHAMEDHALITH S	18	96
11.	821118105017	PRIYADHARSHINI S	17	87
12.	821118105019	SANTHOSH G	15	88
13.	821118105020	SANTHOSH G	16	83
14.	821118105023	VASANTH K	17	95
15.	821118105301	PREMALATHA N	18	96

30/9/20 — Faculty In-Charge

30/9/20 — Head of the Department

J. [signature] 30/9/2020 — Principal

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Acadamic year 2020-21 Odd Sem

VALUE ADDED COURSE

WEBPORTAL ENTRY-2

SUBJECT: EVA002 - ADVANCES IN SOLAR ENERGY TECHNOLOGIES
SEMESTER - V / III - Year EEE

TOTAL HOUR: 12

Roll No.	Register Number	Name of the Students	Attended Hour	Mark
1.	821118105001	ABIRAMI U	11	94
2.	821118105002	AKESH SATHIYA A	11	93
3.	821118105003	BAVANA K	11	86
4.	821118105005	CHANDRAKUMAR S	11	87
5.	821118105006	CHANDRAPRIYA S	11	84
6.	821118105009	JAGADESHWARAN S	11	87
7.	821118105010	JAYAPRAKASH R	12	94
8.	821118105011	KARTHIKEYAN K	12	96
9.	821118105013	KAVIYA M	10	89
10.	821118105015	MOHAMEDHALITH S	11	94
11.	821118105017	PRIYADHARSHINI S	10	83
12.	821118105019	SANTHOSH G	12	82
13.	821118105020	SANTHOSH G	11	87
14.	821118105023	VASANTH K	12	95
15.	821118105301	PREMALATHA N	11	94

13/11/20 — Faculty In-Charge

13/11/20 — Head of the Department

13/11/2020 — Principal

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Assessment Details Entered

NOV. / DEC. EXAMINATION, 2020 - EXAMINATIONS

Inst Code & Name : 8211 - KINGS COLLEGE OF ENGINEERING

Branch Code / Name : 105 : B.E. Electrical and Electronics Engineering **University : AUC**
Semester : 05

Register No.	Name of the Student	Subjects	Attend hr 1	Total hr 1	Attend hr 2	Total hr2	IM 2	Attend hr 3	Tot hr 3	IM 3	Attend hr 4	Total hr4	IM 4
821118105001	ABIRAMI U	CS8383 ✓									60	60	98
		CS8392			10	12	91	13	13	98	19	20	96
		EE8501			14	16	86	12	14	88	17	19	94
		EE8511 ✓									60	60	95
		EE8551			9	11	88	10	12	91	20	22	95
		EE8552			10	12	86	8	8	93	23	25	96
		EE8591			10	11	86	13	13	85	19	20	95
		EVA002 ✓						17	18	96	11	12	96
		HS8581 ✓									28	30	96
		OMD551			9	11	94	8	8	86	23	28	94
821118105002	AKESH SATHIYA A	CS8383									60	60	98
		CS8392			10	12	93	12	13	98	18	20	94
		EE8501			15	16	84	12	14	87	17	19	94
		EE8511									60	60	98
		EE8551			9	11	86	12	12	97	20	22	95
		EE8552			10	12	90	8	8	92	23	25	95
		EE8591			10	11	83	13	13	89	18	20	93
		EVA002						17	18	98	11	12	98
		HS8581									28	30	96
		OMD551			9	11	83	7	8	98	24	28	93
821118105003	DAVANA K	CS8383									60	60	90
		CS8392			10	12	89	11	13	82	18	20	92
		EE8501			14	16	82	12	14	85	17	19	93
		EE8511									60	60	94
		EE8551			10	11	84	11	12	84	20	22	98
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		EE8591			10	11	86	11	13	80	18	20	88
		EVA002						18	16	96	11	12	88
		HS8581									27	30	95
		OMD551			11	11	84	6	8	86	23	26	90
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		EE8501			14	16	82	12	14	86	17	19	93
		EE8511									60	60	94
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		EE8552			10	12	84	7	8	85	22	25	94
		EE8591			9	11	86	11	13	81	18	20	88
		EVA002						16	18	85	11	12	87
		HS8581									28	30	94
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		EE8511									58	60	94
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		EE8591			9	11	91	12	13	88	18	20	88
		EVA002						16	18	98	11	12	84
		HS8581									27	30	94
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	EE8591	9	11	86	11	13	80	17	20	85
	EVA002				16	18	85	11	12	87
	HS8581							27	30	92
	OMD551	9	11	83	6	8	83	24	26	90
821118105010 JAYAPRAKASH R	CS8383							60	60	98
	CS8392	12	12	98	13	13	97	20	20	98
	EE8501	15	16	98	14	14	98	19	19	98
	EE8511							60	60	98
	EE8551	11	11	96	12	12	98	22	22	100
	EE8552	12	12	98	8	8	97	25	25	98
	EE8591	11	11	98	13	13	99	20	20	98
	EVA002				17	18	96	12	12	94
	HS8581							30	30	99
	OMD551	11	11	96	8	8	99	26	26	98
821118105011 KARTHIKEYAN K	CS8383							60	60	98
	CS8392	12	12	98	13	13	95	20	20	98
	EE8501	15	16	98	14	14	98	19	19	98
	EE8511							60	60	98
	EE8551	11	11	98	12	12	98	22	22	100
	EE8552	12	12	98	8	8	99	25	25	98
	EE8591	11	11	98	13	13	99	20	20	98
	EVA002				17	18	94	12	12	96
	HS8581							30	30	99
	OMD551	11	11	96	8	8	94	26	26	98
821118105013 KAVIYA M	CS8383							50	60	90
	CS8392	10	12	80	6	13	90	18	20	94
	EE8501	14	16	80	12	14	83	17	19	90
	EE8511							54	60	92
	EE8551	9	11	80	10	12	87	19	22	84
	EE8552	10	12	80	6	8	97	22	25	95
	EE8591	9	11	80	11	13	85	17	20	90
	EVA002				17	18	87	10	12	89
	HS8581							27	30	92
	OMD551	9	11	80	6	8	85	22	26	89
821118105015 MOHAMED HALITH S	CS8383							60	60	98
	CS8392	12	12	88	13	13	96	20	20	98
	EE8501	16	16	84	13	14	85	19	19	96
	EE8511							60	60	98
	EE8551	11	11	94	12	12	98	22	22	100
	EE8552	12	12	96	8	8	99	25	25	98
	EE8591	11	11	96	11	13	98	20	20	96
	EVA002				18	18	96	11	12	94
	HS8581							30	30	98
	OMD551	9	11	91	8	8	99	24	26	94
821118105017 PRIYADHARSHINI S	CS8383							50	60	90
	CS8392	10	12	87	10	13	80	18	20	90
	EE8501	15	16	82	12	14	81	17	19	90
	EE8511							50	60	90
	EE8551	9	11	89	11	12	88	19	22	84
	EE8552	10	12	82	7	8	95	22	25	95
	EE8591	9	11	87	12	13	89	17	20	88
	EVA002				17	18	87	10	12	83
	HS8581							27	30	90
	OMD551	9	11	80	6	8	89	22	26	89
821118105019 SANTHOSH G	CS8383							51	60	96

ANNA UNIVERSITY :: CHENNAI - 600 025
OFFICE OF THE CONTROLLER OF EXAMINATIONS
Assessment Details Entered
NOV. / DEC. EXAMINATION, 2020 - EXAMINATIONS

Inst Code & Name : 8211 - KINGS COLLEGE OF ENGINEERING

	CS8392	12	12	100	12	13	94	19	20	95
	EE8501	16	16	88	12	14	81	18	19	90
	EE8511							54	60	93
	EE8551	10	11	80	11	12	90	19	22	84
	EE8552	12	12	88	8	8	95	22	25	94
	EE8591	10	11	96	11	13	86	17	20	88
	EVA002				15	18	88	12	12	82
	HS8581							27	30	93
	OMD551	11	11	82	6	8	96	22	26	92
821118105020 SANTHOSH G	CS8383							55	60	96
	CS8392	12	12	98	10	13	85	19	20	95
	EE8501	16	16	80	12	14	85	18	19	90
	EE8511							54	60	93
	EE8551	9	11	92	10	12	82	19	22	84
	EE8552	11	12	98	6	8	84	23	25	94
	EE8591	11	11	87	11	13	80	17	20	88
	EVA002				16	18	83	11	12	87
	HS8581							27	30	93
	OMD551	9	11	88	6	8	82	22	26	92
821118105023 VASANTH K	CS8383							60	60	98
	CS8392	12	12	98	13	13	96	20	20	98
	EE8501	16	16	82	14	14	88	19	19	96
	EE8511							60	60	98
	EE8551	10	11	82	12	12	93	22	22	100
	EE8552	12	12	88	8	8	97	24	25	98
	EE8591	11	11	88	12	13	97	20	20	98
	EVA002				17	18	95	12	12	95
	HS8581							28	30	97
	OMD551	10	11	94	8	8	94	24	26	96
821118105301 PREMALATHA N	CS8383							60	60	98
	CS8392	10	12	91	13	13	87	20	20	98
	EE8501	16	16	82	13	14	90	19	19	98
	EE8511							60	60	98
	EE8551	10	11	86	12	12	95	22	22	100
	EE8552	12	12	92	8	8	91	25	25	98
	EE8591	9	11	90	12	13	93	20	20	98
	EVA002				18	18	96	11	12	94
	HS8581							30	30	98
	OMD551	11	11	94	8	8	89	26	26	96

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Result for Nov. / Dec. Examination, 2020 [Arrear]

Register Number :	821118105002		
Name :	AKESH SATHIYA A		
Branch :	B.E. Electrical and Electronics Engineering		

Semester	Subject Code	Grade	Result
03	EC8353	A	PASS
03	EE8301	B+	PASS
03	EE8391	A	PASS
03	MA8353	B	PASS
03	ME8792	B	PASS
02	BE8252	A+	PASS
02	EE8251	B	PASS
02	PH8253	B+	PASS

Note : [Grade]# The Screen was not shared during the Examination. If this is repeated in future, this will be treated as malpractice.
(Example: A# B# C# ...)

Result for Nov. / Dec. Examination, 2020

Register Number :	821118105002		
Name :	AKESH SATHIYA A		
Branch :	B.E. Electrical and Electronics Engineering		

Semester	Subject Code	Grade	Result
05	CS8392	B+	PASS
05	EE8501	B	PASS
05	EE8551	B+	PASS
05	EE8552	U	RA
05	EE8591	B	PASS
05	EVA002	O	PASS
05	OMD551	B	PASS

Note : [Grade]# The Screen was not shared during the Examination. If this is repeated in future, this will be treated as malpractice.
(Example: A# B# C# ...)

Legends