Roll No												

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

END TERM FINAL EXAMINATION

Semester: Odd Semester 2019-2020
Course Code: EEE 318
Course Name: DISTRIBUTED GENERATION AND MICRO-GRID
Program & Sem: B.Tech (EEE) & VII (DE-IV)

Date: 24 December 2019
Time: 9:30 AM to 12:30 PM
Max Marks: 80
Weightage: 40%

Instructions:

(i) Read the question properly and answer accordingly.

Part A [Memory Recall type Questions]

1. **Answer all the Questions. Each Question carries 2 marks. (10Qx2M=20M)**

i. The main function of the gateway is to provide necessary connectivity amongst devices by message _____,_____,_____,_____ (C.O.No.3) [Comprehension]
ii. The formula for calculating the energy efficiency of the battery in terms of C/D ratio and battery capacity is given as_____ (C.O.No.2) [Comprehension]
iii. The DFIG model is based on _____transformation (C.O.No.4) [Comprehension]
iv. Which of the following charging methods is used to counter the self-discharge of the battery_____ (C.O.No.2) [Comprehension]
v. An MPPT charge controller operates using an algorithm called_____ (C.O.No.4) [Comprehension]
vi. PLL stands for_____ (C.O.No.4) [Comprehension]
vii. As per article 450 of the NEC, overcurrent protection for transformer can be set as high as _____ of the transformer rating. (C.O.No.4) [Comprehension]
viii. Distributed generation (or DG) generally refers to small-scale _____range of electric power generators (C.O.No.1) [Comprehension]
ix. Solar power is expressed in terms of_____ (C.O.No.1) [Comprehension]
x. The model used for simulation and analysis of solar PV cell in MATLAB is _____ (C.O.No.4) [Comprehension]

Part B (Thought Provoking Questions)

Answer all the Questions. Each Question carries 10 marks. (3Qx10M=30M)

2. Photovoltaic (PV) plants consist of inverter-interfaced PV arrays. The inverter keeps the AC output voltage at the specified level irrespective of solar irradiance E (W/m^2) and ambient temperature T (K).Discuss about the development of a robust and very simple mathematical model of a PV array in MATLAB Simulink along with its equivalent circuit.

(C.O.No.4) [Comprehension]

3. A grid tie inverter must synchronize its output voltage with the grid voltage in terms of frequency, phase and amplitude. Ideally the grid maintains a power factor of 1, this number can vary within specified limits but it is usually very close to 1.This means that the current and voltage from the grid are ideally in phase as the current and voltage from the inverter. With the help of block diagram discuss about the special type of setup which is used to accomplish the synchronization of the inverter current to grid voltage.

(C.O.No.4) [Comprehension]

4. Using a solar panel or an array of panels without a controller that can perform Maximum Power Point Tracking (MPPT) will often result in wasted power, which ultimately results in the need to install more panels for the same power requirement. The solution to this problem is to use an MPPT with a proper control. With the help of block diagram explain the operation of MPPT with a controller and the algorithm to track the maximum power point at all instants.

(C.O.No.4) [Comprehension]

Part C (Problem Solving Questions)

Answer both the Questions. Each Question carries 15 marks. **(2Qx15M=30M)**

5. In a site wind is blowing at a steady velocity of 10 m/sec for 12 hours and 5 m/sec for 12 hours. The length of the blade is 10 m. The wind turbine has an efficiency of 0.3.Assume density of air as 1.2 kg/m^3

   a) Identify the unknown quantities that could be computed from the given data

   b) Estimate the unknown Quantities (C.O.No.1) [Comprehension]

6. In a tidal barrage located in Tamil Nadu, the height of the tide is 3 m and the area of the barrage is 300,000 m^2.The barrage drains in 10 Hours. Assume density of water as 1025 kg/m^3.

   a) Identify the unknown quantities that could be computed from the given data

   b) Estimate the unknown Quantities (C.O.No.1) [Comprehension]

SCHOOL OF ENGINEERING

GAIN MORE KNOWLEDGE REACH GREATER HEIGHTS

Semester: 7th

Course Code: EEE 318

Course Name: Distributed Generation and micro-grid

Date: 24.12.2019

Time: 9:30 to 12:30

Max Marks: 80

Weightage: 20%

Extract of question distribution [outcome wise & level wise]

Q.NO.	C.O.NO	Unit/Module Number/Unit /Module Title	Memory recall type [Marks allotted] Bloom's Levels			Thought provoking type [Marks allotted] Bloom's Levels			Problem Solving type [Marks allotted]			Total Marks
			K			C			A C+			
1	1,2,3,4	1,2,3,4	10	5	5							20
2	4	4				10						10
3	4	4					10					10
4	4	4						10				10
5	1	1						5	10			15
6	1	1							5	10		15
	Total Marks											80

K =Knowledge Level C = Comprehension Level, A = Application Level

Note: While setting all types of questions the general guideline is that about 60%

Of the questions must be such that even a below average students must be able to attempt, About 20% of the questions must be such that only above average students must

be able to attempt and finally 20% of the questions must be such that only the bright students must be able to attempt.

I hereby certify that all the questions are set as per the above guidelines.

Faculty Signature:

Reviewer Comment:

All Course outcomes are tested in the QP.

Annexure- II: Format of Answer Scheme

SCHOOL OF ENGINEERING

GAIN MORE KNOWLEDGE REACH GREATER HEIGHTS

SOLUTION

Semester: 7th | **Date**: 24.12.2019

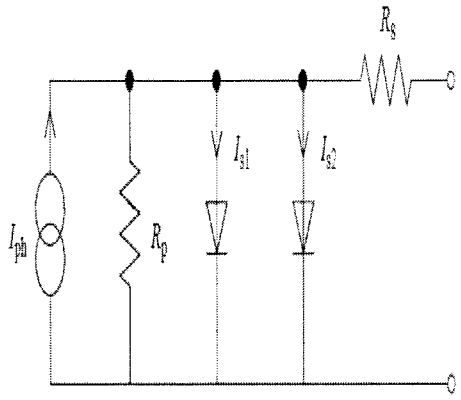
Course Code: EEE 318 | **Time**: 9:30 to 12:30

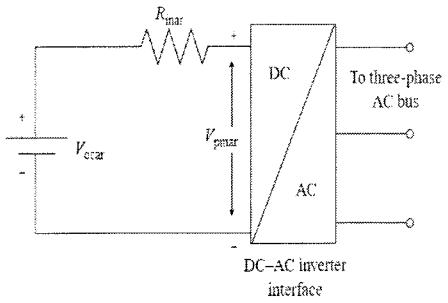
Course Name: Distributed Generation and micro-grid | **Max Marks**: 80 | **Weightage**: 20%

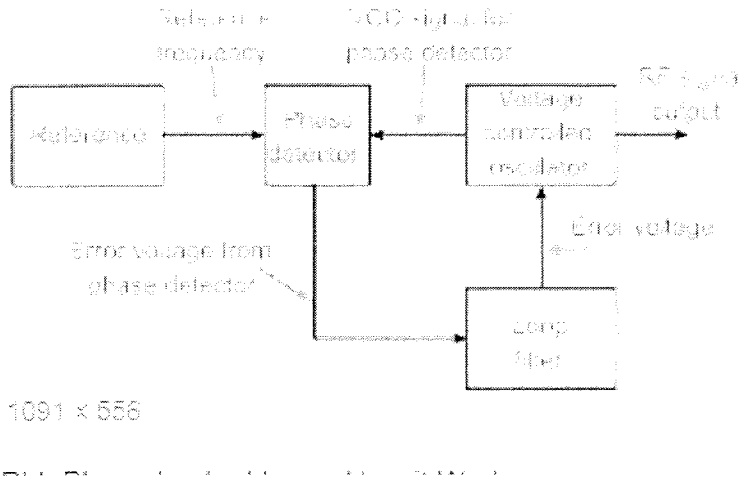
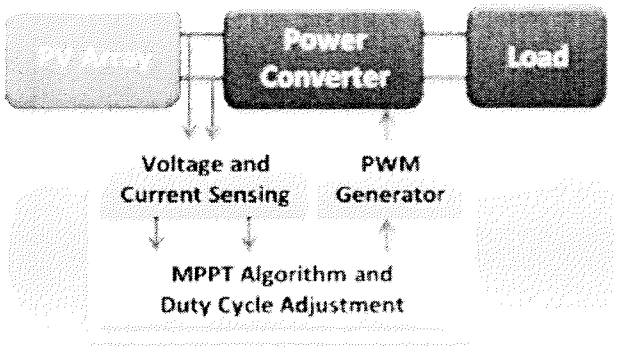
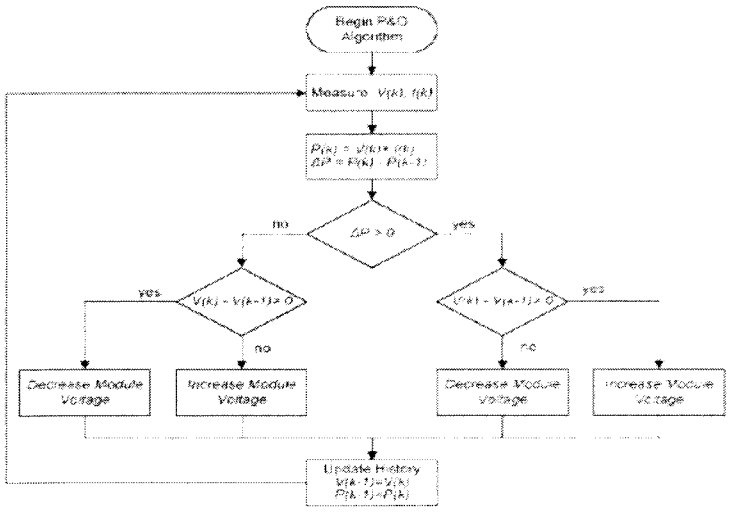
Part A (10Q x2 M =20 Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question(in mins)
1	i. Translating, Formatting, signaling, routing ii. Energy output/ Energy Input iii. D-q-0 transformation iv. Trickle charge v. Perturb and Observe algorithm vi. Phase locked loop vii. 600% viii. 5 kW to 50 Mw ix. W/m^2 x. Polycrytalline cell module	2 marks for each question	1

Part B (3Q x10 M = 30Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
2	 $I = I_{ph} - I_{s1}\left[e^{((V+IR_s)/V_t)} - 1\right] - I_{s2}\left[e^{((V+IR_s)/AV_t)}\right] - \frac{V+IR_s}{R_p}$	EQV Circuit-2M Model diagram-4 marks Equation and explanation-4M	**15**

	 • The model parameters Iph, Isl, Is2, A, Rs and Rp are calculated from the values of irradiance E (W/m2) and ambient temperature T (K) using the following empirical relationships obtained from experimental polycrystalline cell characterization as reported in earlier works • The PV array is modelled as a simple ideal DC voltage source with an internal resistance in series as shown in Figure E.2 such that the values of the ideal DC voltage source and the internal resistance are dependent on the values of E and T. • The DC source is connected to an inverter that converts the DC output of the PV to three-phase, 415 V, 50 Hz AC supply suitable for supplying the loads. The entire modelling and subsequent studies can be done in MATLAB Simulink		
3	A **phase-locked loop** or **phase lock loop (PLL)** is a control system that generates an output signal whose phase is related to the phase of an input signal. There are several different types; the simplest is an electronic circuit consisting of a variable frequency oscillator and a phase detector in a feedback loop. The oscillator generates a periodic signal, and the phase detector compares the phase of that signal with the phase of the input periodic signal, adjusting the oscillator to keep the phases matched. Keeping the input and output phase in lock step also implies keeping the input and output frequencies the same. Consequently, in addition to synchronizing signals, a phase-locked loop can track an input frequency, or it can generate a frequency that is a multiple of the input frequency. These properties are used for computer clock synchronization, demodulation, and frequency synthesis.explain with diagram	5 marks for diagram and 5 marks for explanation	**15**

			
4	  • **Using a solar panel or an array of panels without a controller that can perform Maximum Power Point Tracking (MPPT) will often result in wasted power, which ultimately results in the need to install more panels for the same power requirement.**	**Algorithm-4 M Explanation-4M Block diagram-2M**	**15**

	• **For smaller/cheaper devices that have the battery connected directly to the panel, this will also result in premature battery failure or capacity loss, due to the lack of a proper end of-charge procedure and higher voltage.** • **In the short term, not using an MPPT controller will result in a higher installation cost and, in time, the costs will escalate due to eventual equipment failure. Even with a proper charge controller, the prospect of having to pay 30-50% more up front for additional solar panels makes the MPPT controller very attractive** • **In this case, the algorithm modifies the solar panel operating voltage by using a proportional integral (PI) control loop, which steers the voltage to the desired value.**		

Part C (2Q x 15M =30 Marks)

Q No	**Solution**	**Scheme of Marking**	**Max. Time required for each Question**
5	Power and energy Power= 56.5 kW Energy= 678 kWh Power= 7.08 kW Energy= 84.8 kWh Total energy= 763 kW Average=572 kWh	5 marks for identification and 10 marks for computation	15
6	Energy stored= $1.36*10^{10}$ Joules Power developed= 377 kW	5 marks for identification and 10 marks for computation	15

Roll No.													

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

TEST – 2

Sem & AY: Odd Sem 2019-20
Course Code: EEE 318
Course Name: DISTRIBUTED GENERATION AND MICRO-GRID
Program & Sem: B.Tech (EEE) & VII (DE)

Date: 18.11.2019
Time: 9:30 AM to 10:30 AM
Max Marks: 40
Weightage: 20%

Instructions:

(i) *Read the question properly and answer accordingly.*
(ii) *Question paper consists of 3 parts.*
(iii) Scientific and Non-programmable calculators are permitted.

Part A [Memory Recall Questions]

Answer all the ~~Questions~~. ~~Each~~ Question carries four marks. (3Qx4M=12M)

1. Discuss the impact of micro-grid on market and how utilities must support them so as to encourage micro-grid participation in the power market.
(C.O.NO.3) [Comprehension]
2. List any four advantages of ultra-capacitors over battery
(C.O.NO.2) [Comprehension]
3. Discuss about all the flywheel system components. (C.O.NO.2) [Comprehension]

Part B [Thought Provoking Questions]

Answer both the Questions. Each Question carries ten marks. (2Qx10M=20M)

4. From utilisation point of view, the main advantage of using CHP sources in air conditioning applications is that the peak demand for air conditioning usually coincides with the utility peak demand for power. The idea is that the micro-turbine would generate power for the building while the waste heat in the exhaust would supply the absorption chiller. In that context explain the operation of absorption chillers.
(C.O.NO.3) [Comprehension]

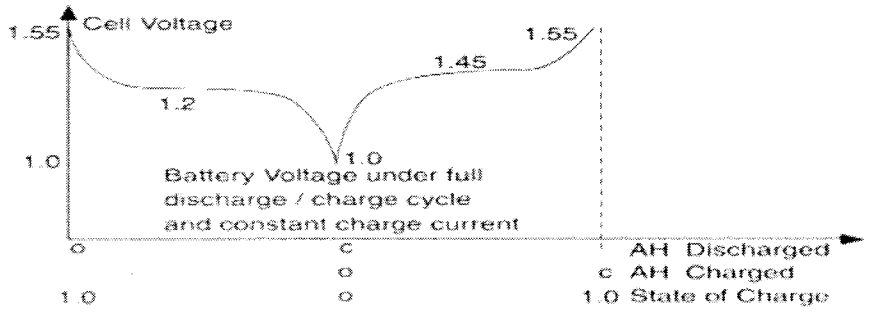
5. The backup energy storage devices that must be included in Micro-grids to ensure uninterrupted power supply are storage batteries, flywheels and ultra-capacitors. These devices should be connected to the DC bus of the Micro-grid and provided with ride-through capabilities during system changes. But a general discussion is going on that ultra-capacitors will completely overshadow batteries and flywheels as far as energy storage is concerned due to its benefits over them. In that context discuss any 2 applications of ultra-capacitors in grid systems (in details) along with its construction.

(C.O.NO.2) [Comprehension]

Part C [Problem Solving Questions]

Answer the Questions. Each Question carries eight marks. (1Qx8M=8M)

6. A Ni-Cd cell was tested in the laboratory by charging and discharging the cell and the following graph was observed. The voltage is maximum when the cell is fully charged (SOC = 1.0 or Ah discharged = 0). As the cell is discharged, the cell voltage (Vc) drops quickly to a plateau value of 1.2 V, which holds for a long time before dropping to 1.0 at the end of capacity (SOC = 0). In the reverse, when the cell is charged, the voltage quickly rises to a plateau value of 1.45 V and then reaches a maximum value of 1.55 V. The C/D ratio is 1.1. Assume battery capacity as C.



a) Identify the unknowns that could be computed from the given data and graph [3M] (C.O.NO.2) [Comprehension]

b) Compute the unknown quantities. [5M] (C.O.NO.2) [Comprehension]

SCHOOL OF ENGINEERING

Semester: 7th

Course Code: EEE 318

Course Name: Distributed Generation and micro-grid

Date: 18.11.2019

Time: 9:30 am to 10:30 am

Max Marks: 40

Weightage: 20%

Extract of question distribution [outcome wise & level wise]

Q.NO	C.O.NO	Unit/Module Number/Unit /Module Title	Memory recall type [Marks allotted] Bloom's Levels			Thought provoking type [Marks allotted] Bloom's Levels			Problem Solving type [Marks allotted]			Total Marks
			K			C			A			
1	3	3		4								4
2	2	2			4							4
3	2	2	4									4
4	3	3					10					10
5	2	2						10				10
6	2	2							3	5		8
	Total Marks											40

K =Knowledge Level C = Comprehension Level, A = Application Level

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be able to attempt and finally 20% of the questions must be such that only the bright students must be able to attempt.

Annexure- II: Format of Answer Scheme

SCHOOL OF ENGINEERING

SOLUTION

Semester: 5th

Course Code: EEE 318

Course Name: Distributed Generation and micro-grid

Date: 30.09.2019

Time: 9:30 am to 10:30 am

Max Marks: 40

Weightage: 20%

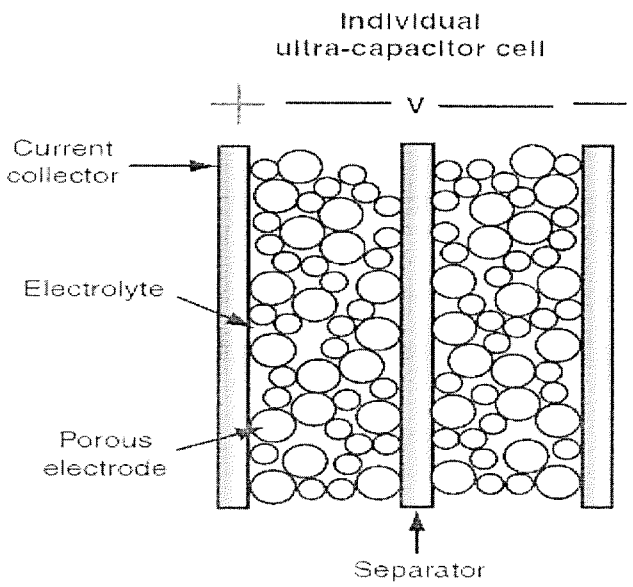
Part A (3Q x4 M =12 Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
1	For successful implementation of Micro-grids, the energy market must come forward with strong financial incentives for both Micro-grid owners and the power utilities. However, financial incentives can only be provided if there is a market for the ancillary services that the Micro-grid may provide to the power utility Some market reforms have already been taken place in some parts of the world. Ancillary services like voltage regulation have already been considered as trial programmes in some areas.	4 mark for explanation	5
2	i) Low cost per cycle ii) high power output iii) quick response iv) very high rates of charge and discharge v) high specific power vi) improved safety	1 mark for each point	5
3	• High-speed rotor attached to the shaft via a strong hub • Bearings with good lubrication system or with magnetic suspension in high-speed rotors • Electromechanical energy converter, usually a machine that can work as a motor during charging and as a generator while discharging the energy • Power electronics to drive the motor and to condition the generator power • Control electronics for controlling the magnetic bearings and other functions	1 mark for each point	5

Part B

(2Q x10 M = 20 Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
4	• The absorption chillers utilise a condenser, an evaporator and a thermal compressor system • It is similar to a conventional vapour compression system, except that it uses a thermal compressor in place of motorised compressor • The thermal compressor consists of an absorber, a generator and a small pump • It takes in low pressure refrigerant at its suction end and delivers a high-pressure refrigerant at its discharge end • The high-pressure refrigerant vapour (water or ammonia) passes from the generator of the compressor to the condenser • This vapour is then condensed into a liquid and the heat of condensation is released into the atmosphere • The liquid refrigerant passes through an expansion valve that reduces its pressure, consequently decreasing the boiling temperature • The low-pressure refrigerant is then moved into the evaporator, where the liquid boils by drawing heat from the chilled water stream flowing through the evaporator. • This in turn cools the chilled water. After this, the low-pressure refrigerant vapour is passed from the evaporator to the absorber	10 marks for explanation	15
5		5 marks for diagram 5 marks for explaining the points	15

	 i) Transmission line stability ii) Voltage regulation iii) Power quality and uninterruptible power iv) Area and frequency control		

Part C (1Q x 8M =8 Marks)

Q No	**Solution**	**Scheme of Marking**	**Max. Time required for each Question**
6	Energy output over the full discharge = 1.2*C Energy input required to restore full charge = 1.45 *1.1*C Average discharge voltage=1.2 V Average charge voltage= 1.45 V Energy efficiency= 1.2*C/(1.45*1.1*C) =0.75 or 75%	3 marks for finding average discharge voltage, average charge voltage and Energy efficiency	10

Roll No												

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

END TERM FINAL EXAMINATION

Semester: Odd Semester 2019-2020
Course Code: EEE 318
Course Name: DISTRIBUTED GENERATION AND MICRO-GRID
Program & Sem: B.Tech (EEE) & VII (DE-IV)

Date: 24 December 2019
Time: 9:30 AM to 12:30 PM
Max Marks: 80
Weightage: 40%

Instructions:

(i) Read the question properly and answer accordingly.

Part A [Memory Recall type Questions]

1. **Answer all the Questions. Each Question carries 2 marks. (10Qx2M=20M)**

i. The main function of the gateway is to provide necessary connectivity amongst devices by message _____,_____,_____,_____ (C.O.No.3) [Comprehension]
ii. The formula for calculating the energy efficiency of the battery in terms of C/D ratio and battery capacity is given as_____ (C.O.No.2) [Comprehension]
iii. The DFIG model is based on _____transformation (C.O.No.4) [Comprehension]
iv. Which of the following charging methods is used to counter the self-discharge of the battery_____ (C.O.No.2) [Comprehension]
v. An MPPT charge controller operates using an algorithm called_____ (C.O.No.4) [Comprehension]
vi. PLL stands for_____ (C.O.No.4) [Comprehension]
vii. As per article 450 of the NEC, overcurrent protection for transformer can be set as high as _____ of the transformer rating. (C.O.No.4) [Comprehension]
viii. Distributed generation (or DG) generally refers to small-scale _____range of electric power generators (C.O.No.1) [Comprehension]
ix. Solar power is expressed in terms of_____ (C.O.No.1) [Comprehension]
x. The model used for simulation and analysis of solar PV cell in MATLAB is _____ (C.O.No.4) [Comprehension]

Part B (Thought Provoking Questions)

Answer all the Questions. Each Question carries 10 marks. (3Qx10M=30M)

2. Photovoltaic (PV) plants consist of inverter-interfaced PV arrays. The inverter keeps the AC output voltage at the specified level irrespective of solar irradiance E (W/m^2) and ambient temperature T (K).Discuss about the development of a robust and very simple mathematical model of a PV array in MATLAB Simulink along with its equivalent circuit.

(C.O.No.4) [Comprehension]

3. A grid tie inverter must synchronize its output voltage with the grid voltage in terms of frequency, phase and amplitude. Ideally the grid maintains a power factor of 1, this number can vary within specified limits but it is usually very close to 1.This means that the current and voltage from the grid are ideally in phase as the current and voltage from the inverter. With the help of block diagram discuss about the special type of setup which is used to accomplish the synchronization of the inverter current to grid voltage.

(C.O.No.4) [Comprehension]

4. Using a solar panel or an array of panels without a controller that can perform Maximum Power Point Tracking (MPPT) will often result in wasted power, which ultimately results in the need to install more panels for the same power requirement. The solution to this problem is to use an MPPT with a proper control. With the help of block diagram explain the operation of MPPT with a controller and the algorithm to track the maximum power point at all instants.

(C.O.No.4) [Comprehension]

Part C (Problem Solving Questions)

Answer both the Questions. Each Question carries 15 marks. **(2Qx15M=30M)**

5. In a site wind is blowing at a steady velocity of 10 m/sec for 12 hours and 5 m/sec for 12 hours. The length of the blade is 10 m. The wind turbine has an efficiency of 0.3.Assume density of air as 1.2 kg/m^3

   a) Identify the unknown quantities that could be computed from the given data

   b) Estimate the unknown Quantities (C.O.No.1) [Comprehension]

6. In a tidal barrage located in Tamil Nadu, the height of the tide is 3 m and the area of the barrage is 300,000 m^2.The barrage drains in 10 Hours. Assume density of water as 1025 kg/m^3.

   a) Identify the unknown quantities that could be computed from the given data

   b) Estimate the unknown Quantities (C.O.No.1) [Comprehension]

SCHOOL OF ENGINEERING

GAIN MORE KNOWLEDGE REACH GREATER HEIGHTS

Semester: 7th

Course Code: EEE 318

Course Name: Distributed Generation and micro-grid

Date: 24.12.2019

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I hereby certify that all the questions are set as per the above guidelines.

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Reviewer Comment:

All Course outcomes are tested in the QP.

Annexure- II: Format of Answer Scheme

SCHOOL OF ENGINEERING

GAIN MORE KNOWLEDGE REACH GREATER HEIGHTS

SOLUTION

Semester: 7th | **Date**: 24.12.2019

Course Code: EEE 318 | **Time**: 9:30 to 12:30

Course Name: Distributed Generation and micro-grid | **Max Marks**: 80 | **Weightage**: 20%

Part A (10Q x2 M =20 Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question(in mins)
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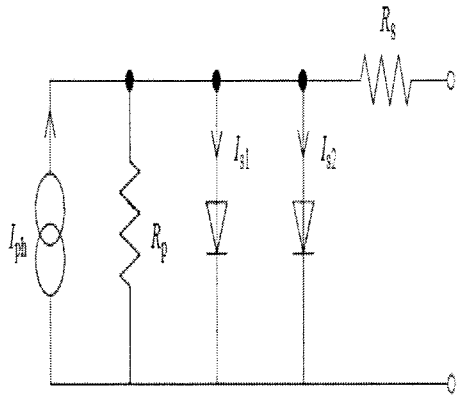
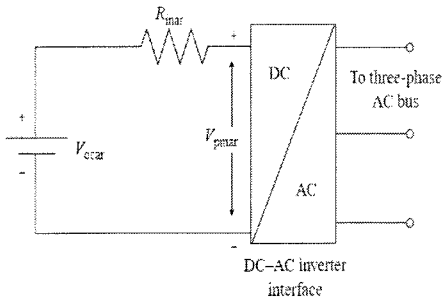
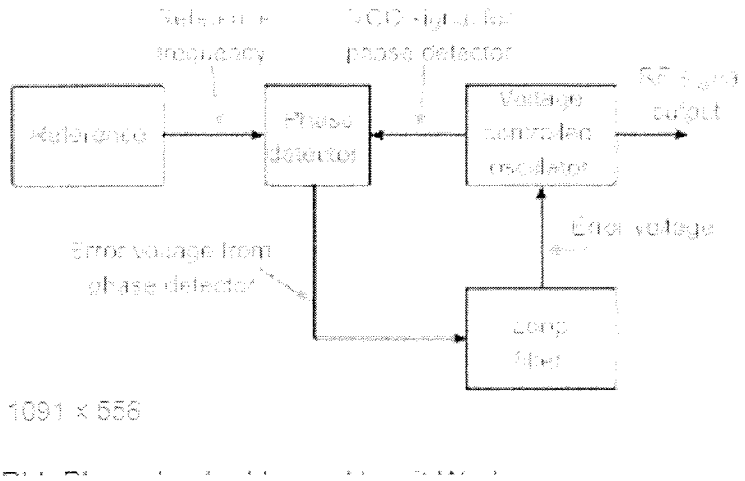
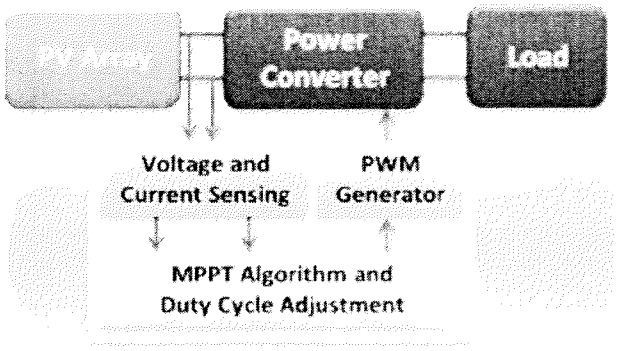
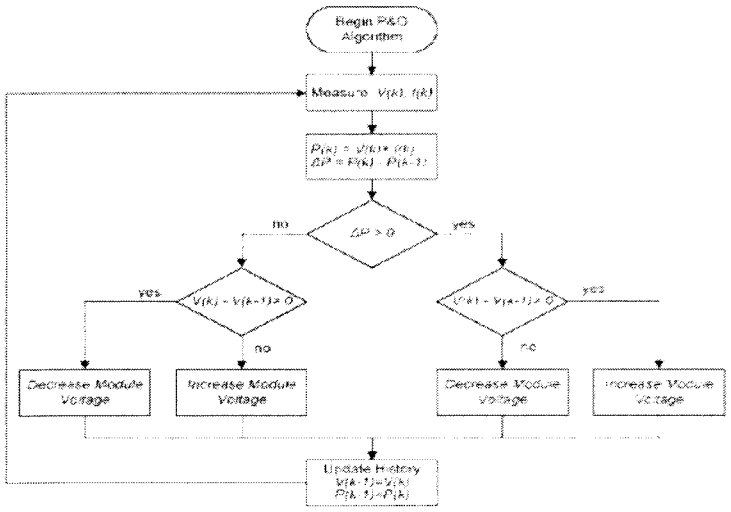
Part B (3Q x10 M = 30Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
2	 $I = I_{ph} - I_{s1}\left[e^{((V+IR_s)/V_t)} - 1\right] - I_{s2}\left[e^{((V+IR_s)/AV_t)}\right] - \frac{V+IR_s}{R_p}$	EQV Circuit-2M Model diagram-4 marks Equation and explanation-4M	**15**

	 • The model parameters Iph, Isl, Is2, A, Rs and Rp are calculated from the values of irradiance E (W/m2) and ambient temperature T (K) using the following empirical relationships obtained from experimental polycrystalline cell characterization as reported in earlier works • The PV array is modelled as a simple ideal DC voltage source with an internal resistance in series as shown in Figure E.2 such that the values of the ideal DC voltage source and the internal resistance are dependent on the values of E and T. • The DC source is connected to an inverter that converts the DC output of the PV to three-phase, 415 V, 50 Hz AC supply suitable for supplying the loads. The entire modelling and subsequent studies can be done in MATLAB Simulink		
3	A **phase-locked loop** or **phase lock loop (PLL)** is a control system that generates an output signal whose phase is related to the phase of an input signal. There are several different types; the simplest is an electronic circuit consisting of a variable frequency oscillator and a phase detector in a feedback loop. The oscillator generates a periodic signal, and the phase detector compares the phase of that signal with the phase of the input periodic signal, adjusting the oscillator to keep the phases matched. Keeping the input and output phase in lock step also implies keeping the input and output frequencies the same. Consequently, in addition to synchronizing signals, a phase-locked loop can track an input frequency, or it can generate a frequency that is a multiple of the input frequency. These properties are used for computer clock synchronization, demodulation, and frequency synthesis.explain with diagram	5 marks for diagram and 5 marks for explanation	**15**

			
4	  • **Using a solar panel or an array of panels without a controller that can perform Maximum Power Point Tracking (MPPT) will often result in wasted power, which ultimately results in the need to install more panels for the same power requirement.**	**Algorithm-4 M Explanation-4M Block diagram-2M**	**15**

	• **For smaller/cheaper devices that have the battery connected directly to the panel, this will also result in premature battery failure or capacity loss, due to the lack of a proper end of-charge procedure and higher voltage.** • **In the short term, not using an MPPT controller will result in a higher installation cost and, in time, the costs will escalate due to eventual equipment failure. Even with a proper charge controller, the prospect of having to pay 30-50% more up front for additional solar panels makes the MPPT controller very attractive** • **In this case, the algorithm modifies the solar panel operating voltage by using a proportional integral (PI) control loop, which steers the voltage to the desired value.**		

Part C (2Q x 15M =30 Marks)

Q No	**Solution**	**Scheme of Marking**	**Max. Time required for each Question**
5	Power and energy Power= 56.5 kW Energy= 678 kWh Power= 7.08 kW Energy= 84.8 kWh Total energy= 763 kW Average=572 kWh	5 marks for identification and 10 marks for computation	15
6	Energy stored= $1.36*10^{10}$ Joules Power developed= 377 kW	5 marks for identification and 10 marks for computation	15