Roll No.													

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

TEST 1

Sem & AY: Odd Sem. 2019-20
Course Code: MEC 411
Course Name: RENEWABLE ENERGY SYSTEMS
Program & Sem: B.Tech. (All Program) – VII OE

Date: 30.09.2019
Time: 1:00 PM to 2:00PM
Max Marks: 40
Weightage: 20%

Instructions:
(i) Draw neat sketches wherever necessary
(ii) Assume suitable data wherever necessary

Part A [Memory Recall Questions]

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

1. What are the advantages and limitations of Renewable energy sources? (C.O.NO.1) [Knowledge]
2. Define the following terms:
   i) Day length ii) Hour angle (C.O.NO.2) [Knowledge]
3. Enumerate the different types of Concentrating type collectors:- (C.O.NO.2) [Knowledge]

Part B [Thought Provoking Questions]

Answer both the Questions. Each Question carries eight marks. (2Qx8M=16M)

4. Calculate the number of day light hours in Srinagar on January 1 and July 1. The latitude of Srinagar is $34^0\ 05^1$ N. (C.O.NO.2) [Comprehension]
5. For New Delhi ($28^0\ 35^1$ N, $77^0\ 12^1$ E), calculate the Zenith angle of the Sun on February 2015.The standard IST latitude for India is $81^0\ 44^1$ E. Equation of time correction -14.28^1 (C.O.NO.2) [Comprehension]

Part C [Problem Solving Questions]

Answer the Question. The Question carries twelve marks. **(1Qx12M=12M)**

6. Data for a Flat plate collector used for heating are given below:

FACTOR	SPECIFICATION
Location & Latitude	Coimbatore $11^0\ 00^1$ N
Day & time	March 22, 14.30- 15.30(IST)
Average Intensity of solar radiation	560 W/m^2
Collector tilt	26^0
Heat removal factor for collector	0.82
Transmittance of glass	0.88
Absorptance of the glass	0.93
Top loss coefficient(U_L) for collector	7.95 W/m^2 ^{0}C
Collector fluid temperature	75^0C
Ambient temperature	25^0C

$$R_b = \frac{\cos(\phi - s)\cos\delta\cos\omega + \sin(\phi - s)\sin\delta}{\cos\phi\cos\delta\cos\omega + \sin\phi\sin\delta}$$

Calculate

(i) Collector efficiency (C.O.NO.2) [Application]

(ii) Declination Angle`

SCHOOL OF ENGINEERING

GAIN MORE KNOWLEDGE REACH GREATER HEIGHTS

Semester: Odd Sem. 2019-20
Course Code: MEC 411
Course Name: RENEWABLE ENERGY SYSTEMS
Program & Sem: B.Tech. (All Program) – VII OE

Date: 31.09.2019
Time: 1 HR
Max Marks: 40
Weightage: 20%

Extract of question distribution [outcome wise & level wise]

Q.NO.	C.O.NO (% age of CO)	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	1(10%)	1	4	-----	-----	4
2	1(10%)	1	4	-----	-----	4
3	2(10%)	2	4	-----	-----	4
4	2(20%)	2	-----	8	-----	8
5	2(20%)	2	-----	8	-----	8
6	2(30%)	2	-----	-----	12	12
	Total Marks		12(30%)	16(40%)	12(30%)	40

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.

Dr.A.M.Surendra kumar

Reviewer Commend :

Annexure- II: Format of Answer Scheme

SCHOOL OF ENGINEERING

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

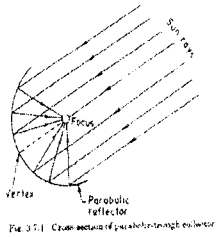
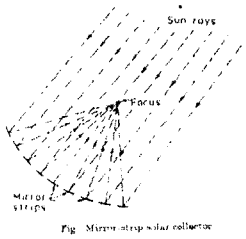
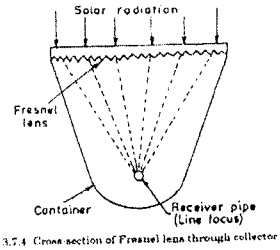
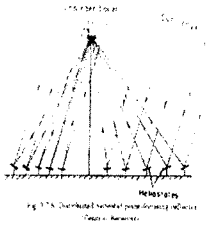
SOLUTION

Semester: Odd Sem. 2019-20
Course Code: MEC 411
Course Name: RENEWABLE ENERGY SYSTEMS
Program & Sem: B.Tech. (All Program) – VII OE

Date: 31.09.2019
Time: 1 HR
Max Marks: 40
Weightage: 20%

Part A (3Q x 4M = 12Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
1	One major advantage with the use of renewable energy is that as it is renewable it is therefore sustainable and so will never run out. Renewable energy facilities generally require less maintenance than traditional generators. Their fuel being derived from natural and available resources reduces the costs of operation. Even more importantly, renewable energy produces little or no waste products such as carbon dioxide or other chemical pollutants, so has minimal impact on the environment. **The Disadvantages(Limitations) of Renewable Energy** It is easy to recognize the environmental advantages of utilizing the alternative and renewable forms of energy but we must also be aware of the disadvantages. One disadvantage with renewable energy is that it is difficult to generate the quantities of electricity that are as large as those produced by traditional fossil fuel generators. Another disadvantage of renewable energy sources is the reliability of supply. Renewable energy often relies on the weather for its source of power. Hydro generators need rain to fill dams to supply flowing water. Wind turbines need wind to turn the blades, and solar collectors need clear skies and sunshine to collect heat and make electricity.. This can be unpredictable and inconsistent. The current cost of renewable energy technology is also far in excess of traditional fossil fuel generation..	Advantage– 2 Marks Limitations- 2 marks	5
2	DAY LENGTH: The Day length t_d (in hours) $t_d = (2\omega)/15 = \frac{2}{15}\cos^{-1}(-\tan\phi\tan\partial)$ where ϕ is the latitude of location and δ is the declination angle HOUR ANGLE (ω):The hour angle ω is the angle through which the earth must turn to bring the meridian of a point directly in line with the sun's rays., ω equivalent to 15^0 per hour It is measured from noon based on the LST It is positive in the morning and negative in the afternoon. $\omega = 15(12 - LST) = \cos^{-1}(-\tan\phi\tan\partial)$	Day length explanation – 2 Marks Hour angle explanation – 2 Marks	5

3	Types of Concentrating collectors: 1.Parabolic trough collector 2. Mirror strip reflector 3. Fresnel lens collector 4. Flat plate collector with adjustable mirrors 5. Compound parabolic concentrator    	**Each type explanation 1 Mark**	5

Part B (2Q x 8M = 16 Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
4	n = 1 and 182 respectively for Jan 1 and July 1 Declination angle(δ) = 23.01^0 and 23.12^0 respectively For Jan 1 t_d = 9.77 hours For July 1 t_d = 14.24 hours	For each δ = 2 Marks For each day length 2Marks	10
5	n = 51 for 20 Feb Declination angle(δ) = -11.58^0 Hour angle(ω) = -14.29^0 Zenith angle(Θ) = 42.55^0	For n = 2 Marks For δ = 2 Marks For ω) = 2 Marks For Θ = 2Marks	10

Part C (1Q x 12M = 12Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
6	δ = 0^0. R_b = 1.40 H_b = 350 W/m^2 hr S = 395 W/m^2 hr Useful gain = 33.21 W/m^2hr Collector efficiency = 8.87 %	For each step 2 Marks	15

Roll No.													

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

TEST 2

Semester: Odd Sem. 2019-20 | **Date**: 18.11.2019

Course Code: MEC 411 | **Time**: 1.00 PM to 2.00 PM

Course Name: RENEWABLE ENERGY SYSTEMS | **Max Marks**: 40

Program & Sem: B.Tech. (All Program) – VII OE | **Weightage**: 20%

Instructions:

(i) Draw neat sketches wherever necessary

(ii) Assume suitable data wherever necessary

Part A [Memory Recall Questions]

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

1. With neat diagram, Explain Solar water heating:-
(C.O.NO.2)[Knowledge]
2. Discuss the advantages and disadvantages of wind energy conversion systems. :
(C.O.NO.3)[Knowledge]
3. Enumerate the different types of Biomass:-
(C.O.NO.4)[Knowledge]

Part B [Thought Provoking Questions]

Answer both the Questions. Each Question carries eight marks. (2Qx8M=16M)

4. Calculate a) The volume of a biogas digester suitable for the output of for cows

b) The power available from the digester. Use the following data:

Retention time is 20 days

Dry matter consumed = 2kg/day

Biogas yield = 0.24 m^3/kg

Burner efficiency = 60%

Methane proportion is 0.8

Heat of combustion of methane =28 MJ/m^3 (C.O.NO.4)[Comprehension]

5. Wind at 1 ata pressure and 15^0C temperature has a velocity of 10 m/s. The turbine has diameter of 120 m and its operating speed is 40 rpm at maximum efficiency. Calculate

a) The total power density in the wind stream

b) The maximum obtainable power density-assuming efficiency of 40 %

c) The torque

d) Axial thrust (C.O.NO.3)[Comprehension]

Part C [Problem Solving Questions]

Answer the Question. The Question carries twelve marks. (1Qx12M=12M)

6. Design a PV water pumping systems for daily requirement of 6000 liters of water from a depth of 32 m Use the following data:

Solar PV module used: BP380 from BP Solar

Peak power = 80 W

Voltage at peak power = 17.6 V

Current at peak power = 4.55 A

Operating factor = 0.75

Mismatch factor = 0.85

Pump-Motor efficiency = 30%

Water density = 1000 kg/m^3

Sunshine hours = 4h/day

Note: Suitable data may assumed wherever be required. (C.O.NO.2)[Application]

SCHOOL OF ENGINEERING

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

Semester: Odd Sem. 2019-20
Course Code: MEC 411
Course Name: RENEWABLE ENERGY SYSTEMS
Program & Sem: B.Tech. (All Program) – VII OE

Date: 18.11.2019
Time: 1 HR
Max Marks: 40
Weightage: 20%

Extract of question distribution [outcome wise & level wise]

Q.NO.	C.O.NO (% age of CO)	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	2(10%)	2	4	-----	-----	4
2	3(10%)	3	4	-----	-----	4
3	4(10%)	4	4	-----	-----	4
4	4(20%)	4	-----	8	-----	8
5	3(20%)	3	-----	8	-----	8
6	2(30%)	2	-----	-----	12	12
	Total Marks		12(30%)	16(40%)	12(30%)	40

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.

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Dr.A.M.Surendra kumar

Reviewer Commend :

Annexure- II: Format of Answer Scheme

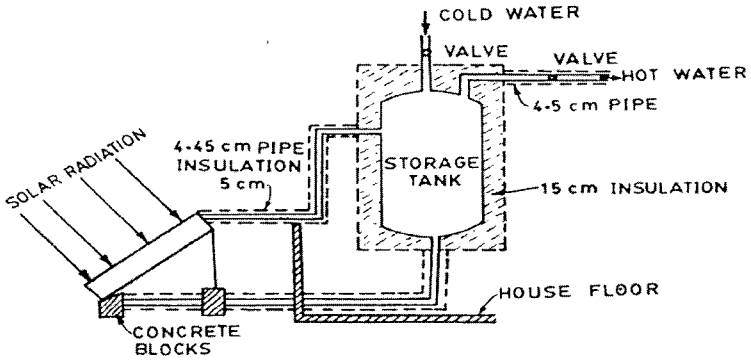
SCHOOL OF ENGINEERING

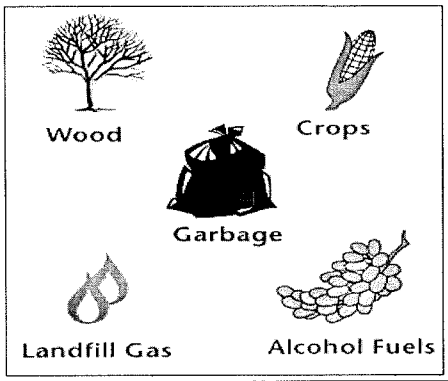
SOLUTION

Semester: Odd Sem. 2019-20
Course Code: MEC 411
Course Name: RENEWABLE ENERGY SYSTEMS
Program & Sem: B.Tech. (All Program) – VII OE

Date: 18.11.2019
Time: 1 HR
Max Marks: 40
Weightage: 20%

Part A (3Q x 4M = 12Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
1	A typical system for domestic water heating is shown in Fig. (5.2.3).  Fig. 5.2.3. A typical solar water heater.	Figure – 2 Marks Explanations - 2 marks	5
2	**Advantages:** • Wind is free, wind farms need no fuel. • Produces no waste or greenhouse gases. • The land beneath can usually still be used for farming. • Wind farms can be tourist attractions. • A good method of supplying energy to remote areas. **Disadvantages:** • The wind is not always predictable - some days have no wind. • Suitable areas for wind farms are often near the coast, where land is expensive. • Some people feel that covering the landscape with these towers is unsightly. • Can kill birds - migrating flocks tend to like strong winds. However, this is rare, and we tend not to build wind farms on migratory routes anyway. • Can affect television reception if you live nearby. • Can be noisy. Wind generators have a reputation for making a constant, low, "swooshing" noise day and night, which can drive you nuts.	Advantages– 2 Marks Disadvantages – 2 Marks	5

3	Types of Biomass  	**Types 1 mark each**	**5**

Part B (2Q x 8M = 16 Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
4	The volume of a biogas digester = 3.2 m^3 The power available from the digester = 300 W	4 Marks each	10
5	The total power density = 613 W/m^3 The maximum obtainable power density =363 The torque = 347 N- m Axial thrust = 255 N	2 Marks each	10

Part C (1Q x 12M = 12Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
6	Hydraulic energy = 840 Wh Power rating of motor = 0.75 HP Required number of PV module =823.87 / 80 =11	For each step 2 Marks	15

Roll No												

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

END TERM FINAL EXAMINATION

Semester: Odd Semester: 2019 - 20 | **Date**: 26 December 2019

Course Code: MEC 411 | **Time**: 9:30 AM to 12:30 PM

Course Name: RENEWABLE ENERGY SYSTEMS | **Max Marks**: 80

Program & Sem: B.Tech. (All Program) – VII (OE –II) | **Weightage**: 40%

Instructions:

(i) Draw neat sketches wherever necessary

(i) Assume suitable data wherever necessary

Part A [Memory Recall Questions]

Answer all the Questions. Each Question carries 4 marks. **(5Qx4M=20M)**

1. a. Name any two types of non-conventional energy source: - [1M](C.O.No.1)[Knowledge]

   b. Full form of MPPT: - [1M](C.O.No.2)[Knowledge]

   c. Biogas is predominantly _____ gas [1M](C.O.No.4)[Knowledge]

   d. What are the different layers of geothermal fields? [1M](C.O.No.5)[Knowledge]

2. What are the different energy available sources from Ocean? (C.O.No.5)[Knowledge]

3. What is meant by Seebeck Thermo Electric effect? (C.O.No.4)[Knowledge]

4. What is the basic principle of Wind energy conversion? (C.O.No.3)[Knowledge]

5. What are the major application of Thermoelectric Power Generator? (C.O.No.4)[Knowledge]

Part B [Thought Provoking Questions]

Answer all the Questions. Each Question carries 8 marks. **(5Qx8M=40M)**

6. A deep ocean wave of 2.5 m peak to peak appears at a period of 10 seconds. Find the wavelength, phase velocity and power associated with the wave:- (C.O.No.5)[Comprehension]

7. For a thermoelectric power generator following parameters are given:

   Temperature of the hot reservoir of source: 700^0K

   Temperature of the sink: 350^0K

Figure of merit for the material: $2 \times 10^{-3}\ k^{-1}$

Determine the efficiency of the thermoelectric generation. What will be its Carnot efficiency?

(C.O.No.5)[Comprehension]

8. A plant produces 1200 litres of biogas daily. Calculate the size of gasholder for a biogas plant that feeds a constant load during following periods daily. (C.O.No.4)[Knowledge]
   - From 6.00 to 8.00 hours (2 hrs)
   - From 12.00 to 14,oo hours (2 hrs)
   - From 19.00 to 21.00 hours (2 hrs)
9. A PV system feeds a D C motor to produce 1 HP power at the shaft. The motor efficiency is 85%. Each module has 36-multi crystalline silicon solar cells arranged in 9 x 4 matrix. The cell size is 125 mm x 125 mm and cell efficiency is 12 %. Calculate the number of modules required in the PV array. Assume global radiation incident as 1 kW /m^2 (C.O.No.2)[Knowledge]
10. Calculate the angle made by the beam radiation on December 1, at 9.00 A.M, solar time for the location at $28^0\ 35^1$ N. The collector is tilted at an angle of latitude pus 10^0, with the horizontal and pointing due south. (C.O.No.1)[Knowledge]

$$\cos \Theta = \cos (\emptyset - s) \cos d' \cos \omega + \sin(\emptyset - s) \sin \delta$$

Part C [Problem Solving Questions]

Answer all the Questions. Each Question carries 10 marks. **(2Qx10M=20M)**

11. A 100 MW vapor power dominated system uses saturated steam from a well with a pressure of 28 bar steam enters the turbine at 5.6 bar and condenses at 0.14 bar. The cooling tower exits is at 21^0C. Calculate the necessary steam in k/hr. and the pant efficiency:

The enthalpy from steam table is as follows

Enthalpy of saturated steam at 28 bar = 2802 kJ/kg

Enthalpy of wet steam at 0.14 kg/cm^2 = 2211 kJ/kg

Enthalpy of water coming from the condenser at pressure of 0.14 kg/cm^2 = 220 kJ/kg

Enthalpy of cooling water coming from the cooling tower at 21^0C = 88 kJ/kg

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

12. A single basin type tidal plant has a basin area of 3 km^2. The tide has an average range of 10 m. Power is generated during flood cycle only. The turbine stops operating when the head on it falls below 3 m. Calculate the average power generated by the plant in single filling process of the basin, if the turbine generator efficiency is 65%. Estimate average annual energy generation of the plant:-

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

SCHOOL OF ENGINEERING

END TERM FINAL EXAMINATION

Extract of question distribution [outcome wise & level wise]

Q.NO	C.O.NO (% age of CO)	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	1(1.25%)+ 2(1.25%+ 4(1.25%)+ 5(1.25%)	Module 1 +2+4+5	4			4
2	5(5%)	Module 6	4			4
3	4(5%)	Module 7	4			4
4	3(5%)	Module 3	4			4
5	4(5%)	Module 7	4			4
6	5(10%)	Module 6		8		8
7	5(10%)	Module 7		8		8
8	4(10%)	Module 4		8		8
9	2(10%)	Module 2		8		8
10	1(10%)	Module 2		8		8
11	4(12.5%)	Module 5			10	10
12	5(12.5%)	Module 6			10	10
	Total Marks		20	40	20	80

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

C.O WISE MARKS DISTRIBUTION:

CO 01: 11.25 MARKS,CO 02: 11.25 MARKS,CO 03: 5MARKS,

CO 04:31.25 MARKS :CO 05:41.25 MARKS

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

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

Faculty Signature: 

Reviewer Commend:

Answer Scheme

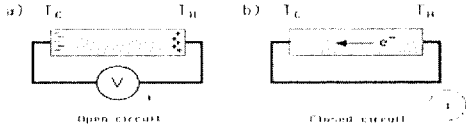
SCHOOL OF ENGINEERING

SOLUTION

Semester: Odd Sem. 2019-20
Course Code: MEC 411
Course Name: RENEWABLE ENERGY SYSTEMS
Program & Sem: B.Tech. (All Program) – VII OE -II

Date: 26 Dec 2019
Time: 9.30 A M -12.30 PM
Max Marks: 80
Weightage: 40 %

Part A (5Q x 4M = 20Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
1	a) Solar & Wind b) Maximum Power Point Tracker(MPPT) c) Methane d) Magma, Igneous rock, permeable reservoir, impermeable rock	½ each 1mark 1mark 1 mark	5 minutes
2	Energy is available from the ocean by • Tapping ocean currents • Using the ocean as a heat engine • Tidal energy • Wave energy	1 mark each	5 minutes
3	• In 1821, Thomas Seebeck found that an electric current would flow continuously in a closed circuit made up of two dissimilar metals, if the junctions of the metals were maintained at two different temperatures. 	4 marks	5 minutes
4	• A wind mill is a machine for wind energy conversion, a wind turbine converts the K.E of wind motion to mechanical energy transmitted by the shaft and generator further converts it to electrical energy.	4 marks	5 minutes
5	a) Water/Beer Cooler b) Cryogenic IR Night Vision c) Cooled Car Seat d) Laser/OE Cooling	4 marks	5 minutes

Part B (5Q x 8M = 40 Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
6	Wave length = $2\pi g/\omega^2$ = 156.14 m Phase velocity = v = g/ω = 61.32 kW/m	To calculate Wave length = 3 marks To calculate Phase velocity=2marks	15 minutes

	Power in wave = $[\rho g^2/8\pi]\ a^2\ T$ = 537.2 MWh/m	To calculate Power = 3 marks	
7	$M = \left[1 + \frac{Z(T_H + T_C)}{2}\right]^{\frac{1}{2}}$ = 1.38 $\eta_{Ideal} = \left(\frac{T_H - T_C}{T_H}\right)\left[\frac{M-1}{M + \frac{T_C}{T_H}}\right]$ = 10.1 % Carnot efficiency = 50%	To calculate M = 3 marks To calculate ideal efficiency =3 marks To calculate Carnot efficiency = 2marks	20 minutes
8	Gas production rate = 1200 /4 = 50 litres /hr Gas consumption rate = 1200 /6 = 200 ltres/ h Gas holder size = Vg(l) = 200-50) x 2 = 300 litres	To calculate production rate = 3 marks To calculate consumption rate =3 marks To calculate holder size = 2 marks	20 minutes
9	Electrical power = 1x 746 0.85 = 877.65 W Cell area in one module = $9x4x125x125x10^{-6}$ Output = 1000x0.5625xnx012 = 67.5n = 877.65 n = number of modules = 13	2 marks 2 marks 2 marks 2 marks	20 minutes
10	Declination = -22.11 ^{0} $\delta = 23.45 \sin\left[\frac{360}{365}(284 + n)\right]$ cos Θ = cos (Ø- s) cos d cos ω + sin(Ø – s) sin δ = 44.72^0	To calculate n = 1 mark To calculate δ = 3 marks To calculate angle = 4 marks	20 minutes

Part C (2Q x 10M = 20Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
11	Steam rate = m_s = 0.844 x 10 6 kg/hr Plant efficiency = 21.29 %	Flow diagram = 2marks T-s diagram = 2marks steam rate = 3 marks Plant efficiency - 3 marks	30 minutes
12	Average power generated = ½ ρAg ($R^2 - r^2$) = 39.93 MW Average annual energy generation = 1.75 x 10^8 kWh	5 marks each	30 minutes