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SEAT No._____

No. of Printed Pages: 02

(68)

SARDAR PATEL UNIVERSITY

M.Sc. Renewable Energy Examination (Semester –III)

Thursday, 02-11-2017, Time: 02.00 to 05.00P.M

PS03CSYT01: Solar Photovoltaic Technology

Total Marks: 70

Q-1 Select most appropriate answer **(8x1=8)**

1. The average solar power incident on the earth surface is about
   a. 1000 $mWcm^{-2}$.
   b. 100Wcm^{-2}.
   c. 1kW m^{-2}.
   d. 2000 Wcm^{-2}
2. A PV module is:
   a. dozens of photovoltaic cells connected together
   b. wired in series
   c. wired in parallel
   d. all answers a, b, c
3. The effect of PV panel temperature
   a. Increasing the temperature reduces the band gap.
   b. PV panels are more efficient at lower temperatures,
   c. When silicon solar cell gets hotter, it generates more current but less voltage
   d. All the above
4. The voltage of single solar cell :
   a. 1.0V
   b. 1.1V
   c. 5W
   d. 0.5V
5. The major disadvantage for solar power generation_____
   a) Lack of availability.
   b) Large area requirement.
   c) Variable power
   d) High cost
6. The contact grid_____
   a. Is between the anti-reflective coating and the P-type silicon.
   b. Is between the anti-reflective coating and the N-type silicon.
   c. Is the third layer of a solar panel
   d. Answer a and c correct
7. The battery _____
   a. Is used in every solar energy system.
   b. Is not used in every solar energy system.
   c. Stores solar energy for use.
   d. Answer b and c correct
8. Thin film solar cells are
   a. Amorphous Si.
   b. Cadmium telluride
   c. Copper-Indium Selenide
   d. All the above

Q-2 Answer **any seven** questions **(7x2=14)**

1. Define solar grade silicon?
2. Define n-type and p-type semiconductors?
3. What are the major components of PV power generation system?
4. Explain the current losses in a silicon solar cell?

5. Define concentrating solar cell.
6. How does a battery work?
7. How are solar cells doped?
8. Explain copper indium gallium selenide solar cell
9. Explain Tandem solar cells

Q-3 A) Classify different types of solar PV cells with their efficiencies and its cost. Which solar panel type is best? (06)

Q-3 B) Explain principle of solar cell? How it is distinguished from a photo cell? Enumerate the advantage and disadvantage of solar photovoltaic technology. (06)

OR

Q-3 B) Describe the metallurgical grade silicon purification technology (06)

Q-4A) Explain amorphous silicon cells and its production technology with diagram (06)

Q-4B) Write in detailed about typical solar cell fabrication process with suitable figures. (06)

OR

Q-4B) Describe growth of silicon crystals by Czochralski method with neat diagram (06)

Q-5 A) Describe thin film solar cell with neat sketch diagram (06)

Q-5 B) Describe lead acid battery energy storage and its anode and cathode reactions (06)

OR

Q-5 B) Explain types of batteries in detailed with suitable example (06)

Q-6 A) Describe the rural electrification in (i) Domestic Supply mode (Stand-alone) (ii) Health care system (iii) Street lighting (iv) battery charging. (06)

Q-6B) Describe grid connected solar photovoltaic power generation system and its various methods. (06)

OR

Q-6B) Describe any case studies of grid connected solar photovoltaic power generation system. (06)

End

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SEAT No._____ No. of Printed Pages : 03

[627]

Sardar Patel University

M.Sc. (Renewable Energy) **Semester: Third**

Course Title: Numerical Method and Computer Programming

Course Code: PS03CSYT02

Day and Date: Monday, 06-11-2017 **Time:** 02:00 AM to 5:00 PM

Total Mark: 70

Note: **1. All the questions are compulsory**
2. Figures on the right bracket indicated marks

Q-1: **Select the correct answer** **(10 x 1 = 10)**

i. The first approximation to the root in bisection method is given by .....
   a. $x_1 = (a + b)^2$ c. $x_1 = (a + b)^{1/2}$
   b. $x_1 = ½ (a + b)$ d. $x_1 = (a + b/2)$

ii. The process of finding the value of y corresponding to any value $x=x_i$, between x_0 and x_n is called
   a. Bisection method c. Interpolation
   b. Error propagation d. None of above

iii. Successive approximation in Secant method is .....
   a. $x_{n-1}=x_n -[x_{n-1})/f(x_n) -F(x_{n-1})] \times f(x_n)$ c. $x_{n-1}=xn -[x_n-x_{n-1}/f(x_n) -F(x_{n-1})]$
   b. $x_{n-1}=x_n -[x_n-x_{n-1}/f(x_n)] \times f(x_n)$ d. $x_{n-1}=x_n -[x_n-x_{n-1}/f(x_n) -F(x_{n-1})] \times f(x_n)$

iv. Approximation in iterative method is given by .....
   a. $x_n=\varphi(x_{n-1})$ c. $x_n=\varphi_n(x_{n-1})$
   b. $x_{n-1}=\varphi(x_{n-1})$ d. $x_n=\varphi(x_n)$

v. Straight line can be fitted to the given data by the method of least square
   a. $y = a + bx$ c. $y= a + bx + cx^2$
   b. $y= a^{ebx}$ d. $y= ax + bx^2$

vi. Newton Raphson successive approximation are $x_3, x_4, \ldots \ldots x_{n+1}$
   a. $X_{n+1}=x_n -f(x_n)/f'(x_n)$ c. $\log_{10}y= a\log_{10}e+ bx\log_{10}e$
   b. $\log_{10}y=\log_{10}a+x\log_{10}b$ d. none of the above

vii. Parabola can be fit to the given data by equation
   a. $y = a + bX +cX^2$ c. $y = ax^2 + b/x$
   b. $y - a = bx^c$ d. None of the above

viii. ..... can be used to calculate derivatives of a function at some assigned value of x from given set of values (xi, yi)
   a. Least square method c. Numerical differentiation
   b. Interpolation method d. None of the above

ix. Which is known as parabolic formula
   a. Simpson's 1/3 rule c. Simpson's 3/8 rule
   b. Trapezoidal rule d. Euler's rule

x. $y_{n+1}= yn+hf(xn,yn)$ is the iterative formula for
   a. Euler's method c. Taylor method
   b. Milne Method d. Principle of least square

Q-2: Solve **any Eight** **(8 x 2.5=20)**

i. Find the positive real root of $x log_{10} x = 1.2$ using bisection method.
ii. Find the root of equation $x^3 - 2x - 5=0$ using secant method
iii. Find the positive root of x4-x=10 correct to three decimal places using Newton Raphson method.
iv. Find the missing value from the first difference provided

y_x	0	-	-	-	-	-
Δy_x	0	1	2	4	7	11

v. One entry in the following table is incorrect and y is cubic polynomial in x. Use the difference table to locate the error

x:	0	1	2	3	4	5	6	7
y:	25	21	18	18	27	45	76	123

vi. Find the cubic polynomial which takes the following values by Newton forward interpolation formula. Hence evaluate f(4).

x	0	1	2	3
y	1	2	1	10

vii. If P is the pull required to lift a load W by means of pulley block, find a linear law of the form P= mW + c connecting P and W, using following data, compute P when W=150 kg.

P	12	15	21	25
W	50	70	100	120

viii. An experiment gave the following values. It is known that v and t are connected by logarithmic relation $v=at^b$. Find the best possible value for a and b

v (ft/min)	350	400	500	600
t (min)	61	26	7	2.6

ix. Find f'(10) from the following data using Newton's divided difference formula

x	3	5	11	27	34
f(x)	-13	23	899	17315	35606

x. Apply Gauss elimination method to solve the equations $x + 4y - z = -5$; $x + y - 6z = -12$; $3x - y - z = 4$

Q-3 (A): Using the bisection method, find the approximate root of the equation $\sin x = \frac{1}{x}$, that lies between x=1 and x=1.5 (measured in radians), carry out computation up to 7th stage. **(05)**

Q-3 (B): Find the real root of the equation $cosx = 3x - 1$ correct to three decimal places using (i) Iterative method (ii) Aitken's Δ^2 method **(05)**

OR

Q-3 (B): Using Newton's iterative method, find real root of $x log_{10} x = 1.2$ correct to five decimal places

Q-4 (A): Given the value as below, evaluate f(9) using Lagrange's formula **(05)**

x	5	7	11	13	17
f(x)	150	392	1452	2366	5202

Q-4 (B): Using Newton's backward differences formula, construct an interpolation polynomial of degree 3 for the data: f (-0.75) =-0.0718125, f (-0.5) =-0.02475, f (-0.25) =0.3349375, f (0) =1.10100. Hence find f (-1/3). **(05)**

OR

Q-4 (B): The table gives the distance in nautical miles of the visible horizon for the given height in feet above the earth surface. Find value of y when-

(i) x=160 ft (Newton's forward interpolation); x=410 ft (Newton's backward interpolation)

x	100	150	200	250	300	350	400
y	10.63	13.03	15.04	16.81	18.42	19.90	21.27

Q-5 (A): Find the second degree parabola to the following data **(05)**

x	1.0	1.5	2.0	2.5	3.0	3.5	4.0
y	1.1	1.3	1.6	2.0	2.7	3.4	4.1

Q-5 (B): Predict the mean radiation dose at an altitude of 3000 feet by fitting an exponential curve to the given data **(05)**

Altitude (x)	50	450	780	1200	4400	4800	5300
Dose of radiation (y)	28	30	32	36	51	58	69

OR

Q-5 (B): Find the curve of form $y = ae^{bx}$ to the following data

x	0	1	2	3
y	1.05	2.10	3.85	8.30

Q-6 (A): Given that : **(05)**

x	1.0	1.1	1.2	1.3	1.4	1.5	1.6
y	7.989	8.403	8.781	9.129	9.451	9.750	10.031

Find $\frac{dy}{dx}$ and $\frac{d^2y}{dx^2}$ at (a) x=1.1 and (b) x= 1.6

Q-6 (B): Evaluate $\int_0^6 \frac{dx}{1+x^2}$ by using **(i)** trapezoidal rule **(ii)** Simpson's 1/3 rule and **(iii)** Simpson's 3/8 rule **(05)**

OR

Q-6 (B): Solve Taylors series method of third order equation $\frac{dy}{dx} = \frac{x^3+xy^2}{e^x}$, y(0)=1 for y at x=0.1, x=0.2 and x=0.3

—X—

(135) SEAT No._____ No. of Printed Pages : 2

Sardar Patel University

M.Sc. Renewable Energy **Semester: Third**

Course Title: Advances in Biomass Gasification

Course Code: PS03CSYT03

Day and Date: Wednesday, 08-11-2017 **Time:** 02:00 PM to 5:00 PM

Total Marks: 70

Note: 1. All the questions are compulsory
2. Figures on the right bracket indicated marks

Q-1 Select the correct answer **(10 x 1=10)**

i. Fermentation process of sugar based feedstock results in formation of .....
a) Ether b) Methanol
c) Ethanol d) All of the above

ii. Temperature range at which biomass gasification takes place is .....
a) 30-70 °C b) 1000–1300 °C
c) 250–330 °C d) 380–530 °C

iii. Biomass consist of .....
a) Cellulose b) Lignin
c) Hemicelluloses d) All of the above

iv. ..... type generates less tar
a) Cross draft gasifier b) Downdraft gasifier
c) Updraft gasifier d) Both b and c

v. Ventury scrubber captures large particles by .....
a) Impaction b) Impingement
c) Both a and b d) None of the above

vi. Spark engine operating on producer gas may achieve thermal efficiency between .....
a) 15-25 b) 25-30
c) 18-20 d) None of the above

vii. The primary goal of fast pyrolysis is to maximize the production of .....
a) Char b) Liquid or bio-oil
c) Gases d) All of the above

viii. Supercritical water has properties of .....
a) 374.29 °C and 22.089 MPa b) 374.29 °C and 33.089 MPa
c) 474.29 °C and 22.089 MPa d) None of the above

ix. The optimum engine operation on producer gas is obtained by advancing the ignition timing.....
a) 3-5 ° b) 8-15 °
c) 15-20 ° d) None of the above

x. Electrostatic precipitator have central high voltage negative electrode with .....
a) 10-30 kV b) 100-300 kV
c) 1000-3000 kV d) None of the above

Q-2 Answer any Eight questions. **(8x2.5=20)**

1. What are the primary fuels produced from biomass and their application.

(P.T.O.)

2. A biomass gasifier is fed wit 200 kg wood/h. the wood has LHV 17 MJ/kg. The gasifier produces 2.50 m3/kg of wood. The gas volumetric compositions are CO-18%; CO_2-13%; H_2-14%; CH_4-2%; H_2O-6% and N_2-47%. Calculate LHV of gas and cold gas efficiency.
3. What is biomass? Explain in brief about the constituents of biomass cells
4. Give the advantages of torrefaction
5. Explain bubbling bed pyrolyser with suitable diagram.
6. Working principle of cyclone with suitable diagram
7. Explain working of ventury scrubber with suitable digram
8. Find the heat of formation of sawdust, the heating value of which is given as 476 kJ/mol. Assume its chemical formula to be $CH_{1.35}O_{0.617}$, heat of formation of CO_2= -393.5 kJ/mole, O_2= 0 kJ/mole, and H_2O= -241.5 kJ/mole.
9. Write note on gasifier suitable for power generation using producer gas.
10. Write note on gas mixture for producer gas engines with diagram

Q-3(A): A air steam gasifier data includes the mass composition of the feedstock as- C-66.5%, O-7%, H-5.5%, N-1%, Mositure-7.3%, Ash-12.7%, LHV-28.4% and volume composition of producer gas: - CO-27.5%, CO_2-3.5%, CH_4-2.5%, H_2-15%, N_2-51.5%. The air supply rate is 2.76 kg/kg feed, steam supply is 0.117 kg/kg feed, moisture content is 0.01 kg of H2o per kg of dry air, and ambient temperature is 20 °C. Find- **(i).** Amount of gas produced per kg feed, **(ii).** Amount of moisture in product gas. (5)

Q-3(B): What are the different gasification processes and reactions occurred during gasification (5)

OR

Q-3(B): What are the different methods of biomass conversion? Explain biochemical method in detail with suitable diagram

Q-4(A): Explain working and operation of bag house filter in details with schematics (5)

Q-4(B): Explain in-situ tar reduction methods for reduction of tar in producer gas (5)

OR

Q-4(B): Explain with suitable diagram **(i)** Sieve plate scrubber **(ii)** Spray tower scrubber

Q-5(A): What are the different methods for increasing power of producer gas fueled engines (5)

Q-5(B): Write about the engine selection for producer gas (5)

OR

Q-5(B): Write about the engine life and engine wear using producer gas

Q-6(A): What is pyrolysis? Explain in details types of pyrolysis. (5)

Q-6(B): Explain with suitable diagram- (5)

(a) Rotating cone pyrolyser (b) Ultra rapid pyrolyser

OR

Q-6(B): What is torrefaction? Explain the mechanism of torrefaction

(134) SEAT No._____ No. of Printed Pages: 02

(134)

SARDAR PATEL UNIVERSITY

M.Sc. Renewable Energy Examination (Semester –III)

Friday, 10-11-2017, Time: 02.00 to 05.00P.M

PS03ESYT03: MODELLING OF SOLAR THERMAL SYSTEM

Total Marks: 70

Q-1 Select most appropriate answer (8x1=8)

1) The duct losses are equal to the integrated losses over the inlet and outlet ducts
   a) True
   b) False
2) The rate at which energy is lost from the storage tank to the surroundings at T_a' is
   a) $(UA)_s (T_s-T_a')$
   b) (T_s-T_a)
   c) (T_a-T_s)
   d) None of the above
3) Solar saving fraction is the fraction of the net reference load that is met by solar energy
   a) $f_{ns} = 1 - L_A/L_{ns}$
   b) $L_{ns} = 24 (UA)ns (DD)$
   c) $L=24(UA)(DD)$
   d) all the above
4) The projected area is the projection of the net glazing area on a vertical plane normal to the azimuth of the glazing
   a) True
   b) False
5) Which type of heat transfer medium used in solar drying
   a) Air
   b) Water
   c) Oil
   d) Metal hydride
6) Which of the following radiation decolouring food items in open sun drying
   a) UV radiation
   b) Solar radiation
   c) Electromagnet radiation
   d) Visible radiation
7) The f-chart method provide for estimating the _____ supplied by solar energy
   a) Total heating load
   b) Total cooling load
   c) Both heating and cooling load
   d) None of the above
8) Passive solar design
   a) Is useful in all climates
   b) Depends on proper house orientation
   c) Can save your money
   d) All the above

Q-2 Answer any seven questions (7x2=14)

1. Define solar saving fraction.
2. Draw the schematic diagram of different type of non-porous absorber air heater
3. List the disadvantages of open sun drying
4. State the utilizability factor in solar collector system
5. Define load collector ratio and total load coefficient.
6. Define solar aperture?
7. Define concentration ratio
8. Define with example for active and passive solar system

(P.T.O.)

9. Write the need for f-chart method

Q-3 A) Describe heat exchanger factor of solar collector with neat schematic diagram. (06)
Q-3 B) Explain performance of serial and parallel connection for solar arrays with neat sketch diagram. (06)

Or

Q-3 B) Describe duct and pipe loss of solar collector system. (06)

Q-4 A) List of different type of air heater. Explain thermal analysis of solar air heater with neat sketch diagram. (06)

Q-4 B) Describe experimental setup, methodology and thermal analysis for open sun drying system. (06)

Or

Q-4 B) Air at 28°C approaches a 0.8m long and 0.5m wide flat plate (at 40°C) with an approach velocity 4m/s. Determine the total rate of heat transfer from the plate to the air. The viscosity of air is 1.578×10^{-5}. The flow being laminar, the heat transfer coefficient is given by the equation $h = \left(\frac{K}{L}\right)(0.664)Re^{1/2}\ Pr^{1/3}$. The value of P_r =0.713, k=0.026, $Re = 2.027 \times 10^5$ (06)

Q-5 A) Design of active solar water heating system using f-Chart method. (06)
Q-5 B) Explain in detailed for the φ, f- Chart method for a design of closed-loop solar system. (06)

Or

Q-5 B) Describe the hourly utilizability of solar flat plate collector system (06)
Q-6 A) Explain monthly energy stream for direct-gain building with neat sketch diagram. (06)
Q-6 B) Explain monthly energy flows for a collector-storage wall building with neat sketch diagram. (06)

Or

Q-6 B) Give brief explanation for active and passive solar system with neat sketch diagram. (06)

End