Bharatiya Vidya Bhavan's

Sardar Patel College of Engineering

(A Government Aided Autonomous Institute)
Munshi Nagar, Andheri (West), Mumbai – 400058.

Endsem
November 2016

Max. Marks: 100 | Duration: 4 Hrs

Class: M.Tech Thermal Engg. | Semester: I | Program: M.Tech Mechanical with Thermal Engg. subjects

Name of the Course: Design & Analysis of Thermal Systems | Course Code : MTTH103

Master file.

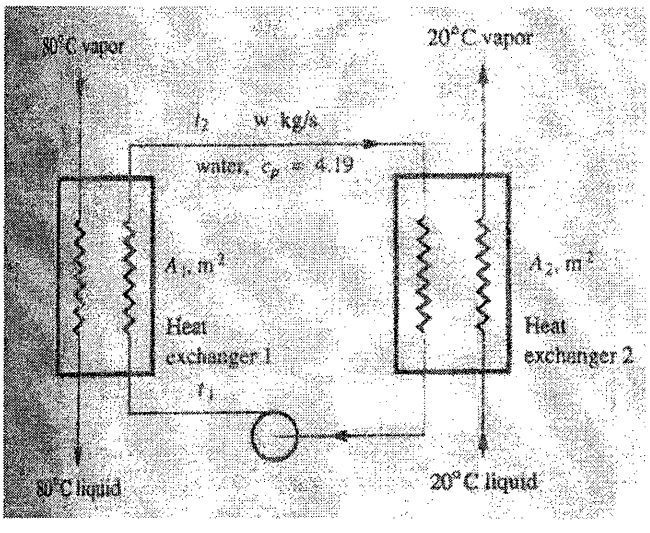
Instructions:
1. Question No.1 is compulsory.
2. Attempt any four out of remaining six questions.
3. Assume suitable data if necessary.

Q. No.			Module No./CO. No.	Max. Marks
Q.1	(A)	Explain in brief Analysis and Selection	01/01	05
	(B)	Explain the Formulation of Design Problems for Thermal Systems.	02/01	05
	(C)	Explain basic features of modeling?	03/03	05
	(D)	Different types of Taxes in India?	05/04	05
Q.2	(A)	Explain with example conceptual design in thermal systems.	02/02	10
	(B)	Using the data from table given below for h_g at t = 40,60,80 and 100 °C, develop a third degree equation by (a) Polynomial Method (b) Lagrange Interpolation Method Also find h_g at 70 °C using both methods.	04/03	10
Q.3	(A)	Write Short Notes on: i) Analog Modeling ii) Mathematical Modeling	03/03	10
	(B)	A cylinder 0.16 m in diameter is to be mounted in a stream of water in order to estimate the force on a tall chimney of 1 m diameter which is subject to wind of 33 m/s. Calculate: (a) the speed of the stream necessary to give dynamic similarity	04/03	10

t °C	40	60	80	100
h_g kJ/kg	2574.4	2609.7	2643.8	2676

		between the model and chimney, & (b) the ratio of forces. Chimney: $\rho = 1.12$ kg/m^3 $\mu = 16 \times 10^{-6}$ kg/ms Model: $\rho = 1000$ kg/m^3 $\mu = 8 \times 10^{-6}$ kg/ms		
Q.4	(A)	Explain dimensional analysis and its importance in physical modeling.	04/03	10
	(B)	Consider a plane wall of thickness 2L. Internal energy is generated at a uniform rate of $\dot{q}$ per unit volume throughout this wall. It is exposed to a fluid temperature T_f with a constant heat transfer co-efficient h on both surfaces. Develop an equation for temperature distribution in wall. Write all assumptions made.	03/02	10
Q.5	(A)	Give the formulation of a general optimization problem and explain the following terms: i) Objective function ii) Constraints	06/04	10
	(B)	A project engineer wants to buy a thermal system for its manufacturing facility. It can buy old system by paying Rs. 50,000 now and 10 yearly payments of Rs. 2000 each, starting at the end of the first year. It can also buy a new system by paying Rs. 1,00,000 now and five yearly payments of Rs. 1,000, starting at the end of sixth year. The salvage value is Rs. 10,000 and Rs. 20,000 respectively for old and new system. The nominal interest rate is 10%. Which is the better option financially?	05/04	10
Q.6	(A)	Write short notes on: i) Bonds ii) Stocks	05/04	10
	(B)	Two Heat exchangers in a circulating water loop, as shown in figure 1 transfer heat from a fluid condensing at 80°C to a fluid boiling at 20°C. The required rate of heat transfer is 65kW., the U value of both heat exchangers is 0.03 kW/(m^2 K), the first cost of the heat exchangers is \$80/m^2 of heat transfer area, and the present worth of the lifetime pumping cost is \$ 12000w. Develop the objective function for the total present cost of the system along with any constraint equation(s).	06/04	04
	(C)	A cylindrical storage tank is to be designed for storing hot water from a solar energy collecting system. The volume is given as 2m^3	07/04	06

		and the surface area is to be minimized in order to minimize the heat loss to the environment. Solve this optimization problem as constrained problem with Lagrange's Multiplier method.		
Q.7	(A)	Find the minimum of the function $f = \lambda^5 - 5\lambda^3 - 20\lambda + 5$ by Fibonacci search method in the interval (0, 5).	07/04	10
	(B)	An open cylindrical vessel is to be constructed to transport $80m^3$ of grain from a warehouse to a factory. The sheet metal used for the bottom and sides cost \$80 and \$10 per square meter, respectively. If it costs \$1 for each round trip of the vessel, find the dimensions of the vessel for minimizing the transportation cost. Assume that the vessel has no salvage upon completion of the operation.	07/04	10



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End Semester
November 2016

Max. Marks: 100 | Duration: 4 Hours
Class: M.Tech Thermal Engg. Semester: I | Program: M.Tech. Thermal Engg.
Name of the Course: Energy Storage Systems | Course Code : MTTH114

Master file.

Instructions:

1. Q.1 is compulsory.
2. Attempt any four out of remaining six questions
3. Assume Suitable Data Wherever Necessary.
4. Include Diagrams Appropriately.
5. Use of Steam Table is allowed.

Q. No			Max. Marks	CO. No.	Module Number
1	A.	Explain Periodic Storage and the Problem of Load Levelling.	10	2	1
	B.	Describe the Alternate Approaches to Hydrogen Energy Storage.	5	1	2
	C.	Illustrate the Temperature Dependence of G, H and S with an example.	5	3	3
2	A.	What are the Effects of Thermal Entropy and Configurational Entropy on Thermal Energy Storage?	7	3	3
	B.	Describe Short Term Transients.	5	2	1
	C.	Explain the Mechanism of Sensible and Latent Thermal Energy Storage Along with the Material Properties Which Affect the Same. Explain with the Help of Graphs and a Few Examples.	8	1	4
3	A.	John Throttles Steam at 7 MPa and 450°C to a Pressure of 3 MPa. Evaluate the Entropy Generated if the Process is a Steady Flow Process. Does his Action Satisfy the Principle of Entropy Increase?	6	3	3
	B.	Explain: i. Inorganic Phase Change Materials. ii. Organic Phase Change Materials. iii. Quasi Latent Phase Change Materials.	 6 4 4	1	4

4	A.	Summarize the Energy Storage phenomena in: i. Living Biomass and Hard Biomass. ii. Synthetic Liquid Fuels. iii. Gaseous Fuels Stored as Liquids.	5 5 5	1	5
	B.	Compare the Above Three Modes of Energy Storage.	5	4	5
5	A.	Describe Rotational Kinetic Energy Storage in Flywheels.	10	1	6
	B.	Explain the Energy Storage Applications for Utility Load Levelling, Peak Shaving and Transients. Compare the Different Systems and Enlist the Respective Advantages and Limitations.	10	4	2
6	A.	How can the Variations in Energy Demand be Reduced?	10	2	1
	B.	Derive an Expression for the Energy Stored in a Material Placed Under a Magnetic Field.	10	4	6
7	A.	Explain: Negative Electrodes in Other Rechargeable Aqueous Systems.	10	4	7
	B.	Illustrate with the Help of Equations, Examples and Graphs, the Phenomenon of Energy Storage in Compressed Gas.	10	1	6

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Munshi Nagar, Andheri (West), Mumbai – 400058.
End Semester
November 2016

Subject: Energy Resources Conversion and Management
Max. Marks: 100
Course: M.Tech. Thermal Engineering

Duration: 4 Hours
Semester: I

Master file.

Instructions:

1. Question No. ONE is Compulsory.
2. Solve any FOUR out of remaining Six questions.
3. Assume Suitable Data Wherever Necessary.
4. Include Diagrams Appropriately.
5. Use of Steam Tables is Allowed

Question No		Maximum Marks	Course Outcome Number	Module Number
1	A. Illustrate the Working of SOFC and the Energy Storage Systems for the Same.	8	3	5
	B. Compare the Li Ion Battery with the Nickel Cadmium Battery.	6	1	6
	C. Explain the Closed Cycle MHD Power Generation Plant.	6	4	5
2	A. Outline the Energy Scenario of India.	7	1	1
	B. How Does LPG and Refinery Gas Compete as Fuels for Household and Industrial Purposes?	7	2	2
	C. Reproduce the Dry Steam and Wet Steam Geo Thermal Systems.	6	4	3
3	A. Describe the Coolants Used in a Nuclear Power Plant.	8	2	3
	B. Derive the Expression for the Concentration Ratio of a Solar Collector. Show the Same With a Sketch.	6	4	3
	C. Explain the Scenario of Biomass Usage in India.	6	3	3
4	A. A piston-Cylinder Device Contains 0.05 kg of steam at 1 MPa and 573 K. Steam Expands to 200 kPa and 323 K. Heat Losses to surroundings is 2kJ. $T_o = 25°C$ and $P_o = 100kPa$. Determine: i) Exergy of the Steam at Initial and Final States, ii) Exergy Change of the Steam, iii) Exergy Destroyed and iv) Second Law Efficiency of the Process.	12	2	4
	B. Illustrate Pinch Analysis with Diagrams and an Example.	8	2	4

5	A. Given: STAG Plant: 200 MW Power GT: Delivery Air Taken by Compressor at 300K and 1 bar, PR=8 Max Temp. Limited to 800°C ST: GT Exhaust Heated to Further 800°C Steam Gen. at 50 bar and 600°C Exhaust Gas Temp. Limited at 200°C to avoid Condensation of Corrosive Gases Condenser Pr. = 0.05 bar η_{isen} = 100% Cp (air and gas) = 1kJ/kg-K Cv (air and gas) = 0.714kJ/kg-K CV of Fuel Used = 42000 kJ/kg To Find: i) $\eta_{thermal}$ of Each Plant and the Combined Plant as a Whole ii) Ratio of Air Supplied to Steam Generated in the Boiler	15	3	5
	B. Enlist the Factors Significant in WECS Turbine Blade Design. Analyze Each Factor.	5	1	5
6	A. Enlist and Elaborate the Methods for Efficient Utilization of Solid Fuels With Sketches.	7	3	1
	B. What is the Nature of Crudes in India?	8	1	1
	C. Summarize the Characteristics of Solid, Liquid and Gaseous Manufactured Fuels Along with Their Applications.	5	3	1
7	A. Installed Capacity = 210 MW, Capital Cost = Rs. 10000/kW, Fixed Cost = 13% of Inv. Cost, Variable Cost = 1.3 * Full Cost at Full Load. Find the Generating Cost When Plant Runs at: i) Full Load, ii) Half Load. (Var. Cost is Proportional to Energy Produced)	8	4	7
	B. Discuss the Parameters for Design and Selection of Co-Generation Systems.	6	3	7
	C. Describe Sensitivity Analysis for Waste Heat Recovery System.	6	2	7

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End Semester

November 2016

Course: MTTH112 Advanced Combustion Techniques **Duration:** 4 Hours

Max. Marks: 100 **Semester:** I

Program: M.Tech. Thermal Engineering

Instructions:

1. **Question No. 1 is a Compulsory.**
2. **Any FOUR** from the Next Six Questions Can be Attempted.
3. Assume Suitable Data Wherever Necessary.
4. Include Diagrams Appropriately.
5. Use of Steam Table is allowed.

Master file.

Q. No.		Max. Marks	CO No.	M No.
1	A. Reproduce The Concept Of Spontaneous Ignition Temperature. Derive An Equation Based On The Thermal Mechanism Of Combustion. Show The Graph Depicting The Three Equilibrium Points. Also, Give The Difference Between Ignition, Deflagration And Detonation.	8	1	5
	B. Solve: A Gas Contains 25% Methane, 45% Hydrogen, 10 % Carbon Monoxide, 10 % Carbon Dioxide And 10 % Nitrogen By Volume. Evaluate The Limits Of Inflammability Of The Gas.	4	3	5
	C. How Is The Limit Of Inflammability Of A Fuel Determined Practically?	4	2	5
	D. What Are The Factors Which Influence Flame Stability? Mention The Conditions Of Stability. Explain its Effect on Burner Design.	4	4	5
2	A. Evaluate The Flue Gas Analysis, The AFR By Weight And Volume Of Combustion Products At 250°c When A Coal Sample Of The Following Composition Burns With 50% Excess Air: • Proximate Analysis, Percent, Air Dried: M-8, A-20, VM-28.5, C-43.5 • Ultimate Analysis, Percent DAF: C-81, H-4.6, N-1.8, S-0.6, O-12	10	3	1
	B. Under Complete Combustion And With A Coal Burning Rate Of 3T/Hr , Find The Capacity Of Air Blower Used.	3	3	1
	C. Using The Calculated Orsat Analysis Of The Flue Gas, Determine Percent Excess Air Used In Combustion.	4	3	1
	D. Compute The Dew Point Of Gases.	3	3	1

3	A. What Are The Methods Available To Measure Laminar Burning Velocity?	5	2	2
	B. How Would The Loss Of Combustibles With Flue Gas And Ash Be Accounted For?	5	2	2
	C. Explain The Concept Of Theoretical Air Required For Combustion.	5	2	2
	D. What Is The Mechanism Of Soot Formation In A Diffusion Flame? Describe It Briefly.	5	1	4
4	A. Discuss Adiabatic Flame Temperature And Specify The Expressions For Evaluating The Same.	7	1	3
	B. Define And Summarize The Significance Of Heat Of Combustion, Enthalpy Of Combustion System And Equilibrium Constants Of Combustion Reactions.	7	1	3
	C. What Do You Mean By Diffusion Flame? How Is It Different From Premixed Flame?	6	2	3
5	A. Describe Surface Combustion And Pulsating Combustion.	5	1	4
	B. Illustrate How The Flame Structure Is Affected By Various Factors Such As Equivalence Ratio, Initial Pressure, Initial Temperature, AFR And Type Of Fuel.	5	2	4
	C. State The Burner Design Factors. What Are The Factors To Be Considered For Burner Locations?	5	4	6
	D. Paraphrase The Following Terms: • Slow Combustion • Thermal Mechanism	5	1	4
6	A. Compare Any Two Types Of Mechanical Stokers.	6	4	6
	B. Explain One Type Of An Atomizing Burner With A Descriptive Sketch.	6	4	6
	C. What Are The Three T's Of Combustion? Explain The Effects Of Each On Combustion Quality.	4	2	4
	D. Explain The Kinetics ofOf Solid Fuel Combustion.	4	1	4
7	A. Analyze The Flamelet Model And Its Applications In The Steady Flamelet Modelling. How Does it Find Application for Burner Design?	8	4	7
	B. Differentiate Between The Eddy Diffusion Model, The Eddy Break Up Model And The Finite Rate Chemistry Model In Fluent For Combustion Modelling. How Does it Find Application for Burner Design?	8	4	7
	C. Summarize The Quasi Dimensional Modelling For A Homogeneous Charge Compression Ignition Engine.	4	2	7