M.Tech. Mech - Sem I.

LD
24/11/17

Bharatiya Vidya Bhavan's

Sardar Patel College of Engineering

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

Endsem
November 2017

Max. Marks: 100

Duration: 3 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		Write Notes on *any four*:		
	(A)	Explain in brief Analysis and Synthesis	01/01	05
	(B)	Computer Aided Design of Thermal Systems	02/01	05
	(C)	Numerical Modeling.	03/03	05
	(D)	Different curve fitting methods	04/03	05
	(E)	Role of depreciations in economics of thermal systems	05/04	05
	(F)	Explain any one search method in optimization.	06/04	05
Q.2	(A)	Describe the methodology used in formulation of a thermal system.	02/02	10
	(B)	What is importance of validation in mathematical modeling? What are the different methods for validating a problem?	03/03	10
Q.3	(A)	List the characteristics of thermal systems? Give one example of each?	01/02	10
	(B)	What are different material properties and material characteristics for thermal systems?	02/01	10
Q.4	(A)	Give the governing equation and the boundary condition equations for a steady state, one dimensional heat conduction with internal heat generation problem as shown in **figure 1**. Derive the mathematical model for the Temperature distribution in thickness 2L.	03/03	10
	(B)	Using the data from table given below for ν_g at t = 0, 40 and 60°C develop a second degree equation by (a) Lagrange Interpolation Method (b) Method of least squares (Contd. on next page)	04/03	10

M. Tech. & Mech - Sem I

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		Also find v_g at 50 °C using both methods. t °C: 0 | 40 | 60 v_g kJ/kg: 206.3 | 19.55 | 7.679		
Q.5	(A)	A stationary sphere in water moving at a velocity of 1.6m/s experiences a drag of 4N. Another sphere of twice the diameter is placed in a wind tunnel. Develop π groups using Buckingham – π theorem for the given problem. Find the velocity of the air and the drag which will give dynamically similar conditions. The ratio of kinematic viscosities of air and water is 13, and the density of air 1.28 kg/m^3.	04/03	12
	(B)	Derive the present worth of a uniform series of amounts. Also derive the series present worth factor (p/a). The monthly cost of energy for a facility is $ 3,000 (starting at the end of first year). Taking the loan of $ 16,000 for this payment at interest rate of 10% compounded monthly, calculate the number of months required to repay the amount.	05/04	08
Q.6	(A)	In a food-processing system, the refrigeration and storage unit is to be purchased. A new unit can be obtained by paying $100,000 on delivery and 5 annual payments of $25,000 at the end of each year, starting at the end of the first year. A used and refurbished unit can be obtained by paying $60,000 at delivery and 10 annual payments of $20,000 at the end of each year. The salvage value of the new unit is $75,000 and that of the used one is $50,000, both being disposed of at the end of 10 years. The interest rate is 9%, compounded annually. Which alternative is financially more attractive?	05/04	12
	(B)	A refrigeration system is to be designed to provide 5 kW of cooling at –5°C, with the ambient at 25°C. If the dimensions of the region that has to be cooled are fixed, list the design variables and requirements for an acceptable design. Suggest an objective function that may be employed for optimization. Also, give the constraints, if any, in the problem.	07/04	08
Q.7	(A)	Explain Objective function and Constraints? Give different physical quantities that are often maximized and minimized in optimization of thermal systems?	06/04	10
	(B)	In the processing plant as shown in **figure 2**, the operation is essentially one of concentrating material A. The concentrator receives a raw material consisting of 40% A by mass and can supply two products of 60% and 80% A, respectively. The flow rate	07/04	10

M.Tech. Mech. Sem I

of the raw material is designated x_1 metric tons per day and the 60% and 80% products are designated x_2 and x_3, respectively. The capacity of the loading facility imposes the constraint:

$$2x_2 + 3x_3 \leq 60$$

The prices are:

Amount	x_1	x_2	x_3
Price per metric ton	₹ 40	₹ 80	₹120

Setup the objective function and give the constratins.
Using Simplex method determine the combination of raw material and products that results in maximum profit for the plant.

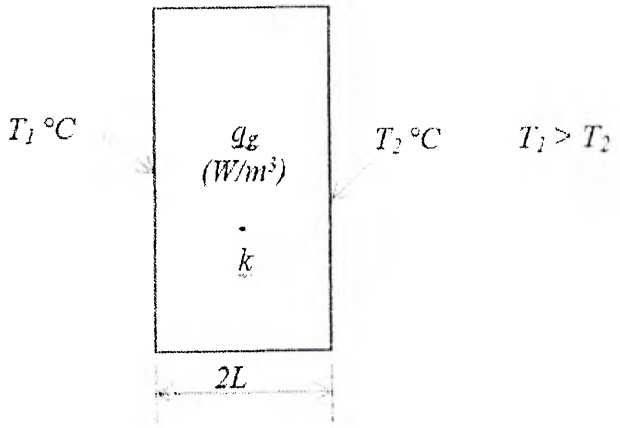

Figure 1: Steady state heat conduction with internal heat generation

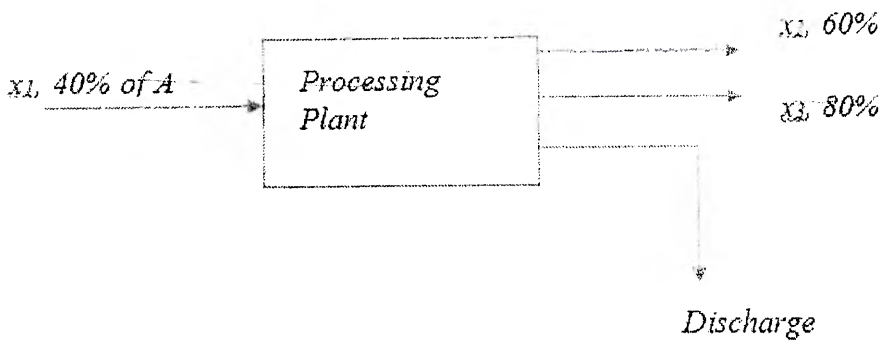

Figure 2: Concentrator in Processing Plant

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First year M.Tech (Thermal) Sem I.

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END SEM
Nov 2017

Program: **M.Tech in Thermal Engineering**
Class: **First Year M.Tech. (Thermal)**
Course code: **MTTH102**
Name of the Course: **Energy Resources and conversion Management**

Date: **Nov 2017**
Duration: **3 Hr.**
Max. Points: **100**
Semester : **I**

Master file.

Instructions:

- Question No 1 is **compulsory**. Attempt any four questions out of remaining six.
- Answers to all sub questions should be grouped together.
- Use of Steam tables and Mollier Diagram is permitted.
- Assume suitable data if necessary.

		Max. Points	CO No.	Module No.
Q1	a) Define the following terms: i. Hour angle ii. Declination iii. Surface azimuth angle iv. Zenith angle v. Air Mass	(5)	1	3
	b) In the absence of friction and other irreversibility, can a heat engine have an efficiency of 100%? explain	(5)	2	4
	c) What are the main sources of irreversibility in an actual Rankine cycle?	(5)	2	5
	d) Write a note on energy storage by Hydrogen	(5)	3	6
Q2	a) The gravimetric analysis of a hydrocarbon fuel indicates 86% C and 14% H. Determine % analysis of combustion products by mass and by volume when 50% excess air is supplied for combustion.	(12)	1	1
	b) With a neat sketch, explain the working of a Fluidized Bed Boiler. What are its advantages	(8)	2	5
Q3	a) Calculate the overall loss coefficient for an absorber with a single glass cover having the following specifications: Plate-to-cover spacing 25mm Plate emittance 0.95 Ambient air and sky temperature 10^0C Wind heat transfer coefficient 10 W/$m2\ ^0C$ Mean plate temperature 100^0C Collector tilt 45^0 Glass emittance 0.88 Back-insulation thickness 50mm Insulation conductivity 0.045 W/$m\ ^0C$	(16)	1	3

M.Tech. Thermal. Sem I.

Collector bank length 10m and width 3m
Collector thickness 75mm
Edge insulation thickness 25mm
Cover temperature 48^0C

b) Calculate the sunset hour angle in Mumbai on 3rd March and 3rd Jun. also calculate corresponding solar time — 2 *1* *3*

c) What would be the solar constant for Venus? Mean Venus – sun distance is 0.72 times the mean sun – earth distance. Assume sun to be a black body emitter at 5777 K — 2 *1* *3*

Q4 a) Two solar water heating systems have the following cost comparison. Which system is more economical if the money is worth 10percent per year? — (10) *1* *7*

Cost Components	System (A)	System (B)
First cost (Rs.)	20,000	30,000
Uniform end of year maintenance (Rs.)	4,000	3,000
Salvage value (Rs.)	500	1,500
Service life, years	2	3

b) With a neat sketch explain the principle of energy storage by flywheel — (10) *3* *6*

Q5 a) Explain Hydrodynamic power generation — (10) *2* *5*

b) Explain refinery process in detail with neat sketch. — (10) *1* *2*

Q6 a) In a combined power and process plant the boiler generates 21,000 kg/h of steam at a pressure of 17 bar and temperature 230^0 C. A part of the steam goes to a process heater which consumes 132.56 kW, the steam leaving the process heater0.957 dry at 17 bar being throttled to 3.5bar. the remaining steam flows through an h.p. turbine which exhaust at a pressure of 3.5 bar.The exhaust steam mixes with the process steam before entering the l. P. Turbine which develops 1337.5 kW. At the exhaust the pressure is 0.3 bar and the steam is 0.912 dry. Draw the line and T-S diagram of the plant and determine — (12) *2* *5*

i. The steam quality at the exhaust of the h.p. turbine
ii. The power developed by the h.p. turbine
iii. The isentropic efficiency of the h.p. turbine — (8) *1* *7*

b) Write a note on Clean Development Mechanism (CDM)

Q7 a) A lump of ice with a mass of 1.5 kg at an initial temperature of 260 K melts at the pressure of 1 bar as a result of heat transfer from the environment. After some time has elapsed the resulting water attains the temperature of the environment. After some time has elapsed the resulting water attains the temperature of the environment, 293 K. Calculate the entropy production associated with this process. The latent heat of fusion of ice is 333.4 kJ/kg, the specific heat of ice and water are 2.07 and 4.2 kJ/ kg K respectively, and ice melts at 273.15 K — (12) *2* *4*

b) Explain biogas production method in detail with neat sketch — (8) *1* *2*

M.Tech. Thermal. Sem I

Data Sheet

$$Nu_L = 1 \; ; \; Ra_L \cos\beta < 1708$$

$$Nu_L = 1 + 1.446\left(1 - \frac{1708}{Ra_L \cos\beta}\right); \; 1708 < Ra_L \cos\beta < 5900$$

$$Nu_L = 0.229\,(Ra_L \cos\beta)^{0.252}; \quad 5900 < Ra_L \cos\beta < 9.23 \times 10^4$$

$$Nu_L = 0.157\,(Ra_L \cos\beta)^{0.285}; \quad 9.23 \times 10^4 < Ra_L \cos\beta < 10^6$$

Temperature t °C	*Density* ρ kg/m^3	*Absolute Viscosity* μ Ns/m^2	*Kinematic Viscosity* ν m^2/s	*Thermal Diffusivity* α m^2/s	*Prandtl Number* Pr	*Specific Heat* c_p J/kgK	*Thermal Conductivity* k W/mK
DRY AIR							
– 50	1.584	14.61×10^{-6}	9.23×10^{-6}	12.644×10^{-6}	0.728	1013	0.02035
– 40	1.515	15.20×10^{-6}	10.04×10^{-6}	13.778×10^{-6}	0.728	1013	0.02117
– 30	1.453	15.69×10^{-6}	10.80×10^{-6}	14.917×10^{-6}	0.723	1013	0.02198
– 20	1.395	16.18×10^{-6}	11.61×10^{-6}	16.194×10^{-6}	0.716	1009	0.02279
– 10	1.342	16.67×10^{-6}	12.43×10^{-6}	17.444×10^{-6}	0.712	1009	0.02361
0	1.293	17.16×10^{-6}	13.28×10^{-6}	18.806×10^{-6}	0.707	1005	0.02442
10	1.247	17.65×10^{-6}	14.16×10^{-6}	20.006×10^{-6}	0.705	1005	0.02512
20	1.205	18.14×10^{-6}	15.06×10^{-6}	21.417×10^{-6}	0.703	1005	0.02593
30	1.165	18.63×10^{-6}	16.00×10^{-6}	22.861×10^{-6}	0.701	1005	0.02675
40	1.128	19.12×10^{-6}	16.96×10^{-6}	24.306×10^{-6}	0.669	1005	0.02756
50	1.093	19.61×10^{-6}	17.95×10^{-6}	25.722×10^{-6}	0.698	1005	0.02826
60	1.060	20.10×10^{-6}	18.97×10^{-6}	27.194×10^{-6}	0.696	1005	0.02896
70	1.029	20.59×10^{-6}	20.02×10^{-6}	28.556×10^{-6}	0.694	1009	0.02966
80	1.000	21.08×10^{-6}	21.09×10^{-6}	30.194×10^{-6}	0.692	1009	0.03047
90	0.972	21.48×10^{-6}	22.10×10^{-6}	31.889×10^{-6}	0.690	1009	0.03128
100	0.946	21.87×10^{-6}	23.13×10^{-6}	33.639×10^{-6}	0.688	1009	0.03210

$$\cos\theta = \sin\delta\sin\phi\cos\beta - \sin\delta\cos\phi\sin\beta\cos\gamma + \cos\delta\cos\phi\cos\beta\cos\omega + \cos\delta\sin\phi\sin\beta\cos\gamma\cos\omega + \cos\delta\sin\beta\sin\gamma\sin\omega$$

$$G_{dn} = G_{sc}\left(1 + 0.033\cos\frac{360\,n}{365}\right)$$

$$\cos\theta = \cos\theta_z\cos\beta + \sin\theta_z\sin\beta\cos(\gamma_s - \gamma)$$

$$\delta = 23.45\sin\left(360\frac{284 + n}{365}\right)$$

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Munshi Nagar, Andheri (West), Mumbai – 400058

END SEMESTER EXAMINATION,

November 2017

Program: M.Tech. (Mechanical) Thermal Engineering | **Date: 20/11/2017**

Duration: 3 hrs.

Course code: MTTH101 | **Max.Marks: 100**

Name of the Course: Transport Phenomena | **Semester: I**

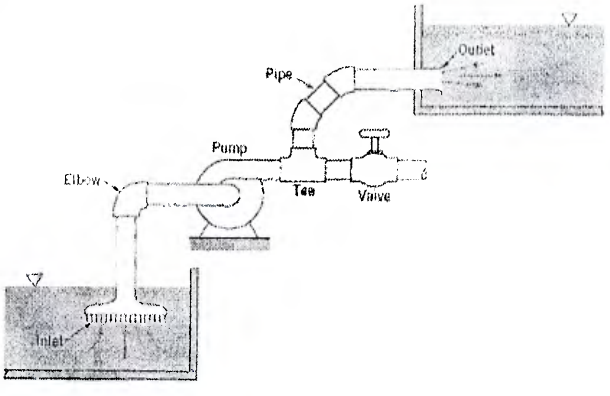
Instructions:

- Question 1 is compulsory. Attempt any FOUR questions out of SIX.
- Make any suitable assumption if needed.
- Draw neat diagrams where ever necessary.
- Answer to all sub questions should be grouped together.
- Use of HMT data book is permitted.

Master file.

Q. No		Max Mark	CO No.	Mod. No.
Q1	**(a)** What is transport phenomenon in context to a thermal system? Discuss different transport quantities associated to thermal system in detail.	8	2	1
	(b) What is meant by exergy? Derive the expression for exergy loss in process executed by closed system & open system. Calculate the decrease in available energy when 20 kg of water at 90°C mixes with 30 kg of water at 30°C, the pressure being taken as constant and the temperature of the surroundings being 10°C. Take C_p of water as 4.18 kJ/kg K.	12	1	1
Q2	**(a)** Explain the development of boundary layer along a thin flat & smooth plate held parallel to uniform flow. In boundary layer theory, a boundary layer can be characterized by any of the following quantities i. Boundary layer thickness ii. Displacement thickness iii. Momentum thickness. How do these quantities differ in their physical as well as mathematical definitions?	10	1	5
	(b) Air at 20°C flows past an 800mm long plate at a velocity of 45m/s. If the surface of the plate is maintained at 300°C, Determine: i. The heat transferred from the entire plate length to air taking into consideration both laminar and turbulent portion of the boundary layer. ii. The percentage error if the boundary layer is assumed to be turbulent from very leading edge of the plate.	10	3	6
Q3	**(a)** Consider two long, horizontal parallel plates with a viscous incompressible fluid placed between them. The two plates moves in two opposite direction with two same constant velocities. Starting with the navier-stokes equation, determine an expression for the velocity profile for laminar flow between two plates. Also estimate maximum and average velocity.	10	3	4

M Tech. Mech. Sem I

	(b) What is the critical radius of insulation? How the expression for critical radius is obtained for a cylinder? Consider a pipe at a constant temperature whose radius is greater than the critical radius of insulation. Someone claims that the rate of heat loss from the pipe has increased when some insulation is added to the pipe. Is this claim valid? If yes then suggest the method to minimize the heat loss.	**10**	**4**	**6**
Q4	**(a)** The velocity distribution in the boundary layer of a flat plate is prescribed by the relation $$\frac{u}{U_\infty} = \text{Sin}\left(\frac{\pi}{2}\frac{y}{\delta}\right)$$ Use momentum integral equation to develop an expression for boundary layer thickness, wall shear stress, skin friction coefficient, drag force on one side of the plate & the drag coefficient in terms of Reynolds number.	**10**	**3**	**5**
	(b) How the head losses during flow of fluid through pipe are classified? Estimate the loss of heads that would take place in the system shown in the figure. How the losses can be minimized? 	**10**	**4**	**4**
Q5	**(a)** The velocity components in a 2D incompressible flow field are expressed as $$u = \frac{y^3}{3} + 2x - x^2y \qquad \& \qquad v = xy^2 - 2y - \frac{x^3}{3}$$ Determine: i. the velocity & acceleration at point P (1,3) ii. Is the flow physically possible? If so obtain an expression for the stream function. iii. What is the discharge between the stream lines passing through (1,3) & (2,3) iv. Is the flow irrotational? If so determine the corresponding velocity potential.	**10**	**3**	**2**
	(b) Derive the expression for momentum conservation equation in differential form.	**10**	**1**	**2**
Q6	**(a)** What are the semi-empirical theories of turbulence? Explain the concept of mixing length introduced by Prandtl. State the relationship between turbulent shearing stress and mixing length. Derive the expression for Prandtl's universal velocity distribution.	**14**	**1**	**3**
	(b) Define and explain physical meaning& significance of following non-dimensional numbers: Reynolds number — Prandtl number Nusselt Number — Grashof Number	**6**	**1**	**6**

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Q7	(a) With sufficient illustration answer following questions: i. Fick's Law of Diffusion ii. Equimolar Counter Diffusion	14	1	7
	(b) State the laws of thermodynamics with proper illustration &explanation. How the concept of energy & entropy does emerge from them?	7	2	1

6 h
20/11/17

PhD Civil/Mech. Engg.

Bharatiya Vidya Bhavan's

SARDAR PATEL COLLEGE OF ENGINEERING

(An Autonomous Institution Affiliated to University of Mumbai)

SubjectCode-PhD101
Total Marks: 100
Class/SEM: Ph.D. Civil/Mech. Engineering

Nov 2017
Duration : 3 Hours
Subject: Research Methodology

Master file.

- Attempt any Five questions out of seven questions
- Figures to the right indicate full marks.
- Assume any suitable data if necessary.
- Attach the Graph to the same page where you solve the relevant problem

<table>
<tr><th>Que.No.</th><th>Question Statement</th><th>Marks</th><th>Module</th><th>CO</th></tr>
<tr><td>Q1A</td><td>A company produces three types of parts for automatic washing machines It purchases castings of the parts from a local foundry and then finishes the parts on drilling, shaping, and polishing machines. The selling prices of parts, A,B and C respectively. are Rs. 8, 10 and Rs. 14. all parts made can be sold. Castings for parts A, B and C, respectively costs Rs.5 Rs.6 and Rs.10. Costs per hour to run each of the three machines are Rs. 20 for drilling, Rs,30 for shaping. and Rs.30 for polishing. The capacities (parts per hour) for each part on each machine are shown in the following Table:
<table>
<tr><th rowspan="2">Machine</th><th colspan="3">Capacity per hour</th></tr>
<tr><th>Part A</th><th>Part B</th><th>Part C</th></tr>
<tr><td>Drilling</td><td>25</td><td>40</td><td>25</td></tr>
<tr><td>Shaping</td><td>25</td><td>20</td><td>20</td></tr>
<tr><td>Polishing</td><td>40</td><td>30</td><td>40</td></tr>
</table>
The manager of the company wants to know how many of each type to produce per hour in order to maximize profit for the hour's run. Formulate the above problem as a Linear Programming Problem.</td><td>10</td><td>M5</td><td>CO4</td></tr>
<tr><td>Q1B</td><td>Solve graphically following LPP
Maximize $1170 X_1 + 1110X_2$, Subject to
$9X_1+5X_2 \geq 450$
$7X_1+9X_2 \geq 315$
$5X_1+3X_2 \leq 1500$
$7X_1+9X_2 \leq 1890$
$2X_1+4X_2 \leq 1000$
$X_1, X_2 \geq 0$</td><td>10</td><td>M5</td><td>CO4</td></tr>
</table>

Ph.D. Civil / Mech. Engg.

Q2A	The company has five jobs A,B,C,D,E to be done and five men L,M,N,O,P to do these jobs. The number of hrs each man would take to do the job is given by following table. Compute optimum time for optimal assignment for above case.	10	M5	CO4

Men → / Jobs ↓	**L**	**M**	**N**	**O**	**P**
A	4	6	11	16	9
B	5	8	16	19	9
C	9	13	21	21	13
D	6	6	9	11	7
E	11	11	16	26	11

Q2B	An oil company has recently acquired rights in certain area to conduct surveys and test drilling to lead to shifting oil where it is found commercially exploitable quantities. The area is already considered to have good potential for finding oil in commercial quantities. At the outset , the company has the choice to conduct further geological tests or to carry out a drilling programme immediately. Company concludes that there are 65: 35 chance of further test showing success. Whether the test shows the possibility of ultimate success or not even if no tests are undertaken at all, the company could still pursue its drilling programme or out the drilling programme , likelihood of final success or failure in considered dependent on the foregoing stages. Thus. 1] If successful test are carried out expectation of success is 75:25 2] If test are failed the expectation if success in drilling is 25:75 3] if no test are carried out, expectation of success in drilling is 55:45. Cost and revenues are as follows	10	M6	CO4

Outcome	**Net present value in Rs millions**
Success with prior test.	105
Success without prior test	125
Failure with prior test	-55
Failure without prior test	-45
Sale of Exploitation Rights Prior test show success	60
Sale of Exploitation Rights Prior test show failure	15
Sale of Exploitation Rights without Prior test	45

Ph.D. Civil / Mech. Engg.

<table>
<tr><td>Q3A</td><td>Refer the Following transportation problem. A multi-plant company has three plants A,B,C and two markets X and Y. Production cost of A,B,and C is Rs 1500,1600 and 1700 per piece respectively. Sale price in X and Y are Rs 4400 and 4700 respectively. Demand in X and Y 3500 and 3600 pieces respectively.
Production capacity at A,B and C is 2000, 3000 and 4000 pieces respectively. Transportation cost are as follows.
<table>
<tr><td>From /To</td><td>X</td><td>Y</td></tr>
<tr><td>A</td><td>1000</td><td>1500</td></tr>
<tr><td>B</td><td>2000</td><td>3000</td></tr>
<tr><td>C</td><td>1500</td><td>2500</td></tr>
</table></td><td>10</td><td>M5</td><td>CO4</td></tr>
<tr><td>Q3B</td><td>The sales of water pumps is as follows. Find the sale for the month 11th and 12th. Use LSM. Develop the regression Equation.
<table>
<tr><td>Months</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td></tr>
<tr><td>Sale in [000]</td><td>30</td><td>33</td><td>37</td><td>39</td><td>42</td><td>46</td><td>48</td><td>50</td><td>55</td><td>58</td></tr>
</table></td><td>10</td><td>M5</td><td>CO2, CO3</td></tr>
<tr><td>Q4A</td><td>Heavy Engineering Division use to load a plate for bending in the process of fabricating Pressure vessel. A team wants to reduce Cycle time in minutes for plate loading. There are 3 major lines A,B,C where the loading takes place. The table below gives the data for each lines for 15 loadings. Find out which line should be focused to improve loading process. Assume any suitable data if necessary.
<table>
<tr><td>Sr.No.</td><td>Plate loading time for machine A</td><td>Plate loading time for machine B</td><td>Plate loading time for machine C</td></tr>
<tr><td>1.</td><td>22</td><td>25</td><td>32</td></tr>
<tr><td>2.</td><td>26</td><td>21</td><td>21</td></tr>
<tr><td>3.</td><td>28</td><td>23</td><td>23</td></tr>
<tr><td>4.</td><td>21</td><td>24</td><td>34</td></tr>
<tr><td>5.</td><td>24</td><td>26</td><td>21</td></tr>
<tr><td>6.</td><td>29</td><td>32</td><td>21</td></tr>
<tr><td>7.</td><td>30</td><td>35</td><td>32</td></tr>
<tr><td>8.</td><td>37</td><td>21</td><td>42</td></tr>
<tr><td>9.</td><td>27</td><td>23</td><td>38</td></tr>
<tr><td>10.</td><td>23</td><td>21</td><td>39</td></tr>
<tr><td>11.</td><td>26</td><td>21</td><td>40</td></tr>
<tr><td>12.</td><td>29</td><td>21</td><td>23</td></tr>
<tr><td>13.</td><td>27</td><td>24</td><td>24</td></tr>
<tr><td>14.</td><td>25</td><td>26</td><td>20</td></tr>
<tr><td>15.</td><td>24</td><td>23</td><td>23</td></tr>
</table></td><td>10</td><td>M3</td><td>CO3</td></tr>
<tr><td>Q4B</td><td>A test of the breaking strength of 6 steel ropes manufactured by Hindustan Cable corporation showed a mean breaking strength [BS] of X Bar =7750 lb and SD of 145 lb whereas the manufacture claimed that a mean BS of 8000lb.Can we support the manufactures claim at levels of a] 0.05 b]0.01 Compute p value</td><td>10</td><td>M4</td><td>CO3</td></tr>
</table>

Ph.D. civil / Mech. Engg.

<table>
<tr><td>Q5A</td><td>A population is divided into three strata so that $N1 = 5000$, $N2 = 2000$ and $N3 = 3000$. Respective standard deviations are: s1=15,s2=18 and s3=5.How should a sample of size $n = 84$ be allocated to the three strata, if we want optimum allocation using disproportionate sampling design?</td><td>10</td><td>M2</td><td>CO1, CO2</td></tr>
<tr><td>Q5B</td><td>A data of 350 Life Cycle Test machines was collected and analysed to know association between type of machines and acceptability of Guage R and R The response by Type of machine are as follows. At alpha =0.05 do these data suggest an association between Type of machine and acceptability of Guage R and R?
<table>
<tr><td></td><td>Automatic machines</td><td>Semi Automatic machines</td><td>Total</td></tr>
<tr><td>Acceptable Guage R&R</td><td>14</td><td>25</td><td>39</td></tr>
<tr><td>Not Acceptable Guage R&R</td><td>159</td><td>152</td><td>311</td></tr>
<tr><td>Total</td><td>173</td><td>177</td><td>350</td></tr>
</table></td><td>10</td><td>M4</td><td>CO3</td></tr>
<tr><td>Q6A</td><td>Draw the Research Methodology Process Flow chart specific to your research problem. Explain each step. Justify the need of each step in your research process</td><td>10</td><td>M2</td><td>CO2</td></tr>
<tr><td>Q6B</td><td>Prepare the 20 guidelines for Literature survey and Literature Review</td><td>10</td><td>M2</td><td>CO1</td></tr>
<tr><td>Q7A</td><td>Prepare the 20 guidelines for case study method of data collection.</td><td>10</td><td>M2, M3</td><td>CO1</td></tr>
<tr><td>Q7B</td><td>How to write Research Proposal. State all the considerations.</td><td>10</td><td>M1</td><td>CO1</td></tr>
</table>

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M. Tech. Thermal Engg. Sem I

Bharatiya Vidya Bhavan's

Sardar Patel College of Engineering

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

End Semester Exam
Nov 2017

Course: Advanced Combustion Techniques | **Duration: 3 Hrs**
Max. Marks: 100 | **Semester: I**
Program: M. Tech. Thermal Engineering | **Course Code: MTTH 112**

Master file.

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.

Q No		Max. Mark	CO No	M No
1.	**Answer the following questions (Any Four)**	**20**	2	1. 7
	A. What are the methods available to measure Laminar burning velocity of flame? Explain at least one method in detail. **B.** Explain the different zones of one-dimensional laminar premixed flame with neat sketch. **C.** What are the assumptions to be considered in laminar flame theory? **D.** What do you mean by flammability limits, quenching distance, ignition energy and flame stability? **E.** What is the utility of spray combustion in designing of liquid fuel combustor? **F.** What are the important properties require for burning characteristics? Explain.			
2.	**A.** Explain qualitatively how the flame is stabilized in a Bunsen burner.	**03**	2	4
	B. In a stoichiometric propane and air flame, nitrogen is replaced by helium, whose original burning velocity is 45 cm/sec. Estimate the laminar burning velocity of this new stoichiometric mixture.	**05**	3	4
	C. Discuss adiabatic flame temperature and specify the expressions for evaluating the same.	**04** **03**	2 1	3 2
	D. What are the special solid fuels and solid oxidizers used in combustion process?	**05**	2	1
3.	**A.** Methane gas is issued from a tube of 0.5 mm diameter at 298 K and 0.1 MPa. Flow rate of methane gas is 5 LPM. Estimate the flame height by phenomenological analysis assuming the Lewis Number equal to one. Take thermal conductivity of methane as 0.031 W/mk, specific heat of methane as 2.22 kJ/kgK	**06**	4	6
	B. What do you mean by diffusion flame? How is it different from premixed flame?	**04**	2	5
	C. Explain the engineering applications where the combustion is used especially for design and performance considerations for engine design.	**05**	4	3
	D. Derive the equation $\sqrt{8C}\ \frac{4}{3}\frac{\alpha}{S_L}$ which is used to calculate quenching diameter.	**05**	3	4

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4.	**A.** State the important properties of liquid fuels and their importance in combustion techniques.	**05**	2	2
	B. Discuss fluidized bed combustion. What are the advantages and limitations of fluidized bed combustion?	**05**	3	6
	C. Explain the modeling of Knock of S I Engine combustion using Ethane gas as fuel. Consider other parameters which are involved in knocking. State the assumptions made. Consider initial conditions corresponding to compression of a fuel-air mixture from 300 K and 1 atm to TDC for a compression ratio of 10:1. Initial volume before compression is 3.68×10^{-4} m^3. Stroke and Bore are equal. Stroke value is 75 mm.	**10**	4	7
5.	**A)** In order to determine the laminar burning velocity of stoichiometric methane-air mixture. A conical flame of height of 6 cm is established using a Bunsen burner with port diameter of 15 mm. If it consumes 20 LPM of fuel-air mixture, determine its velocity by area method.	**10**	4	4
	B) Calculate the following i) Theoretical air required per kg of given fuel, ii) Theoretical CO_2 content in the flue gases iii) Final constituents of flue gas with gases air for every 100 kg of fuel When the Furnace Oil is as fuel and following are the constituents by %weight Carbon = 85.9, Hydrogen = 12, Oxygen = 0.7, Nitrogen = 0.5, Sulphur = 0.5, H_2O = 0.35, Ash = 0.05 Consider gross calorific value of furnace oil = 10880 kcal/kg	**10**	4	1
6.	**A.** A kitchen room of size 4m X 3m X 3m at 0.1 MPa and 298 K is filled with propane due to leakage from propane gas cylinder of volume 0.1 m3 initially at 0.5 MPa. Assuming that the leakage stops when the pressure in the cylinder reaches 0.1 MPa, determine whether the mixture is the kitchen is flammable or not? Consider propane air mixtures are flammable for $0.51 < \Phi < 2.83$. Assume mixture as ideal gas mixture.	**06**	4	5
	B. For igniting stoichiometric methane-air mixture at ambient pressure and temperature, determine Minimum Ignition Energy (MIE). Take n = 2.2, C = 4, thermal conductivity of gas = 0.08 W/mK, Cp of gas = 1.1 kJ/kgK. Assume that the burning velocity of stoichiometric methane-air mixture at ambient conditions is 38 cm/s. If the pressure is reduced by three times, what will be the MIE? Assume that Tad = 2300 K would not change with pressure.	**06**	4	5
	C. Discuss about the physical processes that govern flammability limits.	**02**	2	5
	D. What are the fundamental aspects of combustion? What are the applications of combustion?	**06**	1	1
7.	Solve the following questions (Any Four) **A)** Define and explain Heat of reaction, Heat of combustion, Heat of formation **B)** Explain the Mechanism of soot formation in a diffusion flame **C)** Explain the Liquid fuel combustion **D)** Explain the Effects of chemical and physical variables on burning velocity **E)** State the Burner Design Factors. What are the factors to be considered for burner locations?	**20**	02	1-7

M.Tech. (Mech) Sem I.

GD
29/11/17

Bharatiya Vidya Bhavan's

Sardar Patel College of Engineering

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

END SEMESTER EXAMINATION,
November 2017

Program: M.Tech. (Mechanical) Thermal Engineering | **Date: 29/11/2017**
Duration: 3 hrs.
Course code: MTTH114 | **Max. Marks: 100**
Name of the Course: Energy Storage Systems | **Semester: I**

Instructions: Master file.

- **Question 1 is compulsory.** Attempt any **FOUR** questions out of SIX.
- Make any suitable assumption if needed.
- Draw neat diagrams where ever necessary.
- Answer to all sub questions should be grouped together.

Q. No		Max Mark	CO No.	Mod. No.
Q1	**(a)** Define energy & state problems associated with load leveling. Discuss the methods used to reduce the magnitude of variations in energy demand.	10	2	1
	(b) How the energy is stored in portable electronic devices? Discuss the storage of energy in mobiles and laptops.	10	1	2
Q2	**(a)** What is available energy? How it is calculated for a steady flow system? In a turbine the air expands from 7 bar, 600°C to 1 bar, 250°C. During expansion 9 kJ/kg of heat is lost to the surroundings which is at 1 bar, 15°C. Neglecting kinetic energy and potential energy changes, determine per kg of air: i. The decrease in availability ii. The maximum work iii. The irreversibility For air, take: C_p = 1.005 kJ/kg K, h = C_pT, where C_p is constant.	12	3	3
	(b) State and explain Quality of energy & Law of degradation of energy.	08	3	3
Q3	**(a)** Which characteristics of phase changing materials makes them suitable for TES? Differentiate between organic and inorganic phase changing material.	10	1	4
	(b) What benifits do energy storage systems offer? Explain in detail long term or seasonal energy storage, daily and weekly energy storage.	10	1	1
Q4	**(a)** Elaborate the concept of Entropy. How thermal and configurational entropy is differentiated? Explain temperature dependance of Gibb's free energy, enthalpy and entropy.	10	3	5

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	(b) What is the principle of storage of energy in a flywheel? Explain storage of energy in flywheel used in automotives.	**10**	**1**	**6**
Q5	**(a)** What are biofuels? Enlist the generations of biofuels & discuss them in detail with their respective applications.	**10**	**1**	**5**
	(b) Discuss in brief : 1. Reserve batteries 2. Primary Batteries vs Secondary Batteries	**10**	**1**	**7**
Q6	**(a)** Summarise the energy stored in biomass. Compare between hard biomass, living biomass and synthetic liquid fuels. Which one is superior and why?	**10**	**4**	**5**
	(b) How the hydrogen can be produced and stored? Which factors are to be considered while designing safe hydrogen storage unit.	**10**	**1**	**6**
Q7	**(a)** Illustrate in detail answers of following questions: i. Ocean Thermal Energy Conversion ii. Molten salt technology for TES	**10**	**3**	**4**
	(b) Write short note on following : i. Energy stored in spring ii. Electro-magnetic energy storage	**10**	**1**	**6**