

Code No.: 53101

MR 15-2015-16 & 2016-17 Admitted Students

## MALLA REDDY ENGINEERING COLLEGE (AUTONOMOUS)

(Affiliated to JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD)

Gundlapochampally (H), Maisammaguda (V), Medchal (M), Medchal-Malkajiri (Dist), Hyderabad.

### M.TECH I SEMESTER SUPPLEMENTARY EXAMINATIONS, JANUARY-2018

SUBJECT: ADVANCED THERMODYNAMICS

Branch/Specialization: **ME/Thermal Engineering**

Time: 3 hours

Max. Marks: 60

#### PART – A

Answer All Questions

5 x 4 Marks=20 Marks

1. What is Second law of Thermodynamics? Explain Entropy, reversible and irreversible processes.
2. Discuss Vander Waal's equation in detail.
3. What is Chemical Equilibrium of Ideal Gases
4. What are phenomenological laws?
5. Explain about Photo voltaic cells. Give examples.

#### PART-B

Answer any FIVE questions

5 x 8 Marks= 40 Marks

1. a) Derive Maxwell Relations. (4M)  
b) An inventor claims to have developed an engine that takes in 105 MJ at a temperature of 400K, rejects 42 MJ to a temperature of 200K and delivers 15kWH of mechanical work. Would you advise investing money to put his engine in the market. (4M)
2. Water from a cooling system is itself to be cooled in the cooling tower at a rate of 2.78 kg/s. The water enters the tower at 65°C and leaves a collecting tank at the base at 30°C. Air flows through the tower, entering the base at 15°C, 0.1 MPa, 55% RH, and leaving the top at 35°C, 0.1 MPa, saturated. Make up water enters the collecting tank at 14°C. Determine the air flow rate into the tower in m<sup>3</sup>/s and the make-up water flow rate in kg/s. (8M)
3. A gas mixture contains 1 kg of Oxygen and 3 kg of Nitrogen. The pressure and temperature of the mixture are 1 bar and 27°C. Determine 1) mass fraction and mole fraction of each constituent, 2) average molecular weight of mixture 3) partial pressures of constituents. 4) specific gas constant. (8M)
4. a) Find i) Dew point temperature ii) Relative humidity and iii) Moisture content if dry bulb temperature is 30°C and wet bulb temperature is 21°C. Represent the above on Psychrometric chart. (4M)  
b) Discuss Psychrometric processes in detail. (4M)

5. Explain the principle of operation of a hydrogen-oxygen fuel cell. What is the maximum work obtainable in the cell? (8M)
6. a) A engine working on Otto cycle has a cylinder diameter of 180 mm and a stroke of 320 mm; the clearance volume is 0.0022 m<sup>3</sup>. Find the air standard efficiency for this engine; Assume  $\gamma = 1.4$ . (4M)
- b) Explain phenomenological laws. (4M)
7. a) Explain the equation of state for real gases. Explain the compressibility chart. (4M)
- b) What is a Binary vapour cycle? Explain. (4M)
8. Write short notes on any **two** of the following (4M+4M)
- a) Vander Waal's equation
- b) Photo voltaic cells
- c) Magneto Hydrodynamic generation

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### M.TECH I SEMESTER SUPPLEMENTARY EXAMINATIONS, JANUARY-2018

SUBJECT: ADVANCED FLUID MECHANICS

Branch/Specialization: **ME/Thermal Engg.**

Time: 3 hours

Max. Marks: 60

#### PART – A

Answer All Questions

5 x 4Marks=20 Marks

1. From the consideration of vorticity and rotation show that in case of ideal fluids the flow is irrotational.
2. Explain in detail the Generalized couette flow.
3. Why is the flow in the boundary layer analyzed on the principle of viscous flow theory?
4. Explain why the hydraulic loss in a pipe is influenced by the surface roughness only, at higher Reynolds numbers.
5. Describe compressible flow through a convergent – divergent nozzle. How and where does the shock wave occur in the nozzle?

Answer any five of the following questions

5 x 8 Marks= 40 Marks

1. A conical pipe diverges uniformly from 100 mm to 200 mm diameter over a length of 1m. Determine the local and convective acceleration at the mid-section assuming
  - i) Rate of flow is  $0.12 \text{ m}^3/\text{s}$  and it remains constant;
  - ii) Rate of flow varies uniformly from  $0.12 \text{ m}^3/\text{s}$  to  $0.24 \text{ m}^3/\text{s}$  in 5 sec., at  $t = 2 \text{ sec}$
2. Derive Hagen-Poiseuille equation and state the assumptions made.
3. A plate 450 mm X 150 mm has been placed longitudinally in a stream of crude oil (Specific gravity 0.925 and kinematic viscosity of 0.9 stoke) which flows with velocity of 6 m/s. Calculate:
  - i) The friction drag on the plate
  - ii) Thickness of the boundary layer at the trailing edge, and
  - iii) Shear stress at the trailing edge.
4. A pipeline carrying water has surface protrusions of average height of 0.10mm. If the shear stress developed is  $8.2 \text{ N/m}^2$  determine whether the pipe surface acts as smooth, rough or in transition. For Water take  $\rho = 1000 \text{ kg/m}^3$  and kinematic viscosity  $\nu = 0.0093 \text{ stokes}$ .
5. Derive an expression for shear stress on the basis of 'Prandtl Mixing length Theory'.

6.
  - a) How is a shock wave produced in a compressible fluid? What do you mean by the term “Shock strength” ?
  - b) What do you mean by compressibility correction factor?
7.
  - a) Obtain the expression in differential form for continuity equation for one dimensional compressible flow.
  - b) Show by means of diagrams the nature of propagation of disturbance in compressible flow when Mach number is less than one, is equal to one and is more than one.
8. Explain any **two** of the following:
  - a) Supersonic Wave Drag
  - b) Reynolds theory of turbulence
  - c) Variation of velocity with area ratio

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### M.TECH I SEMESTER SUPPLEMENTARY EXAMINATIONS, JANUARY-2018

SUBJECT: THERMAL AND NUCLEAR POWER PLANTS

Branch/Specialization: ME/Thermal Engg.

Time: 3 hours

Max. Marks: 60

#### PART – A

Answer All Questions

5 x 4Marks=20 Marks

1. Classify Steam Condensers? Differentiate between Jet and Surface Condensers?
2. Discuss the factors influencing site selection for a Gas Turbine Power Plant?
3. What are the main components of a Nuclear Power Station? Briefly give function of each?
4. List out various costs which constitute the overall cost of a Power Generation in a Plant?
5. List out different types of temperature measuring devices?

Answer any five of the following questions

5 x 8 Marks= 40 Marks

1. a) Discuss different energy sources in India? Explain Flue Gas analysis and how it can be implemented in a power plant?  
b) Discuss different steam power plant cycles with efficiencies?
2. a) Describe different IGCC Power plants?  
b) What are the advantages, applications and limitations of Gas Turbines?
3. a) Discuss a Fast Breeder Reactor? Explain the various factors to be considered while selecting the site for a nuclear power station?  
b) Discuss the different by-products in a nuclear power plants? Briefly describe the different applications of nuclear power plants?
4. a) What is meant by a load curve? Explain how it is evaluated in a power plants? What are its major applications?  
b) Describe different methods of determining depreciation? Define the term 'Economic load sharing'
5. a) List out different functions performed by Temperature measurement devices?  
b) Classify different pressure measurement devices and briefly explain one device with a neat sketch.
6. a) Explain the different types and accessories of steam generators?  
b) Explain briefly General layout of Gas Turbine Power plant and discuss 'Closed Cycle Gas Turbine'.

7. a) Briefly explain the functions of each component in a nuclear reactor?

b) Define the following terms:

(i) Load Factor (ii) Demand Factor (iii) Utilization Factor (iv) Diversity Factor

8. Write short notes on any **two** of the following

a) (i) Direct Energy Conversion System

(ii) Fluidised Bed Combustion – Advantages and Disadvantages

b) (i) Safety measures in a Nuclear Power plants

(ii) Energy Rates

c) Write a brief notes on Economics of Nuclear Power Plants?

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**M.TECH I SEMESTER SUPPLEMENTARY EXAMINATIONS, JANUARY-2018**SUBJECT: ADVANCED OPTIMIZATION TECHNIQUES & APPLICATIONSBranch/Specialization: **ME/Thermal Engg.****Time: 3 hours****Max. Marks: 60****PART – A****Answer All Questions****5 x 4Marks=20 Marks**

1. What is a uni-model function?
2. State possible convergence criteria that can be used in direct search methods.
3. Define a complementary geometric programming problem.
4. Explain how simulation can be applied in the case of inventory control, where the demand is probabilistic and lead time is random.
5. What is a random variable? How is stochastic return function handled in stochastic dynamic programming?

**Answer any five of the following questions****5 x 8 Marks= 40 Marks**

1. Minimize  $f(x) = 0.65 - [0.75/(1+x^2)] - 0.65x \tan^{-1}(1/x)$  in the interval  $[0.3]$  by the Fibonacci method using  $n=6$  (8M)
2. a) How are the search directions generated in the Fletcher- Reeves method? (3M+5M)  
b) Minimize the function  $f(x_1, x_2) = 100 (x_2 - x_1^2)^2 + (1 - x_1)^2$  using Steepest Descent method.
3. A man is engaged in buying and selling identical items. He operates from a warehouse that can hold 500 units. Each month he can sell any quantity that he chooses up to the stock at the beginning of the month. Each month he can buy as much as he wishes for delivery at the end of the month so long as his stock does not exceed 500 units. For the next four months he has the following error-free forecasts of cost and sales prices:

Month(i):	1	2	3	4
Cost( $c_i$ ):	27	24	26	28
Sales price( $p_i$ ):	28	25	25	27

If he currently has a stock of 200 units, what quantities should he sell and buy in the next four months? Find the solution using dynamic programming. (8M)

4. Minimize  $f = -45x_1 - 100x_2 - 30x_3 - 50x_4$  (8M)

Subject to  $7x_1 + 10x_2 + 4x_3 + 9x_4 \leq 1200$  $3x_1 + 40x_2 + x_3 + x_4 \leq 800$ and  $x_1, x_2, x_3, x_4 \geq 0$

- a) Determine the optimum solution to the LP problem.
- b) Find the effect of changing  $C_1$  from  $-45$  to  $-40$  and  $C_2$  from  $-100$  to  $-90$ . Using sensitivity analysis.
5. a) Explain how Gomory's cutting plane algorithm works (3M)
- b) Solve the following integer programming problem using Gomory's cutting plane algorithm:
- $$\begin{aligned} \text{Maximize } f &= 1.5x_1 + 3x_2 + 4x_3 \\ \text{Subject to } 2.5x_1 + 2x_2 + 4x_3 &\leq 12 \\ 2x_1 + 4x_2 - x_3 &\leq 7 \\ \text{and } x_1, x_2, x_3 &\geq 0 \end{aligned}$$
- (5M)
6. a) What is the difference between Fibonacci and golden section methods? (4M)
- b) Define the following (4M)
- i) Gradient of a function
- ii) Steepest descent direction using contour representation
7. a) What is arithmetic-geometric inequality? How is the degree of difficulty defined for a constrained geometric programming problem? (4M)
- b) Explain in brief the various types of simulation models. Explain the phases of simulation models. (4M)
8. Write short note on any two of the following: (4M+4M)
- a) Find the extreme points of the function  $f(x_1, x_2) = x_1^3 + x_2^3 + 2x_1^2 + 4x_2^2 + 6$
- b) Briefly discuss about single variable and multi variable optimization problems.
- c) Describe the concept of conversion of final problem to an initial value problem.