Printed Page:- 04 **Subject Code**:- **AME0404**

Roll. No:

NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA

(An Autonomous Institute Affiliated to AKTU, Lucknow)

B.Tech

SEM: IV - THEORY EXAMINATION (2023 - 2024)

Subject: Applied Thermodynamics

Time: 3 Hours **Max. Marks: 100**

General Instructions:

IMP: *Verify that you have received the question paper with the correct course, code, branch etc.*

1. *This Question paper comprises of* **three Sections -A, B, & C.** *It consists of Multiple Choice Questions (MCQ's) & Subjective type questions.*

2. *Maximum marks for each question are indicated on right -hand side of each question.*

3. *Illustrate your answers with neat sketches wherever necessary.*

4. *Assume suitable data if necessary.*

5. *Preferably, write the answers in sequential order.*

6. *No sheet should be left blank. Any written material after a blank sheet will not be evaluated/checked.*

SECTION A **20**

1. Attempt all parts:-

1-a. What are the main constituents of fuel from given options? (CO1) 1

(a) Carbon and Nitrogen

(b) Oxygen and Hydrogen

(c) Carbon and Hydrogen

(d) Helium and Oxygen

1-b. The most economic fuels are (CO1) 1

(a) Solid fuel

(b) Liquid fuel

(c) Gaseous fuel

(d) All (a), (b) & (c)

1-c. The economiser is used in boilers to (CO2) 1

(a) Increase thermal efficiency of boiler

(b) Economise on fuel

(c) Extract heat from the exhaust the gases

(d) Increase flue gas temperature

1-d. The number of fire tubes in lancashire boiler is (CO2) 1

(a) one

(b) two

(c) three

(d) four

1-e. Which processes do the Rankine cycle contain? (CO3) 1

(a) two isothermal and two isochoric processes

(b) two isentropic and two isobaric processes

(c) two isentropic and two isothermal processes

(d) two isothermal and two isobaric processes

1-f. What is the effect of increase in regeneration on steam rate? (CO3) 1

(a) steam rate increases

(b) steam rate decreases

(c) steam rate is independent of regeneration

(d) none of the above

1-g. What is a steam turbine? (CO4) 1

(a) Machine that uses pressurised steam to extract mechanical energy

(b) Machine that uses pressurised steam to extract thermal energy

(c) Machine that uses pressurised steam to extract kinetic energy

(d) Machine that uses pressurised steam to extract electrical energy

1-h. In a reaction turbine, when the degree of reaction is zero, then there is (CO4) 1

(a) No heat drop in the moving blades

(b) No heat drop in the fixed blades

(c) Maximum heat drop in the moving blades

(d) Maximum heat drop in the fixed blade

1-i. Automatic spray nozzles (CO5) 1

(a) increases the waste

(b) maintains a clean environment

(c) doesn’t spray precise volume

(d) none of these

1-j. Electronic control of gas turbine engines (CO5) 1

(a) increases efficiency

(b) helps in efficient working of gas turbine engine

(c) both (a) and (b)

(d) none of these

2. Attempt all parts:-

2.a.	Explain heat of reaction. (CO1)	2
2.b.	Explain water tube boilers with examples. (CO2)	2
2.c.	What are the basic components of a steam power plant? (CO3)	2
2.d.	Explain the principle of operation of steam turbine.(CO4)	2
2.e.	State the function of electrically actuated nozzles.(CO5)	2

SECTION B **30**

3. Answer any <u>five</u> of the following:-

3-a.	What is meant by adiabatic flame temperature? Also, explain effect of temperature on standard heat of reaction. (CO1)	6
3-b.	In an experiment, 15 g of ice is used to bring down the temperature of 50 g of water at 40 degree C to its freezing temperature. The specific heat capacity of water is 4.2 J/g/K. Calculate the specific latent heat of ice. State one important assumption made in the above calculation. (CO1)	6
3-c.	Derive a relation for the condition of maximum discharge through the chimney of height H. (CO2)	6
3-d.	Explain low level counter flow jet condenser with a neat sketch. (CO2)	6
3.e.	A steam power plant works between 40 bar and 0.05 bar. If the steam supplied is dry saturated and the cycle of operation is Rankine, find : a) Cycle efficiency b) Specific steam consumption. (CO3)	6
3.f.	State advantages and disadvantages of Velocity compounded impulse turbine. (CO4)	6
3.g.	What are gas turbines? State the advantages of using electronically controlled gas turbine engines. (CO5)	6

SECTION C **50**

4. Answer any <u>one</u> of the following:-

4-a.	What is the use of calorimeter? A molten metal of mass 150 g is kept at its melting point 800 °C. When it is allowed to freeze at the same temperature, it gives out 75000 J of heat energy. What is the specific latent heat of the metal? If the specific heat capacity of metal is 200 J/kg/K, how much additional heat energy will the metal give out in cooling to – 50 °C ? (CO1)	10

4-b.	Explain: a) Heat of reaction b) Heat of formation c) Significance of adiabatic flame temperature d) Fuel air ratio e) Fuel (CO1)	10

5. Answer any <u>one</u> of the following:-

5-a.	With the help of neat sketch explain Babcock and Wilcox boiler. (CO2)	10
5-b.	What are boiler mountings? State the location and function of a) Water level indicator b) Pressure gauge c) Feed check valve d) Manhole e) Safety valve (CO2)	10

6. Answer any <u>one</u> of the following:-

6-a.	In a Rankine cycle, the steam at inlet to turbine is saturated at a pressure of 30 bar and the exhaust pressure is 0.25 bar. Assume flow rate of 10 kg/s. Determine: a) The pump work b)Turbine work c) Rankine efficiency d) Condenser heat flow e) Dryness at the end of expansion. (CO3)	10
6-b.	In an air standard Brayton cycle the minimum and maximum temperature are 300 K and 1200 K respectively. The pressure ratio is that which maximizes the net work developed by the cycle per unit mass of air flow. Calculate the compressor and turbine work, each in kJ/kg air, and thermal efficiency of the cycle. (CO3)	10

7. Answer any <u>one</u> of the following:-

7-a.	Derive an expression for a fluid passing through a nozzle in terms of Mach number. (CO4)	10
7-b.	An impulse steam turbine of 180 kW has steam flowing at rate of 165 kg/min and leaving axially. Steam turbine blade speed is 175 m/s and it leaves nozzle at 400m/s. For the blade velocity coefficient of 0.9 find nozzle angle, blade angle at inlet and exit, axial thrust. (CO4)	10

8. Answer any <u>one</u> of the following:-

8-a.	Explain in detail about the need of methods and means of controls of fuel combustion process? Also draw the schematic diagram. (CO5)	10
8-b.	How electrically actuated nozzles differ from automatic spray nozzles. Explain in detail. (CO5)	10