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

Roll. No:

NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA

(An Autonomous Institute Affiliated to AKTU, Lucknow)

B.Tech

SEM: IV - CARRY OVER THEORY EXAMINATION - APRIL 2023

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. One of the products formed by combustion of the hydrocarbon fuels is water which is in the_____. (CO1) 1

(a) Solid state

(b) Liquid state

(c) Gaseous state

(d) solid, liquid, and gaseous states

1-b. Presence of _____ in a fuel does not contribute to its calorific value of combustion. (CO1) 1

(a) oxygen

(b) hydrogen

(c) sulphur

(d) nitrogen

1-c. For pure vapour dryness fraction is_____. (CO2) 1

(a) 0

(b) 1

(c) between 0 and 1

(d) more than 1

1-d. ____ is used to measure the pressure of steam inside the steam boiler. (CO2) 1

(a) Pressure guage

(b) Steam stop valve

(c) Feed pump

(d) Fusible plug

1-e. In a real power-plant cycle, the compression by the pump and the expansion in the turbine are _____. (CO3) 1

(a) isentropic

(b) isobaric

(c) isothermal

(d) isochoric

1-f. Open Brayton-type engine consists of _____ components. (CO3) 1

(a) 2

(b) 3

(c) 1

(d) 4

1-g. The flow of steam in a nozzle is subsonic at_____. (CO4) 1

(a) throat

(b) entrance

(c) convergent portion

(d) divergent portion

1-h. Degree of reaction is defined as the ratio of_____. (CO4) 1

(a) heat drop in fixed blades to the heat drop in moving blades

(b) heat drop in moving blades to the heat drop in fixed blades

(c) heat drop in moving blades to the heat drop in fixed blades plus heat drop in moving blades

(d) heat drop in fixed blades plus heat drop in moving blades to the heat drop in moving blades

1-i. When electrical load increases than the generation then turbine speed_____. (CO5) 1

(a) increases

(b) decreases

(c) remains same

(d) may increase or decrease

1-j. When gas turbines are operated in parallel their disturbances_____. (CO5) 1

(a) decreases

(b) increases

(c) remains constant

(d) may increase or decrease

2. Attempt all parts:-

2.a. What are the ideal properties of a fuel? (CO1) 2

2.b. Determine the height of chimney required in a boiler having natural draught equivalent to 20mm of water. The flue gases are at temperature of 300^{o}C, atmospheric air temperature is 27^{o}C and 18 kg air per kg of fuel is required in boiler. (CO2) 2

2.c. How rocket propulsion is different from jet propulsion? (CO3) 2

2.d. List the various losses in a steam turbine. (CO4) 2

2.e. Why electrically actuated nozzles are required? (CO5) 2

SECTION B **30**

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

3-a. Calculate stoichiometric air/fuel ratio by mass and percentage composition of products of combustion per kg of ethyl alcohol. (CO1) 6

3-b. In an experiment, 17 g of ice is used to bring down the temperature of 40 g of water at 34^{o}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. State the significance of boiler draught. How boiler draught is measured? (CO2) 6

3-d. Explain low level counter flow jet condenser with a neat sketch. (CO2) 6

3.e. Compare between solid propellent rocket engine and liquid propellant rocket engines. (CO3) 6

3.f. Explain: a) Degree of reaction b) Parsons's reaction turbine. (CO4) 6

3.g. Explain turbine control system and also state its advantages. (CO5) 6

SECTION C **50**

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

4-a. The volumetric composition of the dry products of combustion of an unknown fuel $C_\chi H_\gamma$ gives: Carbon dioxide 12.1%, oxygen 3.8%, carbon monoxide 0.9% and nitrogen 83.2%. Determine a) Chemical composition of fuel b) Air fuel ratio c) Percentage of excess air used. (CO1) 10

4-b. A hydrocarbon fuel when burned with air gave the following analysis, Carbon dioxide : 11.94%, Oxygen : 2.26%, Carbon monoxide: 0.41%, Nitrogen : 83.39%. Assume air to have 21% oxygen, determine: a) the air-fuel ratio on mass basis b) the percent of carbon and hydrogen in the fuel on mass basis c) percentage of theoretical air supplied. (CO1) 10

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

5-a. Show that the height of chimney required for producing a draught equivalent to 15 mm of water cannot be less than 30 m, if the flue gas temperature is 250^o C, ambient temperature is 20^{o}C and minimum 18 kg air per kg of fuel is required. (CO2) 10

5-b. With the help of neat sketch explain Babcock and Wilcox boiler. (CO2) 10

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

6-a. Explain with the help of neat diagram a 'Regenerative Cycle'. Derive also an expression for its thermal efficiency. (CO3) 10

6-b. 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

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

7-a. Define critical pressure ratio for nozzle of steam turbine. Obtain an expression for it in terms of adiabatic constant. (CO4) 10

7-b. Derive expressions for velocity and mass flow rate per unit area of steam in a nozzle. (CO4) 10

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

8-a. Differentiate between electronic control of gas turbine and digital steam turbine. (CO5) 10

8-b. Explain in detail about the need of methods and means of controls of fuel combustion process? Also draw the schematic diagram. (CO5) 10