Printed Page:- Subject Code:- AME0404

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NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA

(An Autonomous Institute Affiliated to AKTU, Lucknow)

B.Tech

SEM: IV - THEORY EXAMINATION (2021 - 2022)

Subject: Applied Thermodynamics

Time: 3 Hours Max. Marks: 100

General Instructions:

1. The question paper comprises three sections, A, B, and C. You are expected to answer them as directed.
2. Section A - Question No- 1 is 1 marker & Question No- 2 carries 2 mark each.
3. Section B - Question No-3 is based on external choice carrying 6 marks each.
4. Section C - Questions No. 4-8 are within unit choice questions carrying 10 marks each.
5. 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. Incomplete combustion of hydrocarbon fuels. (CO1) 1

(a) yields carbon dioxide and water vapour

(b) takes place due to too much air

(c) takes place due to an insufficient amount of air

(d) yields hydrogen and carbon dioxide

1-b. The total quantity of heat liberated when a unit mass (or volume) of a fuel is burnt completely is called its. (CO1) 1

(a) Heat value

(b) Calorific value

(c) Burning value

(d) Combustion value

1-c. The difference between Cornish boiler and Lancashire boiler is. (CO2) 1

(a) Former is fire tube type and latter is water tube type boiler

(b) Former is water tube type and latter is fire tube type boiler

(c) Former contain one fire tube type and latter contains two water tube type boiler

(d) None of the mentioned

1-d. The function of fusible plug is (CO2) 1

(a) To control the flow of steam

(b) To regulate the supply of water

(c) To put off the fire when the level of water falls to an unsafe level

(d) To empty the boiler whenever required

1-e. The efficiency of a Rankine cycle may be expected to (CO3) 1

(a) increase with decreasing temperature of heat rejection

(b) decrease with decreasing temperature of heat rejection

(c) decrease with increasing temperature of heat rejection

(d) increase with increasing exhaust pressure

1-f. If pressure ratio in Brayton cycle increases... (CO3) 1

(a) the efficiency of the cycle increases

(b) the efficiency of the cycle decreases

(c) there is no any effect on the efficiency of the cycle

(d) may increase or decrease

1-g. Nozzle efficiency is described as....(CO4) 1

(a) isentropic heat drop/useful heat drop

(b) useful heat drop/isentropic heat drop

(c) saturation temperature/supersaturation temperature

(d) supersaturation temperature/saturation temperature

1-h. In a reaction turbine.....(CO4) 1

(a) the steam is allowed to expand in the nozzle, where it gives a high velocity before it enters the moving blades

(b) the expansion of steam takes place partly in the fixed blades and partly in the moving blades

(c) the steam is expanded from a high pressure to a condenser pressure in one or more nozzles

(d) the pressure and temperature of steam remains constant

1-i. Digital steam turbine control system.... (CO5) 1

(a) Maintains the safety and reliability of the turbine

(b) Quickly respond to loss-of-load or emergency

(c) Lead to failures due to the complexity of the system

(d) All of these

1-j. Boiler parameters are expressed by... (CO5) 1

(a) tonnes/hr. of steam

(b) pressure of steam in kg/cm2

(c) temperature of steam in °C

(d) all of these

2. Attempt all parts:-

2.a. Describe different types of fuel. (CO1) 2

2.b. Enlist the requirements of a good boiler. (CO2) 2

2.c. Why Rankine cycle is use instead of Carnot cycle for steam power plant? (CO3) 2

2.d. What is degree of reaction in turbines? (CO4) 2

2.e. State the function of automatic spray nozzles. (CO5) 2

SECTION B 30

3. Answer any five of the following:-

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

3-b. Calculate the total amount of heat energy required to convert 100 g of ice at -20 degree C completely into water at 100 degree C. Specific heat capacity of ice = 2.1 J/g/K, specific heat capacity of water = 4.2 J/g/K, specific latent heat of fusion of ice = 336 J/g. (CO1) 6

3-c. Derive a relation for the condition of maximum discharge through the chimney of height H. (CO2) 6

3-d. What are the advantages and disadvantages of artificial draught? (CO2) 6

3.e. What is the need of intercooling in Gas turbine? Draw schematic diagram of combination of regeneration and intercooling in Brayton cycle. Also draw T-s plot. (CO3) 6

3.f. What do you understand by governing of steam turbines? State various methods used for governing of steam turbine. (CO4) 6

3.g. State objectives of using a) digital steam turbine control b) electronic control of gas turbine engines. (CO5) 6

SECTION C 50

4. Answer any one of the following:-

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| 4-a. | 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 |
| 4-b. | A sample of coal supplied to a boiler has following composition by mass: Carbon= 88%, Hydrogen=5%, Oxygen=3%, Nitrogen=1%, Sulphur=0.5%, Ash= 2.5%. Calculate: a) Mass of air required for complete combustion of 1 kg of fuel b) Dry analysis both by mass and by volume of products of combustion when 15% excess air is supplied. (CO1) | 10 |
| 5. Answer any one of the following:- | | |
| 5-a. | What are different types of boiler draught? For the maximum discharge conditions through a chimney having height of 15 m determine the draught in mm of water when ambient air temperature is 15 degree C. (CO2) | 10 |
| 5-b. | Differentiate between jet and surface condenser. (CO2) | 10 |
| 6. Answer any one of the following:- | | |
| 6-a. | Explain Brayton cycle in detail and also derive the expression for its efficiency in terms of pressure ratio. (CO3) | 10 |
| 6-b. | In a Rankine cycle, the steam at inlet to turbine is saturated at a pressure of 40 bar and the exhaust pressure is 0.5 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 one of the following:- | | |
| 7-a. | Dry saturated steam enters a nozzle at 12 bar and leaves at 1.5 bar with a dryness fraction of 0.95. Neglecting approach velocity, calculate the exit velocity. If 12% of heat drop is lost due to friction, find the percentage reduction in exit velocity. (CO4) | 10 |
| 7-b. | Explain constructional design and working of Pressure-Velocity Compounded impulse turbine. (CO4) | 10 |
| 8. Answer any one of the following:- | | |
| 8-a. | Explain boiler operation using computerized system in detail. (CO5) | 10 |
| 8-b. | How electrically actuated nozzles differ from automatic spray nozzles. Explain in detail. (CO5) | 10 |