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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 (2022-2023)****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. 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. Adiabatic flame temperature of a fuel is dependent on the initial temperature of (CO1) 1
- (a) Fuel
- (b) Air
- (c) Both (a) and (b)
- (d) Neither (a) and (b)
- 1-c. Which of the following boiler is best suited to meet the fluctuating demand of steam? (CO2) 1
- (a) Locomotive boiler

- (b) Lancashire boiler
 - (c) Cornish boiler
 - (d) Babcock and wilcox boiler
- 1-d. 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-e. Sometimes the pump work in vapour power cycle is neglected because (CO3) 1
- (a) the pump work in not considered in efficiency of vapour power cycle
 - (b) the pump work is very small compared to the heat addition
 - (c) the pump work is very small compared to the turbine work
 - (d) none of the above
- 1-f. 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-g. In order to generate energy in Sahara Desert where water is available in significantly low amount. Which of the following system can we employ in such a place? (CO4) 1
- (a) Gas turbine
 - (b) Tidal engine
 - (c) Steam turbine
 - (d) Gas and steam engine
- 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. Electrically actuated Nozzles (CO5) 1
- (a) are costly

- (b) need maintenance
- (c) has uniform spray coverage
- (d) all of these

1-j.	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	

2. Attempt all parts:-

2.a.	How lower calorific value and higher calorific value related. State S.I unit of calorific value. (CO1)	2
2.b.	Explain the significance of equivalent evaporation. (CO2)	2
2.c.	Draw a schematic diagram of Brayton cycle with intercooling and regeneration. (CO3)	2
2.d.	What is blade efficiency? (CO4)	2
2.e.	What is the need of monitoring the process of fuel combustion? (CO5)	2

SECTION B

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3. Answer any five of the following:-

3-a.	A mass m_1 of a substance of specific heat capacity c_1 at temperature T_1 is mixed with a mass m_2 of other substance of specific heat capacity c_2 at a lower temperature T_2 . Deduce the expression for the temperature t of the mixture. State the assumption made, if any. (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.	A boiler house has natural draught chimney of 25 m height. Flue gases are at temperature of 400 degree C and ambient temperature is 30 degree C. Determine the draught in mm of water column for maximum discharge through chimney and also the air supplied per kg of fuel. (CO2)	6
3-d.	Differentiate between down flow and central flow surface condenser. (CO2)	6
3.e.	Compare the Rankine efficiency of a high pressure plant operating from 80 bar and 400°C and a low pressure plant operating from 40 bar 400°C, if the condenser pressure in both cases is 0.07 bar. (CO3)	6

- 3.f. Show the following statement, "Converging duct behaves as nozzle for subsonic flows and the diverging duct shall behave as nozzle when flow is supersonic." (CO4) 6
- 3.g. State the pros and cons of automatic spray nozzles.(CO5) 6

SECTION C

50

4. Answer any one of the following:-

- 4-a. The volumetric composition of the dry products of combustion of an unknown fuel C_xH_y 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 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. A chimney of 33 m height is used to create a draught of 19.2 mm of water column. The temperature of the flue gases in the chimney is 369°C. Estimate the quantity of air used for each kilogram of fuel burnt in a boiler having above chimney. Take the temperature of ambient as 29.7°C. Also calculate a) Draught in terms of column of hot flue gases b) Velocity of flue gases. (CO2) 10

6. Answer any one of the following:-

- 6-a. A steam power plant running on Rankine cycle has steam entering HP turbine at 20 MPa, 500 degree C and leaving LP turbine at 90% dryness. Considering condenser pressure of 0.005 MPa and reheating occurring upto the temperature of 500 degree C determine, a) the pressure at which steam leaves HP turbine b) the thermal efficiency. (CO3) 10
- 6-b. A reheat cycle has steam generated at 50 bar, 500 degree C for being sent to high pressure turbine and expanded upto 5 bar before supplied to low pressure turbine. Steam enters at 5 bar, 400 degree C into low pressure turbine after being reheated in boiler. Steam finally enters condenser at 0.05 bar and subsequently feed water is sent to boiler. Determine cycle efficiency, specific steam consumption and work ratio. (CO3) 10

7. Answer any one of the following:-

- 7-a. Derive an expression for a fluid passing through a nozzle in terms of Mach number. (CO4) 10
- 7-b. Explain the role of compounding in the turbines. Also discuss the effect of velocity compounding with the help neat sketch diagram. (CO4) 10

8. Answer any one 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

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