# MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, WEST BENGAL

**Paper Code : ME-701**

**PUID : 07185 (To be mentioned in the main answer script)**

## POWER PLANT ENGINEERING

*Time Allotted* : 3 Hours | *Full Marks* : 70

*The figures in the margin indicate full marks.*

*Candidates are required to give their answers in their own words as far as practicable.*

### GROUP – A

**( Multiple Choice Type Questions )**

1. Choose the correct alternatives for any *ten* of the following : $10 \times 1 = 10$

i) Which one of the following is a fire tube boiler ?

a) Babcock-Wilcox boiler

b) Locomotive boiler

c) Stirling boiler

d) Benson boiler.

ii) The circulation ratio in a natural circulation water tube boiler varies between these two values

a) 4 and 20 b) 6 and 25

c) 8 and 35 d) 10 and 40.





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iii) In a boiler, feed water supplied per hour is 205 kg while coal fired per hour is 23 kg. Net enthalpy rise per kg of water is 145 KJ for conversion to steam. If the calorific value of coal is 2050 KJ/kg then the boiler efficiency will be

a) 78% b) 74%

c) 63% d) 59%.

iv) The function of an economizer in a steam power plant is to

a) increase the temperature of air supplied to a boiler

b) increase the enthalpy of feed water

c) condense the exhaust steam from the turbine

d) heat the fuel before combustion.

v) In a balanced draught steam generator, a slightly negative pressure is maintained in the furnace since

a) the FD fan cannot produced the required draught

b) the ID fan produces more draught than what is required

c) the flue gases cannot leak out from the furnace

d) no air should get out of the furnace.



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vi) Which one of the following sequence indicates the correct order for flue gas flow in the steam power plant layout ?

a) Economizer, Superheater, Air preheater

b) Economizer, Air preheater, Superheater

c) Air preheater, Economizer, Superheater

d) Superheater, Economizer, Air preheater.

vii) The critical pressure ratio for initially dry saturated steam is

a) 0·528 b) 0·546

c) 0·577 d) 0·582.

viii) For Parson's reaction turbine, the degree of reaction is

a) 20% b) 30%

c) 40% d) 50%.

ix) The flow through a nozzle is regarded as

a) Constant volume flow

b) Constant pressure flow

c) Isentropic flow

d) Isothermal flow.

x) The maximum efficiency of a De-Laval turbine is

a) $\sin^2\alpha$ b) $\cos^2\alpha$

c) $\tan^2\alpha$ d) $\cot^2\alpha$.









xi) The compounding of turbines is done in order to

a) reduce speed of rotor

b) improve efficiency

c) reduces exit losses

d) all of these.

xii) De-Laval turbine is

a) impulse reaction turbine

b) single rotor impulse turbine

c) multi rotor impulse turbine

d) none of these.

## GROUP – B

### ( Short Answer Type Questions )

Answer any *three* of the following. 3 × 5 = 15

2. What are the comparative advantages & disadvantages of firetube and watertube boilers ?

3. Differentiate between boiler mountings and boiler accessories. List out the name of boiler mountings and boiler accessories. 2 + 3

4. Derive the condition for maximum efficiency of an Impulse turbine.

5. A steam turbine operates on the Rankine cycle. It receives steam from the boiler at 20 bar and 350°C and it is exhausted into a condenser at 0·08 bar. Condensate is returned back to the boiler by a feed

pump. Assume ideal process, calculate per kg of steam (i) heat supplied in the boiler drum, (ii) net work, (iii) cycle efficiency.

6. Derive the condition for maximum discharge through a Nozzle.

## GROUP – C

### ( Long Answer Type Questions )

Answer any *three* of the following. $3 \times 15 = 45$

7. a) Write short notes on Locomotive boiler along with neat sketch. 7

b) A boiler produces 200 kg of dry and saturated steam per hour at 10 bar and feed water is heated by an economiser to a temperature of 110°C. 225 kg of coal of a calorific value of 30100 kJ/kg are fired per hour. If 10% of coal remains unburnt, find the thermal efficiency of the boiler and boiler & grate combined. 8

8. a) Derive the expression of chimney height for natural draught. 5

b) Define the term 'circulation ratio' in a water tube boiler. Write a short note on natural circulation. 5

c) Draw neat diagrams to represent schematically :

i) Induced draught

ii) Forced draught

iii) Balance draught.

Also give the advantage of forced draught over induced draught. 3 + 2







9. a) Air at 1 MPa and 600°C enters a conversing nozzle with a velocity of 150 m/s. Determine the mass flow rate through the nozzle throat area of 50 $cm^2$ when the back pressure is (i) 0·7 MPa, (ii) 0·4 MPa. 8

b) State and explain different methods of compounding. 7

10. a) A reaction turbine uses 9000 kg of steam per hour. The blades are 20 mm high and discharge angle of both fixed and moving blades is 20°. The steam leaves the fixed blades at 0·32 $N/mm^2$ with a dryness fraction of 0·95 and a velocity of 120 m/s. Assume the ratio of axial velocity of flow to blade velocity as 0·70 at entry and 0·76 at exit from moving blades. Assumed a tip leakage of 6% of the total steam. Determine —

i) Speed of turbine in rev/min

ii) Power developed. 8

b) Steam enters a group of nozzles of a steam turbine at 12 bar and 220°C and leaves at 1·2 bar. The steam turbine develops 220 kW with a specific steam consumption of 13·5 kg/kwh. If the diameter of nozzle at throat is 7 mm, calculate the number of nozzles. 7

11) Write short notes on any *three* of the following : 3 × 5

a) Benson Boiler

b) Circulating Fluidised Bed Combustion (CFBC)

c) Air pre-heater

d) Compounding of Impulse Turbine

e) Components of Nuclear Reactor.