

# Unit 10 - Week 8: Cogeneration & Combined Cycles

## Course outline

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### Week 1 : Review of Thermodynamic Principles

### Week 02 : Thermodynamic Property Relations

### Week 3 Properties of pure substances

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### Week 8: Cogeneration & Combined Cycles

 Combined gas-steam power plant

 Different arrangements in combined cycles

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 Assignment 8 solution

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## Assignment 8

The due date for submitting this assignment has passed.  
As per our records you have not submitted this assignment.

**Due on 2019-09-25, 23:59 IST.**

1) In a combined cycle power plant, having an ideal Brayton cycle as the topic cycle and an ideal Rankine cycle with reheating as the bottoming cycle, then which one among the following parameters will be independent of the condenser temperature? **1 point**

- gas turbine power output
- steam turbine power output
- net heat rejection from the combined cycle
- overall thermal efficiency

No, the answer is incorrect.  
Score: 0

Accepted Answers:  
*gas turbine power output*

2) In a Binary vapor cycle, mercury can be used as the working fluid in the topping cycle, whereas water is preferred as the working fluid in the bottoming cycle. Why mercury is not a good fluid to be used in a stand-alone power station? **1 point**

- Critical temperature of mercury is lower than water
- Saturation pressure of mercury at atmospheric temperature is too high
- Saturation pressure of mercury at atmospheric temperature is too low
- Mercury is an inferior heat conductor compared to water

No, the answer is incorrect.  
Score: 0

Accepted Answers:  
*Saturation pressure of mercury at atmospheric temperature is too low*

3) When two power producing cycles are connected in series to form a combined cycle, the effect of supplementary firing is **1 point**

- reduction in the efficiency of the topping cycle
- reduction in the efficiency of the bottoming cycle
- reduction in the power output from the bottoming cycle
- reduction in overall cycle efficiency

No, the answer is incorrect.  
Score: 0

Accepted Answers:  
*reduction in overall cycle efficiency*

4) Several combinations of power producing plants for forming combined cycles are given below, where the first one is the topping cycle and the second one is the bottoming cycle. Which one is not feasible? **1 point**

- gas turbine – steam turbine
- MHD – steam turbine
- Gas turbine – MHD
- thermoionic power generator – steam turbine

No, the answer is incorrect.  
Score: 0

Accepted Answers:  
*Gas turbine – MHD*

5) Hot gas in the MHD duct is seeded with some alkaline material such as  $K_2CO_3$  or  $KOH$  in order to **1 point**

- reduce the gas temperature
- reduce the ionization potential
- reduce the thermal conductivity
- reduce the viscosity

No, the answer is incorrect.  
Score: 0

Accepted Answers:  
*reduce the ionization potential*

6) Working of a thermoelectric power generator is based on the **1 point**

- Peltier effect
- Seebeck effect
- Thomson effect
- Joule effect

No, the answer is incorrect.  
Score: 0

Accepted Answers:  
*Seebeck effect*

7) In a combined cycle plant, the topping and bottoming cycles are having efficiencies of  $\eta_1$  and  $\eta_2$  respectively. Out of the total energy input received by the topping plant,  $x$  fraction gets lost to the surrounding at the intermediate heat exchanger. Then the overall efficiency of the cycle is **1 point**

- $\eta_1 + \eta_2 - \eta_1\eta_2 + x\eta_1$
- $\eta_1 + \eta_2 - \eta_1\eta_2 - x\eta_1$
- $\eta_1 + \eta_2 - \eta_1\eta_2 + x\eta_2$
- $\eta_1 + \eta_2 - \eta_1\eta_2 - x\eta_2$

No, the answer is incorrect.  
Score: 0

Accepted Answers:  
 *$\eta_1 + \eta_2 - \eta_1\eta_2 - x\eta_2$*

8) Three power producing cycles are connected in series to form a combined cycle. If their thermal efficiencies are 31%, 38% and 27% respectively, starting from the topmost cycle, then the percentage thermal efficiency of the combined cycle (correct to 1 decimal place) is \_\_\_\_\_%.

Hint

No, the answer is incorrect.  
Score: 0

Accepted Answers:  
*(Type: Range) 68,69.4*

**1 point**

9) The efficiency of the topping cycle of a combined cycle is 40%. The topping cycle receives 500 W of power from a high-temperature source and the bottoming cycle rejects energy at a rate of 150 W to a sink. Then the percentage efficiency of the bottoming cycle (correct to 1 decimal places) is \_\_\_\_\_%.

Hint

No, the answer is incorrect.  
Score: 0

Accepted Answers:  
*(Type: Range) 49.5,50.5*

**1 point**

10) A Rankine cycle based steam power plant should operate with a highest pressure of 3 MPa, a lowest pressure of 10 kPa, and the temperature at boiler exit must be 500°C. The available heating source is the exhaust air from a gas turbine plant with a flow rate of 175 kg/s and an entry temperature of 600°C. The boiler needs to operate as a counterflow heat exchanger, with the lowest possible temperature difference between the two fluids as 20°C. If air can be assumed as an ideal gas, the maximum possible mass flow rate of water (correct to 1 decimal place) is \_\_\_\_\_ kg/s.

Hint

No, the answer is incorrect.  
Score: 0

Accepted Answers:  
*(Type: Range) 26.1,27.1*

**1 point**