

**POWER PLANT INSTRUMENTATION
(AEIE 4231)**

Time Allotted : 2½ hrs

Full Marks : 60

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any4 (four) from Group B to E, taking one from each group.

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

Group – A

1. Answer any twelve:

12 × 1 = 12

Choose the correct alternative for the following

- (i) In a steam power plant the function of a condenser is
(a) To maintain pressure below atmospheric to increase work output from the prime mover
(b) To receive large volumes of steam exhausted from steam prime mover
(c) To condense large volume of steam to water which may be used again in boiler
(d) All the above
- (ii) NO_x formation in boiler during combustion can be reduced by
(a) Increasing the flame temperature
(b) Decreasing the flame temperature
(c) Increasing the excess air
(d) None of these
- (iii) Which of the following is generally used as a coolant in nuclear power plants?
(a) Graphite
(b) Heavy water
(c) Concrete
(d) Carbon dioxide
- (iv) Blowing down of the boiler water is the process to
(a) Control the solid concentration in the boiler water by removing some of the concentrated saline water
(b) Increase the steam temperature
(c) Reduce the boiler water pressure
(d) None of these
- (v) Blade erosion in steam turbines takes place due to
(a) High temperature steam
(b) High rotational speed
(c) Droplets in steam
(d) High flow rate.

- (vi) The function of surge tank in hydro-power plant is to
 - (a) Supply water at constant pressure
 - (b) Produce surges in the penstock pipe
 - (c) Relieve water hammer pressure in the penstock pipe
 - (d) Supply water at constant head
- (vii) The commercial sources of energy are
 - (a) Solar, wind, biomass
 - (b) Fossil fuel, hydro power and nuclear energy
 - (c) Wood, animal wastes and agriculture wastes
 - (d) None of the above
- (viii) The balance draught system uses
 - (a) Only FD fan
 - (b) Only ID fan
 - (c) Both FD fan and ID fan
 - (d) Neither FD nor ID fan
- (ix) In coal fired thermal power plant the pulverized coal is used for
 - (a) Saving fuel
 - (b) Better combustion
 - (c) Obtaining more heat
 - (d) None of these
- (x) Safety interlocks ensures
 - (a) Maximum safety to plant personnel
 - (b) To guard against catastrophic damage to equipment
 - (c) Safe starting conditions of the equipment's
 - (d) All of these

Fill in the blanks with the correct word

- (xi) In hydro power plant _____ is converted into mechanical energy.
- (xii) Swelling of boiler drum level occurs due to _____.
- (xiii) Economizer recovers heat from _____.
- (xiv) Economizer is used to heat _____.
- (xv) In a nuclear reactor heavy water serves as _____.

Group - B

2. (a) Briefly discuss the feed water and steam flow circuit of a thermal power plant with a suitable block diagram. *[[CO1] (Understand/LOCQ)]*
- (b) Outline the unit system used in pulverized coal handling plant. *[[CO1] (Remember/LOCQ)]*
- (c) Analyse how the smallest ash particles from the flue gas can be separated? *[[CO1] (Analyse/IOCQ)]*

4 + 3 + 5 = 12

3. (a) What do you mean by deration? Why is deration of feed water important for thermal power plant? *[[CO1] (Remember/LOCQ, Analyse/IOCQ)]*
 (b) Describe T-S diagram for Rankin cycle and compute the efficiency expression. Hence suggest possible ways to increase the cycle efficiency. *(CO2) (Analyse/IOCQ, Evaluate/HOCQ)]*
(2 + 3) + (4 + 3) = 12

Group - C

4. (a) State the importance of hotwell level control. Hence Draw the control scheme and discuss the same. *[[CO3](Analyse/HOCQ)]*
 (b) State the standard sequence of operations followed in burner management system. *[[CO4](Understand/LOCQ)]*
 (c) Draw the schematic of differential pressure transmitter and explain its working. *[[CO1](Apply/IOCQ)]*
(2 + 2 + 2) + 3 + 3 = 12
5. (a) Design an electronic circuit to visualise the steam and water level in the steam drum by glowing blue and red LED respectively. *[[CO3] (Evaluate/HOCQ)]*
 (b) Why boiler should always run in air rich condition? State suitable control scheme to address the same with necessary P&I diagram. *[[CO3] (Analyse/IOCQ)]*
4 + (2 + 6) = 12

Group - D

6. (a) State the automatic trip conditions of turbine that are generally provided in order to ensure safe running of the turbine. And hence design the electronic circuit to generate the turbine trip command. *[[CO4](Evaluate/HOCQ)]*
 (b) Draw and describe the bearing vibration measurement system. *[[CO5](Remember/LOCQ)]*
(4 + 4) + 4 = 12
7. (a) Describe with suitable schematic diagram the lubrication system for Turbo-Alternator. *[[CO5] (Understand/LOCQ)]*
 (b) With necessary schematic diagram, explain how turbine speed can be measured using hall sensor. *[[CO5] (Evaluate/HOCQ)]*
 (c) Draw the schematic for measurement of casing expansion and explain the same. *[[CO5] (Analyse/IOCQ)]*
4 + 4 + 4 = 12

Group - E

8. (a) What do you mean by hardness of raw water? How can hardness cause problems on a thermal power plant? *[[CO6] (Remember/LOCQ, Analyse/IOCQ)]*
 (b) Explain the procedures of evaporator distillation and the lime-soda softening process for raw water treatment. *[[CO6] (Understand/LOCQ)]*
(2 + 4) + (3 + 3) = 12

9. (a) Describe selective non-catalytic reduction method of NO_x emission control used in thermal power plant. [[CO6](Understand/LOCQ)]
- (b) Draw typical layout of a hydroelectric power plant and show various units. Describe function of Track Rash. [[CO1](Analyse/IOCQ)]
- (c) Describe the control mechanism of nuclear reactor with necessary diagram. [[CO3](Apply/IOCQ)]
- 3 + (3 + 2) + 4 = 12**

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	32.3	41.7	26

Course Outcome (CO):

After the completion of the course, the students will be able to:

1. Develop mathematical models of the liquid, thermal and gas systems by their knowledge of Mathematics, Science and engineering and analyze the process response.
2. Explore the controller modes and analyse the close loop response of the 1st and 2nd order process in presence of P, PI, PD, PID controllers.
3. Design and simulate the ON-OFF, P, PI, PID controllers with the electronic components and software like simulink, LabVIEW etc.
4. Select the control valve necessary to provide engineering solutions of various societal, professional & environmental responsibilities if imposed.
5. Identify, formulate/model, analyze the process and provide solutions using knowledge of complex control systems like feed forward, cascade, ratio, override, split range and multivariable process control.
6. Design and develop the ladder logic program in PLC for the solution of the sequential events performed in industry.

*LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question; HOCQ: Higher Order Cognitive Question.