

**POWER PLANT INSTRUMENTATION
(AEI3221)**

Time Allotted : 2½ hrs

Full Marks : 60

Figures out of the right margin indicate full marks.

*Candidates are required to answer Group A and
any 4 (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) Which of the following is a non-renewable energy source used in power plants?
(a) Solar (b) Wind
(c) Coal (d) Hydro
- (ii) In a steam power plant, the condenser is used to:
(a) Convert water into steam (b) Increase pressure of steam
(c) Condense exhaust steam from turbine (d) Remove impurities from water
- (iii) Drum level measurement using a DP transmitter is based on:
(a) Temperature difference (b) Density difference
(c) Pressure difference (d) Flow rate
- (iv) Oxygen measurement in flue gas helps in:
(a) Increasing pressure (b) Monitoring combustion efficiency
(c) Measuring steam quality (d) Controlling water level
- (v) Which of the following is a typical turbine trip condition?
(a) High lube oil pressure (b) Low vibration
(c) High bearing temperature (d) Low steam flow
- (vi) Interlocking in turbine systems ensures:
(a) Sequential and safe operation (b) Maximum power output
(c) Continuous fuel supply (d) Faster startup
- (vii) NO_x emissions in power plants are mainly formed due to:
(a) High temperature combustion (b) Low temperature combustion
(c) Low pressure (d) High humidity
- (viii) Electrostatic precipitators (ESP) are used to remove:
(a) Gaseous pollutants (b) Solid particulate matter
(c) Liquid droplets only (d) Heat from flue gases

- (ix) A mechanical overspeed trip device works based on:
 (a) Pressure variation (b) Temperature rise
 (c) Flow rate change (d) Centrifugal force
- (x) Nuclear power plants generate energy through:
 (a) Combustion of coal (b) Nuclear fusion
 (c) Nuclear fission (d) Solar radiation

Fill in the blanks with the correct word

- (xi) A thermal power plant using steam operates on the ____ cycle.
- (xii) The ____ acts as the prime mover in a steam power plant.
- (xiii) Oxygen analyzer helps in monitoring ____ efficiency.
- (xiv) The Burner Management System ensures ____ operation of burners.
- (xv) Cyclone separators are used as ____ collectors.

Group - B

2. (a) Describe T-S diagram for Rankin cycle and compute the efficiency expression. Hence suggest possible ways to increase the cycle efficiency. *[[CO1](Analyse/IOCQ)]*
- (b) Briefly discuss the feed water and steam flow circuit of a thermal power plant with a suitable block diagram. *[[CO1](Remember/LOCQ)]*
(2 + 3 + 2) + 5 = 12
3. (a) With the necessary schematic diagram, describe coal and ash circuit. *[[CO1](Remember/LOCQ)]*
- (b) Outline the unit system used in pulverized coal handling plant. *[[CO1](Remember/LOCQ)]*
- (c) What do you mean by balance draft system? Mention the range of pressure maintained inside the furnace and why is it so? *[[CO1](Remember/LOCQ)]*
4 + 4 + (2 + 2) = 12

Group - C

4. (a) Design a LED based Hydra-step system used to indicate approximate water and steam level in boiler drum. *[[CO2](Create/HOCQ)]*
- (b) State the standard sequence of operations followed in burner management system. *[[CO2](Remember/LOCQ)]*
- (c) Explain how 2/3 logic works? *[[CO3](Apply/IOCQ)]*
4 + 5 + 3 = 12
5. (a) Why dearator storage tank levels need to be maintained? Design a PI diagram for dearator storage tank level control. *[[CO2](Analyse/IOCQ)]*
- (b) Describe the operation of attemperator with necessary diagram. *[[CO2](Remember/LOCQ)]*

- (c) Why is it required to purge the furnace before it fired? Describe the operational circumstances that the burner management system monitors. [[C02](Apply/IOCQ)]
(2 + 3) + 3 + (2 + 2) = 12

Group - D

6. (a) The starting sequence of various boiler auxiliaries is configured as follows: i) Regenerative air heaters, ii) Induced draft (ID) fans, iii) Forced draft (FD) fans, iv) Primary air (PA) fans, v) Pulverisers and vi) Coal feeders. Design start interlock system using logic gates. [[C06](Create/HOCQ)]
 (b) What do you mean by differential expansion for turbine? Propose a measuring scheme for the same. [[C05](Remember/LOCQ)]
 (c) Name the sensor that can be used to measure vibration. [[C03](Remember/LOCQ)]
5 + (2 + 4) + 1 = 12
7. (a) With necessary schematic diagram, explain how turbine speed can be measured using hall sensor. [[C03](Analyse/IOCQ)]
 (b) State six important parameters monitored by Turbine Supervisory Instrumentation (TSI) system. [[C03](Remember/LOCQ)]
 (c) What is the purpose of interlock system? Describe start interlock system with suitable example. [[C06](Apply/IOCQ)]
5 + 3 + (2 + 2) = 12

Group - E

8. (a) What do you mean by hardness of raw water? How can hardness cause operational hazards in a thermal power plant? [[C06](Analyse/IOCQ)]
 (b) Explain one method of combustion control techniques that prevents the formation of NO_x during combustion. [[C04](Remember/LOCQ)]
 (c) Draw the Off-grid photovoltaic (PV) system and describe the same. [[C05](Apply/IOCQ)]
(2 + 3) + 3 + 4 = 12
9. (a) Describe any two mechanical method of raw water treatment. [[C06](Analyse/IOCQ)]
 (b) Describe selective non-catalytic reduction method of NO_x emission control used in thermal power plant. [[C04](Remember/LOCQ)]
 (c) Describe the process of indirect cooling of nuclear reactor with necessary schematic diagram. [[C05](Remember/LOCQ)]
(2 + 2) + 3 + 5 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	47.92	42.70	9.38

