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 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) In a steam power plant, the choice of high temperature steam is for
(a) Increasing the efficiency of boiler alone
(b) Increasing the efficiency of turbine alone
(c) Increasing overall efficiency
(d) None of the above.

(ii) Which of the following is a non-renewable energy source used in power plants?
(a) Solar (b) Wind (c) Coal (d) Hydro

(iii) Shrinking of boiler drum level occurs when
(a) Load demand increases (b) Steam demand decreases
(c) Boiler pressure increases (d) Both (b) and (c)

(iv) The Burner Management System (BMS) is mainly responsible for:
(a) Load sharing (b) Safe start-up and shutdown of burners
(c) Steam temperature control (d) Water treatment

(v) Differential expansion of turbine refers to
(a) Radial relative expansion between casing and rotor
(b) Axial relative expansion between casing and rotor
(c) Expansion of rotor only
(d) Expansion of casing only

(vi) Turbine Supervisory Instrumentation (TSI) system does not include measurement of
(a) Differential Expansion (b) Bearing temperature
(c) Rotor eccentricity (d) Drum level

(vii) The function of moderator in a nuclear reactor is to
(a) Slow down the fast moving neutrons
(b) Speed up the fast moving neutrons
(c) Start the chain reaction
(d) Transfer heat produced inside the reactor to a heat exchanger.

(viii) Hydro power plant is a unit that converts
(a) Kinetic energy into Potential energy
(b) Potential energy into Kinetic energy
(c) Potential energy into Electrical energy
(d) Electrical energy into Kinetic energy

(ix) Which one of the following is a chemical process of feed water treatment?
(a) Distillation by evaporators (b) Coagulation
(c) Hot lime-soda softening process (d) Sedimentation

(x) 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

Fill in the blanks with the correct word

(xi) The thermodynamic cycle commonly applied in steam power plant is _____.

(xii) Function of control rod in nuclear power plant is _____.

(xiii) Turbine shaft eccentricity causes _____

(xiv) Economizer is used to heat _____.

(xv) Cyclone separators are used as _____ collectors.

Group - B

2. (a) Briefly discuss the air and flue gas flow circuit of a thermal power plant with a suitable block diagram. *[(CO1)(Analyse/IOCQ)]*
(b) What do you mean by balance draft system? Mention the range of pressure maintained inside the furnace and why is it so? *[(CO3)(Understand/LOCQ)]*
(c) Draw and describe the schematic of a cyclone separator used for separating particulate matter. *[(CO1)(Remember/LOCQ)]*

4 + (1 + 3) + 4 = 12

3. (a) With the necessary schematic diagram, describe coal and ash circuit. *[(CO1)(Remember/LOCQ)]*
(b) Using a block diagram, describe the activities that are performed on raw coal to convert it to a furnace-acceptable condition. *[(CO1)(Understand/LOCQ)]*
(c) Why is it necessary to pre-heat the air that enters the furnace? Describe how did it done? *[(CO1)(Analyse/IOCQ)]*

4 + 5 + (1 + 2) = 12

Group - C

4. (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

5. (a) State the ways of generating load demand control signal for the furnace firing. *[(CO3) (Understand/LOCQ)]*

(b) Explain, using the appropriate graphs, how excess air affects boiler efficiency. *[(CO3) (Analyse/IOCQ)]*

(c) Discuss best control scheme adopted for steam temperature control during dynamic load condition. *[(CO3) (Analyse/IOCQ)]*

4 + 3 + 5 = 12

Group - D

6. (a) What is the purpose of interlock system. Describe start interlock system with suitable example. *[(CO4) (Understand/LOCQ)]*

(b) 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 stop interlock system using logic gates. *[(CO4) (Create/HOCQ)]*

(c) State six emergency boiler Shutdown/Tripping conditions. *[(CO4) (Remember/LOCQ)]*

(2 + 2) + 5 + 3 = 12

7. (a) Describe the turbine speed control scheme with necessary P&I diagram. *[(CO5) (Analyse/IOCQ)]*

(b) What do you mean by differential expansion for turbine? Why it may occurs in turbine. *[(CO5) (Understand/LOCQ)]*

(c) Draw and explain a schematic for detecting turbine differential expansion. *[(CO5) (Understand/LOCQ)]*

5 + 4 + 3 = 12

Group - E

8. (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 for heat generation in nuclear reactor with necessary diagram. *[(CO3)(Apply/IOCQ)]*

3 + (3 + 2) + 4 = 12

9. (a) Describe typical layout of the hydroelectric power plant. Hence explain the function of surge tank. *[(CO3)(Analyse/HOCQ)]*

(b) Describe the operation of direct cooling system of nuclear reactor with suitable schematic diagram. *[(CO4)(Remember/LOCQ)]*

(c) State desirable properties of coolant used in nuclear power plant.

[(CO1) (Remember/LOCQ)]

(4 + 2) + 4 + 2 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	45.83	38.54	15.63