

Birla Institute of technology & Science, Pilani.

I Semester 2022-2023MEF420 Power Plant Engineering

Comprehensive examinations

Dated:22/12/2022

Total Time: 180 Minutes

Maximum marks: 80

Weightage: 40%

(Part:A Closed Book) Answer very brief and to the point15x2=30Marks.

- Q1)**What are the challenges in installing FGD technologies in Indian Coal based power plants?
- Q2)** Why Solar Thermal Power Generation is still not popular like solar PV Cell technology?
- Q3)** Why off shore windmills are still not popular in India despite the long coastline available for exploration while many European countries go for this technology?
- Q4)** What is the importance of PLF on the LCOE? Justify with suitable example.
- Q5)** What is the effect of Circulation ratio (CR)on the compact design of evaporator section of the boiler and failure prevention of boiler tubes? Justify your answer.
- Q6)** Why the natural draught, hyperbolic cooling towers needs to be very tall to the tune of 100m or more? What are the advantages of such cooling tower?
- Q7)** What is the term “LOCA” associated with the nuclear safety and when does this happen?
- Q8)**Why gas turbine power plants are popular in UAE, but not in India? Justify in terms of LCOE.
- Q9)** Is it possible to use the cooling tower designed for summer season of Rajasthan in coastal region of TN? Justify your answer.
- Q10)**Why the coal handling system of 210MW capacity power plant unit in NLC, Neyveli is much larger in size when compared to the same capacity unit in NTPC,Singrauli? Justify your answer.
- Q11)** Explain the difference between hydrograph and flow duration curve. Also explain the method of arriving at flow duration curve of a river.
- Q12)**Why auxiliary power consumption by ID fans is more than FD fans for the same unit?
- Q13)** What will be the impact of moisture content in the coal on its grind ability combustibility?
- Q14)** Why the regions more suitable for the installation wind farm may not be suitable for solar thermal power plant? Justify your answer.
- Q15)**What are the three controls used in wind mill? Explain the need for these controls?
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(Part: B Open Book)

Answer very brief and to the point

5x10=50Marks.

Q16) In India, some of the coal based power plants are very old and operating using subcritical cycle and some of the modern power plants operate with ultra supercritical technology. It is suggested to compare the performance of the two in terms of a) SCC b) Fuel cost/kWh c) PM released in kg/ kWh d) Auxiliary Power consumption in FD and ID fans and e) CO₂ released in kg/kWh. Make a table showing the comparison based on the data given below. Take atmospheric temperature as 25°C and pressure as 760mm of mercury column.

Table. 1 Coal composition used in both the power plants

Coal	C (% In mass)	M(% in mass)	A(% in mass)	S (% in mass)	H(% in mass)	O(% in mass)	V(% in mass)	N(% in mass)	Cost of Coal
Indian	34.5	11.14	40.88	0.5	2.98	9.56	20.96	0.27	Rs.2500/T

Table.2 Data related two power plants

Power Plant	Overall Efficiency	Capacity	Suction Pressure drop	Delivery pressure drop	Efficiency of FD/ID Fans (%)	A:F	Flue gas temperature
Ultra Super critical	43%	800MW	200mmWC	300mmWC	65/55	6:1	150°C
Sub critical	30%	220MW	220mmWC	320mmWC	60/50	7:1	180°C

Q17) A wind mill having sweep diameter of 30m with inlet air velocity of 12m/s. Conversion efficiency of the wind mill is 80% of the maximum possible efficiency. Wind velocity is available only for 9 months in a year. Find the following a) Total units of electricity produced b) PLF c) Installed capacity of the wind mill d) Total cost of wind mill if 1MW installed capacity cost Rs.7C/MW. e) Time to recover the initial cost if the electricity is supplied to the grid @Rs.4/kWh as per the power purchase agreement.

Q18) A parabolic trough based solar thermal power plant is to be installed to generate 100MW capacity. Overall efficiency of the power cycle is 20%. HTF (Density= 700kg/m³ and Cp= 2.8kJ/kgK) undergoes temperature increase of 200°C to 400°C in the solar field. Efficiency of the collectors is 45% and the heat input to the absorber is 1.5kW/m if the maximum velocity of the HTF inside the tube is restricted to 0.8m/s. Find a) Total flow rate of HTF required in heat exchanger b) Number of parallel rows required c) Number of collectors required in each row if

length of each collector is 5m d) total area of solar field is each collector occupies 20m² area. Take the ID of absorber tube as 37.5mm.

Q19) Compare the LCOE of a thermal and solar based power plants based on the following details.

Type	Life (years)	Initial cost	Availability (in Years)	SCC (kg/kWh)	Wages and Maintenance/ unit	Capacity	I+I+T
Coal based Thermal	25	Rs.7C/MW	90%	0.9kg/kWh	Rs.0.5	800MW	15%
Solar Thermal	30	Rs.12C/MW	33%	Nil	Rs.0.1	10MW	5%.

Take depreciation is uniformly distributed throughout the life. Take salvage value of 20% for both.

Q20) A pumped storage power plant gets power of 100MW during 15hours of non peak hour operation and need to supply excess power during peak demand. Maximum head available is 100m neglecting the variation in the head, taking the efficiency of pump and turbine as 60% and 70% respectively. Find 1) Peak power demand which can be met by the plant for the remaining 9hours of the day and 2) loss in revenue due to energy storage taking cost of electricity as Rs.5/kWh. Also explain the need for energy storage from the view point of DSM.
