Chapter 1 – Thermal Power Plant

Sr. No.	Questions	DEC – 16	MAY – 17	NOV – 17	MAY – 18	DEC – 18	MAY – 19	DEC – 19
Theory								
1.	Draw a neat general layout of thermal power plant and make a list of site selection criteria for the same. OR State the factors to be considered for selection of site for thermal power plant	4	7	4	3		3	
2.	Explain the present power position in India.							3

Chapter 2 – High Pressure Boiler

Sr. No.	Questions	DEC – 16	MAY – 17	NOV – 17	MAY – 18	DEC – 18	MAY – 19	DEC – 19
Theory								
1.	Explain in brief water circulation methods in boilers with neat sketch.				4			
2.	Describe the unique features of high pressure boilers in brief. Explain constructional difference between Low pressure and High pressure boiler.				3			4
3.	Explain the function of following equipments in a thermal power plant: Reheater, control room and air-preheater.					3		
4.	List the different methods used to control the superheat temperature of steam and explain any one method in details.	3					4	
5.	Explain working of Schmidt-Hartmann boiler with neat sketch.	7						
6.	Explain with neat sketch construction and working of Benson boiler and state its advantages. OR Draw a line diagram of a Benson boiler. State the main difficulties experienced in the La Mont boiler and how it is prevented?		7				7	
7.	Name two indirectly heated high pressure boilers and explain construction and working of any one of them.					7		
8.	Discuss FBC. Explain CFBC with neat sketch			7		4		

	OR Explain the principle of fluidized bed combustion.							
9.	State the advantages and disadvantages of pressurized fluidized bed combustion boiler.						3	
10.	What is sub-critical and super critical boiler?				3			

Chapter 3 – Coal and Ash Handling System

Theory

Sr. No.	Questions	DEC – 16	MAY – 17	NOV – 17	MAY – 18	DEC – 18	MAY – 19	DEC – 19
1.	Explain working of Bowl pulverizing mill with neat sketch.	7		3				7
2.	Explain unit pulverized coal handling system with neat sketch.	4				4		
3.	State the requirements of pulverized coal burners.						4	
4.	Discuss requirements of oil burners. With neat sketch explain long flame, turbulent burners and tangential Burners. OR Explain cyclone burner with neat diagram		7			7		
5.	Discuss In-plant coal handling system			4				
6.	Discuss out-plant coal handling system				4			
7.	Explain the statement:- “Coal handling system is called lifeline of the coal fired power plants”.				3			
8.	Explain pulverized coal system and state its merits and demerits.				7			
9.	Write a short note on electrostatic precipitator.					7	7	
10.	What are the requirements of a good ash handling plant.					3	4	3
11.	Enumerate different types of Ash handling system. Explain Pneumatic ash handling system with advantages and disadvantages.		7					

Chapter 4 – Draught Systems

Theory

Sr. No.	Questions	DEC – 16	MAY – 17	NOV – 17	MAY – 18	DEC – 18	MAY – 19	DEC – 19
1.	Explain the term, "Boiler Draught". Also state the classification of boiler draught.				4			
2.	Distinguish between force draught and induced draught.	3		3		4		
3.	With a neat diagram explain balanced draught. Also explain pressure distribution in balanced draught.					4		
4.	State the classification of Draught. Derive an expression for maximum discharge through a chimney.		7		4			
5.	Explain Natural draft cooling tower with neat sketch.							7
6.	State the advantages of Mechanical draught over Natural draught.			3			3	
7.	With usual notations derive an expression of estimation of height of chimney and condition of maximum discharge and Prove the following: Maximum discharge through chimney occurs when $T_g/T_a = 2(m_a + 1)/m_a$ Where Tg and Ta are gas and air temperature respectively and ma is mass of air.			7				
8.	Derive equation for maximum discharge through chimney.							7

Chapter 5 – Steam Nozzles

Sr. No.	Questions	DEC – 16	MAY – 17	NOV – 17	MAY – 18	DEC – 18	MAY – 19	DEC – 19
	Theory							
1.	Define the term nozzle and diffuser. Also state its applications				3			
2.	Define critical pressure. Derive $\frac{p_2}{p_1} = \left(\frac{2}{n+1}\right)^{\frac{n}{n-1}}$; where P2 is throat pressure, P1 is inlet pressure and n is the index of isentropic expansion of steam through the nozzle.	7			7			
3.	Derive equation of critical pressure ratio of nozzle and explain its significance. Calculate its value for superheated steam.				7			3
4.	Derive the condition and then equation of maximum discharge through the nozzle, also write maximum discharge for different condition of steam. OR Derive expression for mass flow rate of steam through nozzle.		7				7	4
5.	Derive the expression for the velocity in terms of enthalpy drop for a flow through the nozzle.					3		
6.	Explain friction in nozzle during steam flow.							4
	Examples							

1.	The pressure and temperature of steam entering the nozzle are 12 bar and 200°C and steam leave the nozzle at 1 bar. The diameter of the nozzle at throat is 10 mm. Calculate the mass flow rate of steam in a nozzle and which type of nozzle is required?	7						
2.	Steam is expanded in nozzle from 15 bar and 350 ºC to 1 bar. Find the throat and exit area if flow rate is 1 kg/sec. What should be coefficient of velocity if exit velocity is 1150 m/sec?		7					
3.	Dry saturated steam at a pressure of 8 bar enters a convergent divergent nozzle and leaves it at a pressure of 1.5 bar. If the flow is isentropic and the corresponding expansion index is 1.135; Calculate the ratio of cross-sectional area at exit throat for maximum discharge.			7				
4.	Steam at a pressure of 15 bar and dryness fraction 0.95 is discharged through a convergent-divergent nozzle to a back pressure of 0.5 bar. The mass flow rate is 9 kg/kwhr. If the power developed is 200 kW, determine : (i) Throat pressure (ii) Number of nozzles required if each nozzle has a throat of rectangular cross-section of 4 mm x 8 mm. (iii) If 10% of overall isentropic enthalpy drop reheats by friction the steam in divergent portion, find the cross-section of the exit rectangle.					7		
5.	A nozzle expands steam from 12 bar and 250°C to 6 bar. Is the nozzle convergent or divergent? Neglecting the initial velocity, find the minimum area of the nozzles to flow 2.2 kg/s of steam under the given conditions. Assume the expansion of steam isentropic. Calculate the actual throat area if the coefficient of discharge is 0.97.							7

Chapter 6 – Steam Turbines

Sr. No.	Questions	DEC – 16	MAY – 17	NOV – 17	MAY – 18	DEC – 18	MAY – 19	DEC – 19
Theory								
1.	Give detailed classification of steam turbines.				4		4	
2.	Explain the principle of operation of steam turbine. Give comparison of Impulse and Reaction Turbine					3		3
3.	Describe the term, "compounding of steam turbine". Why it is essential? Explain pressure-velocity compounding of impulse turbine with diagram.	7		7	7			4
4.	Define blade efficiency and derive an expression for maximum blade efficiency for single stage impulse steam turbine.	7						
5.	State and explain losses in steam turbine.		7					
6.	Explain working principle of pressure compounding with neat sketch.			3			7	
7.	Explain nozzle governing system. Differentiate between throttle governing and nozzle control governing.			3			4	
8.	Explain the working principle of plain Labyrinth glands used in steam turbine.					3		
Examples								
1.	Steam issues from the nozzles at angle of 18° at a velocity of 450 m/sec. the friction factor is 0.88. For a single stage turbine designed for maximum efficiency, determine (i) Blade velocity (ii) Moving blade angles for equi-angular blades (iii) blade efficiency (iv) stage efficiency if the nozzle efficiency is 95% (v) Power developed for a mass flow rate of steam of 4 kg/sec.	7						

2.	The Data pertaining to an impulse turbine is as: Blade speed = 300 m/s, Isenthalpic enthalpy drop in nozzle = 450 kJ/kg, Nozzle efficiency = 90 %, Nozzle angle = 20º, Blade velocity co efficient = 0.85, Blade exit angle = 25^0 Calculate for a mass of 1 kg/sec; (1) Inlet angle of moving blades (2) The axial thrust (3) The driving force on the wheel (4) The diagram power (5) The energy lost in blades due to friction (6) Blade efficiency		7					
3.	A reaction turbine runs at 3000 RPM and steam consumption is 18000 kg/hr. The pressure of Steam at a certain pair is 2 bar, its dryness fraction is 0.94 and the power developed by the pair is 52 kW. The discharge blade angle is 20° for both fix and moving blades and the axial flow velocity is 0.72 times the blade velocity. Find out the drum diameter and blade height. Take the tip leakage steam as 8 %. Neglect the Blade thickness.		7					
4.	The data refer to a stage of Parson's reaction turbine: The mean diameter of blade ring is 680 mm. Running speed is 3100 rpm. The steam velocity at exit from fixed blades is 160 m/s. Blade outlet angle is 21°. Steam flow rate through blades is 7.4 kg per second. Draw the velocity diagram and find:(i) Blade inlet angle(ii) Power developed in the stage.(iii) The maximum blade efficiency.			7				
5.	In a 50% reaction turbine, the speed of rotation of blade group is 3000 rpm with min blade velocity of 120 m/sec. The velocity ratio is 0.8 and the exit angle of the blade is 20º. If the mean blade height is 30 mm, Calculate the total steam flow rate through the turbine. Neglect the effect of blade edge thickness of the annular area, but consider 10% of the total steam				7			

	flow rate as the tip leakage loss. The mean condition of the steam in that blade group is found to be 2.7 bar and 0.95 dry.							
6.	A single row impulse turbine develops 135 kW at a blade speed of 180 m/sec using 2 kg of steam per second. Steam leaves the nozzle at 400 m/sec. Velocity coefficient of the blades is 0.9. Steam leaves the turbine blades axially. Determine (i) Nozzle angle (ii) Blade angles at entry and exit assuming no shock					7		
7.	A mean blade ring diameter of a single stage impulse turbine is 1.3 meter. It runs at 3200 R.P.M. The nozzle angle is 150 and blade speed ratio is 0.45. The blade friction factor is 0.9 and the discharge is axial. Calculate blade inlet and outlet angles and power output per kg of steam.						7	
8.	A single stage impulse turbine has a mean blade ring diameter of 120 cm and runs at 3500rpm. The blade speed ratio is 0.45 and discharge is axial. The nozzle angle is 16° and blade friction factor is 0.9. Determine : (i) blade angles and (ii) theoretical specific power output							7

Chapter 7 – Condensers and Cooling Tower

Sr. No.	Questions	DEC – 16	MAY – 17	NOV – 17	MAY – 18	DEC – 18	MAY – 19	DEC – 19
Theory								
1.	Explain the methods for obtaining maximum vacuum in condenser.		4	3				
2.	Explain following terms pertaining to cooling tower: Drift, Approach, Range and Cooling efficiency of cooling tower.		3	4				
3.	Types of Cooling Towers. What is the necessity of cooling tower in a steam power plant?			4			3	
4.	Classification of Condensers. Discuss the importance of condenser in thermal power plant.			3	3			
5.	Explain downflow surface condenser. OR Write short not on surface condenser.				4	4		
6.	Give comparison between jet and surface condenser.							3
7.	What are the sources of air leakage in a condenser?					3		
8.	Define following term: 1) Vacuum efficiency 2) Condenser efficiency						3	
9.	How the Dalton's law of partial pressure can be applied to condenser application?				4			
Examples								
1.	In a condenser, vacuum reads 716 mm of Hg while barometer reads 756 mm of Hg. The temperature of condensate is 25°C. Determine (i) The pressure of the steam and air (ii) Mass of air per kg of steam (iii) The vacuum efficiency.	7						

Chapter 8 – Feed Water Treatment

Sr. No.	Questions	DEC – 16	MAY – 17	NOV – 17	MAY – 18	DEC – 18	MAY – 19	DEC – 19
Theory								
1.	Explain Zeolite ion exchange process for feed water treatment plant.	7			7	7	7	
2.	Explain reverse osmosis process.							3
3.	Describe working of hot sodium zeolite process with neat sketch and chemical reactions. List advantages and disadvantages over ion exchange system.		7					
4.	Why feed water treatment is essential in power plants? Explain the role of boiler feed water pH in corrosion of boiler tubes.			4	3		3	3
5.	Discuss various methods of water treatment.			7				

Chapter 9 – Gas Turbine

Sr. No.	Questions	DEC – 16	MAY – 17	NOV – 17	MAY – 18	DEC – 18	MAY – 19	DEC – 19
Theory								
1.	Explain closed cycle gas turbine plant with figure.				4			
2.	Explain the parameters affected on work ratio in gas turbine power plant.	7						
3.	Derive an expression for air standard efficiency of ideal Bryton cycle in terms of pressure ratio. State the assumption made. OR Draw the P-V and T-S diagram of ideal Brayton cycle.						4	
4.	The air at p_1 and T_1 enters into a gas turbine cycle and compressed to p_2 ($R = p_2/p_1$) and then heated to temperature T_3. The air is expanded into two stages having same pressure ratio in each turbine. The air after expansion in first stage is reheated to T_3 before passing to second stage of the turbine. Considering all processes ideal and intermediate pressure, $p_i = \sqrt{p_1 p_2}$ Prove that, $$\frac{W_{net}}{C_p T_1} = 2T\left(1 - \frac{1}{\sqrt{K}}\right) - (K - 1)$$ Where, $T = T_3 / T_1$, $K = R^m$ and $m = \gamma -1 / \gamma$ Also derive for the maximum specific work output, $R = \left(\frac{T_3}{T_1}\right)^{\frac{2}{3m}}$		7					7

5.	Explain open cycle gas turbine plant with figure.							3
6.	A short note on Gas turbine with Inter cooling, Regeneration and Reheating with schematic and temperature-entropy diagram.			7	7			
7.	Explain combined cycle power plant OR Give importance & State the advantages of combined gas and steam power plant.			7		4		3
8.	Explain the effect of operating variables on the thermal efficiency of a gas turbine cycle.				7			
9.	What is the need of cooling gas turbine blades? Explain transpiration cooling of gas turbine blades.					3		
	Examples							
1.	A gas turbine operates on Brayton cycle. The temperature range is 1050 K and 288 K. Find pressure ratio for maximum power output. Also determine thermal efficiency, work ratio and power output, if the mass flow rate of air is 20 kg/sec. Take Cp = 1.005 kJ/kg K and ϒ = 1.4 for compression and expansion process.	7						
2.	In a closed cycle gas turbine the following data apply, Working substance is air, Cp = 1 kJ/kg K and γ = 1.4; Ambient temperature = 27 ºC; Top temperature = 823 ºC; Pressure at compressor inlet = 1 bar; Pressure ratio = 4; Compressor efficiency = 80 %; Turbine efficiency = 85 %; Heating value of fuel = 41800 kJ/kg; Heater loss = 10 % of heating value; Neglect mass of fuel. Find the following : (1) Specific Compressor work (2) Heat supplied per kg of air (3) Specific Turbine work (4) Specific Net work output (5) Work ratio (6) Thermal efficiency of cycle.		7					

3.	A gas turbine plant is operated between 1 bar and 9 bar pressures and minimum and maximum cycle temperatures are 25 °C and 1250 °C. A compression is carried out in two stages with perfect intercooling. The gases coming out from H.P. turbine are heated to 1250 °C before entering into L.P. turbine. The expansions in both turbines are arranged in such a way that each stage develops same power. Assuming compressors and turbines isentropic efficiencies as 83 %. (a) Determine the cycle efficiency assuming ideal regenerator. (b) Find the power developed by the cycle in kW if the air flow through the power plant is 16.5 kg/sec. Neglect the mass of fuel. All the components are mounted on a single shaft.		7					
4.	A gas turbine operates on Brayton cycle. The temperature range is 1050 K and 288 K. Find pressure ratio for maximum power output. Also determine thermal efficiency, work ratio and power output, if the mass flow rate of air is 20 kg/sec. Take C_p = 1.005 kJ/kg K and γ = 1.4 for compression and expansion process.					7		
5.	Air enters to compressor of gas turbine plant operating on Brayton cycle at 100 kPa and 300 K with a volumetric flow rate of 5 m^3 / sec. the compression pressure ratio is 10. The turbine inlet temperature is 1300 K. The turbine and compressor has an isentropic efficiency of 0.82 and 0.8 respectively. Calculate 1) Thermal efficiency of the cycle 2) Back work ratio 3) Net power developed in kW Assume C_p =1.005 kJ/kg and Υ=1.4 for air and gases.						7	

Chapter 10 – Nuclear Power Plant

Sr. No.	Questions	DEC – 16	MAY – 17	NOV – 17	MAY – 18	DEC – 18	MAY – 19	DEC – 19
Theory								
1.	Write down the function of following components of nuclear reactor :1) Moderator 2) Control rod						3	
2.	List the nuclear reactors. Explain working of Pressurized water reactor.	7						
3.	Explain with neat sketch construction and working of CANDU type reactor.		7		7			7
4.	Main components of nuclear reactor and nuclear control			3				
5.	Discuss Boiling Water Reactor (BWR) with neat sketch.			4				
6.	Chain Reaction in Nuclear Power plant			3				
7.	What is the difference between fissionable and fertile materials? OR Differentiate between nuclear fusion and fission.				3	7		4
8.	Write a note on fast breeder reactor.					4	7	
9.	Discuss Chain Reaction in Nuclear Power plant							3

Chapter 11 – Jet Propulsion

Sr. No.	Questions	DEC – 16	MAY – 17	NOV – 17	MAY – 18	DEC – 18	MAY – 19	DEC – 19
Theory								
1.	Explain construction and working of Turbojet.	7						
2.	State classification of rocket engines.					3		
3.	Explain the principle of jet and rocket propulsion with neat sketch.		3					4
4.	Discuss Turbojet Engine, also discuss with equations of (1) Thrust (2) Thrust power (3) Propulsive efficiency and (4) Thermal efficiency.			4			3	
5.	Explain the working principle of Turboprop engine with neat sketch.				4			
6.	What do you mean by thrust augmentation? State the methods for thrust augmentation in a turbojet engine and discuss any one of them.					4		
7.	Differentiate between ramjet engine and pulsejet engine						4	

Chapter 12 – Economics of Power Generation

Sr. No.	Questions	DEC – 16	MAY – 17	NOV – 17	MAY – 18	DEC – 18	MAY – 19	DEC – 19
Theory								
1.	Explain Demand Factor, Diversity Factor and Plant Capacity Factor.		3					
2.	Define the following terms:- (i) Peal load (ii) Average load (iii) Plant Capacity factor (iv) Connected load (v) Demand factor (vi) Diversity factor (vii) Plant use factor		3		7		4	3
3.	What do you understand by the term tariff? State the various methods for calculation of tariff and discuss any three of them.					7		7
4.	Write short note on cost of power plant.							4
Examples								
1.	A 200 MW thermal power plant has peak load of 130 MW. The power station supplies load to four town having their maximum demand of 30 MW, 40 MW, 25 MW and 45 MW. The annual load factor is 65%. Find: (i) Average load on the plant (ii) Energy supplied per year (iii) Diversity factor (iv) Demand factor (v) Plant capacity factor.	7						
2.	The maximum load on thermal power plant of 70 MW capacity is 55 MW at an annual load factor of 60 %. The Coal consumption is 0.96 kg per unit of energy generated and the cost of coal is Rs. 2 per kg. Find the annual revenue earned if the electric energy is sold at Rs. 2.5 per kWh.		7					

3.	The annual peak load on 30 MW power station is 25 MW. The power station supplies load having maximum demand of 10 MW, 8.5 MW, 5 MW and 4.5 MW. The annual load factor is 0.45. Calculate: 1. Average load2. Energy supplied per year3. Diversity factor4. Demand factor			7				
4.	Calculate the cost of generation per kWhr for a power station having following data: Installed capacity of plant = 200 MW, Capital cost = Rs. 400 crores, Rate of interest and depreciation = 12 %, Annual cost of fuel, salaries and taxation = Rs. 5 crores, Load factor = 50%.						7	