NARASIMHA REDDY ENGINEERING COLLEGE

(Autonomous)

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Department Of Mechanical Engineering

Steam Power & Jet Propulsion

QUESTION BANK

Unit-I

Part – A (Short Answer Questions)					
1		What is adiabatic process?	L1	CO1	PO1,PO2
2		Explain different methods to improve the efficiency of Rankine cycle	L1	CO1	PO1,PO2
3		Compare and contrast the boiler Mountings and Accessories.	L4	CO1	PO1,PO2
4		Explain regenerative cycle with neat sketch.	L1	CO1	PO1,PO2
5		Differences between external fired and internal fired boilers	L1	CO1	PO1,PO2
6		State differences between high-pressure and low pressure boilers?	L1	CO1	PO1,PO2
7		Name the methods adopted for improving the performance of the Rankine cycle	L1	CO1	PO1,PO2
8		State the essential differences between Carnot and Rankine cycles.	L2	CO1	PO1,PO2
9		What is the function of fusible plug?	L2	CO1	PO1,PO2
10		Differentiate the super heater and economizer	L3	CO1	PO1,PO2
11	a)	Explain the effect of operating variables on Rankine cycle performance.	L2	CO1	PO1,PO2
	b)	A steam power plant operates on ideal Rankine cycle. The steam enters the turbine at 3 MPa, 350 ^{0}C and is condensed in the condenser at 75 kPa, calculate thermal efficiency, back work ratio and work ratio of this cycle.	L3	CO1	PO1,PO2
12		Explain the working principle of a volex boiler with a neat sketch and indicate all mountings and accessories on it.	L2	CO1	PO1,PO2
13	a)	Calculate the height of a chimney required to produce a draught equivalent to 1.7cm of water if the flue gas temperature is 270^{0}C and ambient temperature is 22^{0}C and minimum amount of air per kg of fuel is 17kg.			
	b)	What are the advantages and disadvantages of regenerative cycle over simple Rankine cycle?.	L3	CO1	PO1,PO2

14		Steam at 15 bar and 300 ^{0}C expands isentropically in a steam turbine till the temperature falls to 80 ^{0}C. Find the condition of steam at the end of expansion process and the work done per kg of steam. If the steam flow rate is 10 kg/s, what power will be produced by the turbine	L3	CO1	PO1,PO2
15		A power generating plant uses steam as working fluid and operates at boiler pressure of 50 bar, dry saturated and condenser pressure of 0.5 bar. Calculate for these limits i) the cycle efficiency and ii) the work ratio and iii) specific steam consumption for Carnot cycle and Rankine cycle.	L3	CO1	PO1,PO2
16		In a steam turbine installation running on ideal Rankine cycle steam leaves the boiler at 10 MPa and 700^{0}C and leaves turbine at 0.005 MPa. For the 50 MW output of the plant and cooling water entering and leaving condenser at 15^{0}C and respectively determine. i) The mass flow rate of steam in kg/s ii) The mass flow rate of condenser cooling water in kg/s iii) The thermal efficiency of cycle iv) The ration of heat supplied and rejected (in boiler and condenser respectively). Neglet K.E. and P.E. changes.	L3	CO1	PO1,PO2

UNIT–II

S.No.		Questions	BT	CO	PO
Part – A (Short Answer Questions)					
1		Explain super saturated flow of steam in steam nozzles.	L2	CO2	PO2
2		Derive an expression for maximum mass flow through a convergent divergent nozzle when steam is expanded isentropic ally.	L2	CO2	PO2
3		What is the effect of friction on nozzle?.	L2	CO2	PO2
4		Draw different nozzle cross sections and explain them.	L1	CO2	PO2
5		Define Metastable state and critical velocity.	L2	CO2	PO2
6		Discuss the effects of friction on the performance of nozzles	L3	CO2	PO2
7		What do you understand by nozzle? Discuss different types of nozzles.	L1	CO2	PO2
8		What is the effect of friction on flow through steam efficiency	L2	CO2	PO2
9		What are the parameters affect the nozzle efficiency?	L2	CO2	PO2
10		Explain the phenomenon of supersaturated flow ?	L1	CO2	PO2
Part – B (Long Answer Questions)					
11	a)	Derive the equation for critical pressure ratio of nozzle for different conditions.	L2	CO2	PO2
	b)	In a convergent-divergent nozzle, the steam enters at 15 bar and 300 ^{0}C and leaves at 2 bar. The inlet velocity to the nozzle is 150 m/s. Find the required throat and exit areas for a mass flow rate of 1 kg/s. Assume nozzle efficiency to be 90% and Cp_s = 2.4 kJ/kg K.	L2	CO2	PO2
12		Derive the equation for critical pressure ratio in nozzles.	L2	CO2	PO2
13		Air is expanded reversibly and adiabatically in a nozzle from 13 bars and 150^{0}C to a pressure of 6 bar. The inlet velocity of the nozzle is very small and the process occurs under steady flow conditions. Calculate the exit velocity of the nozzle. b) Describe the ‘over expansion’ and ‘under expansion’ in nozzles.	L1	CO2	PO2

14		Calculate the throat and exit diameters of a convergent- divergent nozzle, which will discharge 820 kg of steam per hour at a pressure of 8 bar superheated to 220^0C into a chamber having a pressure of 1.5 bar. The friction loss in the divergent portion of the nozzle may be taken as 0.15 of the isentropic enthalpy drop.	L1	CO2	PO2
15		A convergent-divergent nozzle is required to discharge 2 kg of steam per second. The nozzle is supplied with steam of 10 bar and 200 ^{0}C and discharge takes place against a back pressure of 0.34 bar. Estimate the throat and exit areas. Assume isentropic flow and take the index n = 1.3. If the nozzle efficiency is assumed to be 85%, determine the exit area.	L1	CO2	PO2
16		A single stage of simple impulse turbine produce 120 kW at blade speed of 150 m/s when steam mass flow rate is 3 kg/s. Steam enters moving blade at 350 m/s and leaves the stage axially. Considering velocity coefficient of 0.9 and smooth entry without shock into blades, determine the nozzle angle and blade angles. Solve using velocity diagram.	L1	CO2	PO2
17		An impulse turbine of 1MW has steam entering at 20 bar 3000C and steam consumption of 8 kg per kW hour. Steam leaves at 0.2 bar and 10% of total heat drop is lost in overcoming friction in deveining portion of nozzle. If throat diameter of each nozzle is 1 cm then determine (i) the number of nozzle required (ii) exit diameter of each nozzle. Solve using mollier diameter	L4	CO2	PO2

Unit-III

S.No.		Questions	BT	CO	PO
Part – A (Short Answer Questions)					
1		Write the equation for blade efficiency (or) diagram efficiency derivation for impulseTurbine.	L2	CO3	PO2,PO4
2		Write the equation for blade efficiency (or) diagram efficiency derivation for impulseturbine	L3	CO3	PO2,PO4
3		Draw velocity triangle for 50% reaction steam turbine	L2	CO3	PO2,PO4
4		What is the difference between impulse and reaction blading.	L1	CO3	PO2,PO4
5		Explain the working of a single stage impulse turbine with the help of sketch.	L2	CO3	PO2,PO4
6		Derive the equation optimum work out put in impulse turbine.	L2	CO3	PO2,PO4
7		Why compounding is necessary in the steam turbines? What are the types and explain any one type of compounding with neat sketch.	L2	CO3	PO2,PO4
8		Explain the concept of critical pressure ratio	L3	CO3	PO2,PO4
9		Briefly explain the saturated flow through the nozzle.	L2	CO3	PO2,PO4
10		Sketch the velocity diagram of a single stage impulse turbine and determine the expression for the force, work done, diagram efficiency and axial thrust.	L2	CO3	PO2,PO4
Part – B (Long Answer Questions)					
11	a)	Draw the line diagram and velocity triangles and explain the working details of impulse turbine	L2	CO3	PO2,PO4
	b)	Steam leaves the nozzle of a single stage impulse turbine at 850 m/s. The nozzle angle is 180 and the blade angles are 290 at the inlet and outlet. The friction coefficient is 0.9. Calculate blade velocity and steam mass flow rate in kg/hr to develop 300 W power	L2	CO3	PO2,PO4
12	a)	Derive the condition for maximum efficiency and blade height of reaction turbine.	L2	CO3	PO2,PO4
	b)	In a Parson reaction turbine, the angles of receiving tips are 350 and of discharging tips, 200. The blade speed is 100 m/s. Calculate the tangential force, power developed, diagram efficiency and axial thrust of the turbine, if its steam consumption is 1 kg/min	L2	CO3	PO2,PO4
13	a)	Describe construction of inlet and exit velocity triangles of simple impulse turbine	L2	CO3	PO2,PO4
	b)	A simple impulse turbine has one ring of moving blades running at 150 m/s, absolute velocity of steam at exit is 85 m/s at an angle 800 with the tangent of wheel, friction coefficient is 0.82, rate of steam flowing 2 Kg/s. Assuming the moving blades to be a symmetrical, find the i) Blade angles ii) Nozzle angle iii) absolute velocity of steam at entrance and iv) power developed.	L2	CO3	PO2,PO4

14		A single stage steam Turbine is supplied with steam at 5bar and 200^0C at the rate of 50Kg/min. It expands into a condenser at a pressure of 0.2bar. The blade speed is 400m/sec. The nozzles are inclined at an angle of 20^0 to the plane of wheel and outlet blade angle is 30^0. Neglecting friction losses. Determine the power developed, blade efficiency and stage efficiency	L3	CO3	PO2,PO4
15	a)	Sketch the velocity diagram of a single stage impulse turbine and determine the expression for the force, work done, diagram efficiency and axial thrust.	L4	CO3	PO2,PO4
	b)	The reaction turbine runs at 300 rpm and the steam consumption is 20000 kg/h. The pressure of steam at a certain pair is 2 bar, its dryness fraction is 0.93 and the power developed by the pair is 50 kW. The discharge blade angle is 20^0 for both the fixed and Moving blades and the axial velocity of flow is 0.72 times the blade velocity. Find the drum diameter and the blade height. Take the tip leakage steam as 8%. Neglect the blade thickness.	L4	CO3	PO2,PO4
16	a)	. Define the following: i) Blade efficiency ii) Stage efficiency iii) Overall efficiency	L2	CO3	PO2,PO4

UNIT–IV

S.No.		Questions	BT	CO	PO
Part – A (Short Answer Questions)					
1		Explain the deviation of actual Brayton cycle to the theoretical one.	L2	CO4	PO1,PO2,PO4
2		Draw line diagram and explain the working of Evaporative Condenser.	L2	CO4	PO1,PO2,PO4
3		What are the different types of combustion chambers in gas turbines?	L2	CO4	PO1,PO2,PO4
4		Discuss the merits and demerits of surface condensers over jet condensers.	L2	CO4	PO1,PO2,PO4
5		Write briefly about the usage of gas turbines.	L2	CO4	PO1,PO2,PO4
6		Distinguish between an ideal gas turbine plant and an actual gas turbine plant	L2	CO4	PO1,PO2,PO4
7		What are the types of Condensers? Classify.	L3	CO4	PO1,PO2,PO4
8		Is it always useful to have a regenerator in a gas turbine power cycle? Why?	L3	CO4	PO1,PO2,PO4
9		Derive the expression for thermal efficiency of the simple gas turbine cycle	L2	CO4	PO1,PO2,PO4
10		Sketch and describe the operation of central flow surface condenser.	L2	CO4	PO1,PO2,PO4
11	a)	Explain the deviation of actual gas turbine cycle from ideal Brayton cycle.	L2	CO4	PO1,PO2,PO4

11		A gas turbine takes in air at 27 ^{0}C and 1 bar. The pressure ratio is 4. The maximum temperature of the cycle is 560 ^{0}C. The efficiency of the compressor and turbine is 0.83 and 0.85 respectively. Find the overall efficiency, if the regenerator effectiveness is 0.75.	L2	CO4	PO1,PO2,PO4
12	a)	Explain the effect of regeneration; inter cooling, and reheating on the performance of Gas turbine plant.	L2	CO4	PO1,PO2,PO4
	b)	A gas turbine unit receives air at 100kPa and 300K and compresses it adiabatically to 620kPa with efficiency of the compressor 88%. The fuel has a heating value of 44,180kJ/kg and the fuel/air ratio is 0.017kg fuel/kg air. The turbine internal efficiency is 90%. Calculate the compressor work, turbine work and thermal efficiency.	L3	CO4	PO1,PO2,PO4
13		The following data refers to a test of the surface condenser of a steam turbine Absolute pressure of the steam entering the condenser =5.628 kPa Temperature of condensate leaving the condenser =32^{0}C Inlet temperature of cooling water=15^{0}C Outlet temperature of cooling water=30^{0}C Mass of cooling water per kg of steam=32 kg Assuming that all the heat lost by the exhaust steam is taken up by the circulating water; determine the dryness fraction of the steam as it enters the condenser.	L3	CO4	PO1,PO2,PO4
14		A gas turbine unit has a pressure ratio of 6 and maximum cycle temperature of 610^{0}C. The isentropic efficiency of the turbine and compressor are 0.82 and 0.8 respectively. Calculate the power output in kW of an electric generator, geared to the turbine, when air enters the compressors at 15^{0}C at a rate of 16 kg/s. Take C_p = 1.005 kJ/kg.K and γ = 1.4 for compression process and Cp = 1.11 kJ/kg.K and γ= 1.333 for expansion process.	L3	CO4	PO1,PO2,PO4
15		Why boiler mountings are installed. Explain the operation of fusible plug with the help of simple diagram.	L3	CO4	PO1,PO2,PO4
16		Explain the stages of combustion in a gas turbine combustion chamber with a neat sketch.			

UNIT–V

S.No.		Questions	BT	CO	PO
Part – A (Short Answer Questions)					
1		List out the factors which are to be considered for the comparison of different types of Rockets?	L1	CO5	PO1,PO2
2		List out the desirable properties required for liquid propellant rockets	L2	CO5	PO1,PO2
3		Why propeller engines are not recommended now days in air craft's?	L3	CO5	PO1,PO2
4		Explain thrust augmentation used in jet and rocket propulsion.	L2	CO5	PO1,PO2
5		State the fundamental difference between the jet propulsion and rocket propulsion.	L2	CO5	PO1,PO2
6		Derive the expressions for thermal efficiency of thrust and thrust power	L2	CO5	PO1,PO2
7		Explain the principle and working of liquid propellant rocket engine with neat sketch.	L4	CO5	PO1,PO2
8		What are the various propulsive devices for aircrafts and missiles?	L2	CO5	PO1,PO2
9		How rockets are classified? What is the essential difference between rocket propulsion and turbojet propulsion	L2	CO5	PO1,PO2
10		Describe the operation of ramjet engine.	L2	CO5	PO1,PO2
11	a)	Showing the basic components, explain the working of turbojet engine.	L3	CO5	PO1,PO2
	b)	turbojet is flying with a speed of 850 KMPH at an altitude, where air density is 0.17 kg/m3. The propulsive and overall efficiencies are 55% and 17% respectively. If the drag on air craft is 6000 N, calculate the exit velocity of jet, diameter of jet and propulsive power.	L3	CO5	PO1,PO2
12	a)	What are the desirable properties of a liquid propellant for a rocket engine?	L3	CO5	PO1,PO2
	b)	Derive the expressions for thermal efficiency of thrust and thrust power	L3	CO5	PO1,PO2
13		A turbojet engine flying at a speed of 800 km/hr consumes air at the rate of 45 kg/s. Calculate i) jet exit velocity, the change in enthalpy for the nozzle is 190 kJ/kg and the velocity coefficient is 0.95, ii) fuel flow in kg/hr and thrust specific fuel consumption, assuming that air-fuel ratio is 80:1, iii) thermal efficiency of plant given calorific value of fuel used is 43890 kJ/kg, iv) propulsive power and thrust power and v) propulsive efficiency and overall efficiency.	L3	CO5	PO1,PO2
14		For a rocket engine, jet velocity is 1600 m/s, flight to jet speed ratio is 0.7. Oxidizer flow rate is 4 kg/s. Fuel flow rate is 1 kg/s. Heat of reaction per kg of exhaust gas is 2500 kJ/kg. Calculate the Thrust, specific impulse, propulsive efficiency, thermal and overall efficiency of rocket engine.	L3	CO5	PO1,PO2

15	a)	An aircraft fitted with a turbojet engine is flying at a higher altitude where, the ambient conditions are 0.07 bar pressure and 1 ^{o}C temperature. The flight speed is 800 kmph. Determine the rate of fuel consumption and thrust specific fuel consumption, when the thrust developed is 25000 N under the following conditions: Ram efficiency is 95%, total head pressure ration across the compressor 5:1, isentropic efficiency of compressor is 85%, isentropic efficiency of turbine is 90%. Consider an isentropic nozzle with expansion upto the ambient pressure. Take C.V. of the fuel as 42 MJ/kg.			
	b)	What is meant by thrust augmentation? When is it necessary?	L3	CO5	PO1,PO2
16		A jet plane having 2 jets works on turbo-jet system. It flies at a speed of 800km/hr at an altitude where density of air is 0.15 kg/m^{3} . The propulsive efficiency is 55%. The drag on the plane is 6500N. Calculate i) Absolute velocity of jet ii) quantity of compressed air and iii) diameter of jet.	L3	CO5	PO1,PO2