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QUESTION BANK (DESCRIPTIVE)

Subject with Code: Thermal Engineering (18ME0315) **Course & Branch: B. Tech - ME**
Year & Semester: III-B. Tech & I-Semester **Regulation: R18**

UNIT – I

1	a	Define Engine.	L1	CO1	2M
	b	Recall the meaning of Heat Engine	L1	CO1	2M
	c	How are heat engine classified	L2	CO1	2M
	d	Give example of EC and IC engines	L3	CO1	2M
	e	What are the important basic components of an IC engines.	L1	CO1	2M
2	a	Explain any six classifications of Internal Combustion engines.	L2	CO1	5M
	b	With a neat sketch explain any three parts in Internal Combustion engine	L2	CO1	5M
3	a	a) Explain the working of 4-stroke Diesel engine.	L2	CO1	5M
	b	b) Show the theoretical and actual valve-timing diagram for Diesel engine.	L3	CO1	5M
4	a	Give explanation about the Working Principle of 2-Stroke SI Engine	L2	CO1	5M
	b	Express the Working Principles of 2-Stroke Diesel Engine	L2	CO1	5M
5	a	Explain the working of 4-stroke Petrol engine.	L2	CO1	5M
	b	Show the theoretical and actual valve-timing diagram for Petrol engine.	L2	CO1	5M
6		Following observations were recorded during a test on a single cylinder oil engine:Bore = 300 mm, Stroke = 450 mm, Speed = 300 rpm, i.m.e.p. = 6 bar, net brake laod = 1.5 kN, brake drum diameter = 1.8 m, brake rope diameter = 2 cm. Calculate: i) Indicate power, ii) Brake power, iii) Mechanical efficiency.	L4	CO1	10M
7	a	A two stroke cycle internal combustion engine has a mean effective pressure of 6 bar. The speed of the engine is 1000 rpm. If the diameter of piston and stroke are 110 mm and 140 mm respectively, find the indicated power developed.	L4	CO1	5M
	b	A single cylinder, four stroke cycle oil engine is fitted with a rope brake. The diameter of the brake wheel is 600 mm and the rope diameter is 26 mm. The dead load on the brake is 200 N and the spring balance reads 30 N. If the engine runs at 450 rpm, Discover the brake power of the engine?	L4	CO1	5M
8		The following results refer to a test on a petrol engine: Indicated power = 30 kW, Brake power = 26 kW, Engine speed = 1000 rpm, fuel per brake power hour = 0.35 kg, calorific value of the fuel used = 43900 kJ/kg.	L4	CO1	10M

		Calculate: i) The indicated thermal efficiency ii) The brake thermal efficiency iii) the mechanical efficiency.			
9		A single cylinder 4 stroke diesel engine gave the following results while running on full load: Area of indicator card = 300 mm^2, Length of diagram = 40 mm, Spring constant = 1 bar/mm, Speed of the engine = 400 rpm, Load on the brake = 370 N, Spring balance reading = 50 N, Diameter of brake drum = 1.2 m, Fuel consumption = 2.8 kg/hr, Calorific value of fuel = 41800 kJ/kg, Diameter of the cylinder = 160 mm, Stroke of the piston = 200 mm. Calculate: i)Indicate mean effective pressure, ii)Brake power and brake mean effective pressure, iii)Brake specific fuel consumption, brake thermal and indicated thermal efficiencies.	L4	CO1	10M
10		The following observations were recorded in a test of one hour duration on a single cylinder oil engine working on four stroke cycle. Bore = 300mm, Stroke = 450 mm, Fuel used = 8.8 kg, Calorific value of fuel = 41800 kJ/kg, Average speed = 200 rpm, m.e.p. = 5.8 bar, Brake friction load = 1860 N, Quantity of cooling water = 650 kg, Temperature rise = 22°C, Diameter of the brake wheel = 1.22 m. Calculate: i). Mechanical efficiency, ii). Brake thermal efficiency. Draw the heat balance sheet.	L4	CO1	10M

UNIT-II

1	a	Enumerate the application of compressed air.	L1	CO2	2M
	b	State how the air compressors are classified.	L1	CO2	2M
	c	How are rotary compressor classified.	L1	CO2	2M
	d	Mention single stage compressor equation for work, if neglecting clearance volume.	L2	CO2	2M
	e	Construct the multi stage compressor equation for work with perfect inter cooling.	L3	CO2	2M
2	a	Construct an expression for minimum work required for two stage reciprocating air compressor with perfect inter-cooling and neglect clearance volume.	L3	CO2	5M
	b	A single stage reciprocating compressor takes I m^3 of air per minute at 1.013 bar and 15 °C and delivers it at 7 bar. Assuming that the law of compression is $pV^{1.35}$ = constant, and the clearance is negligible, calculate the indicated power.	L4	CO2	5M
3	a	a) Explain the working principle of single stage single acting reciprocating air compressor.	L2	CO2	5M
	b	b) Construct the expression for work done single stroke single acting reciprocating compressor.	L3	CO2	5M
4		Construct an expression for minimum work for two stage reciprocating air compressors.	L3	CO2	10M
5	a	In a two stage air compressor the pressure are atmospheric 1.0 bar:	L4	CO2	5M

		intercooling 7.4 bar: delivery 42.6 bar. Assuming complete intercooling to the original temperature of 15°C and compression index n = 1, find the work done in compressing 1 kg of air.			
	b	Explain the working of Centrifugal compressors with neat sketch	L2	CO2	5M
6		Construct the relation for Volumetric efficiency of a single stage reciprocating compressor.	L3	CO2	10M
7	a	Summarize the working process of Centrifugal compressor with neat sketch	L2	CO2	5M
	b	Explain the working process of Axial flow compressor with neat sketch	L2	CO2	5M
8		A single-stage double-acting air compressor is required to deliver 14 m of air per minute measured at1.013 bar and 15°C. The delivery pressure is 7 bar and the speed 300 r.p.m. Take the clearance volume as 5% of the swept volume with the compression and expansion index of n = 1.3. Calculate : (i) Swept volume of the cylinder ; (iii) Indicated power.	L4	CO2	10M
9		A single – stage double – acting air compressor is required to deliver 14 m3 of air per Minute measured at 1.013 bar and 150^{0}C. The delivery pressure is 7 bar and the speed 300 r.p.m. Take the clearance volume as 5% of the swept volume with the compression and expansion index of 1.3 Calculate: (i). Swept volume of the cylinder; (ii). The delivery temperature; (iii). Indicated power.	L4	CO2	10M
10		An air compressor takes in air 1 bar and 20 °C and compresses it according to law to $pV^{1.25}$ = constant. It is then delivered to a receiver at a constant pressure of 10 bar. R= 0.287 kJ/kg K. Determine: i). Temperature at the end of compression, ii) Work done, iii) Heat transferred during compression per kg of air.	L4	CO2	10M

UNIT-III

1	a	Define Dryness fraction	L1	CO3	2M
	b	Recall meaning of Enthalpy of steam	L1	CO3	2M
	c	Describe term Sensible heat	L2	CO3	2M
	d	Name the meaning of Latent heat	L1	CO3	2M
	e	What is Saturation temperature	L1	CO3	2M
2	a	Describe the different operations of Rankine cycle and also derive the expression for its efficiency.	L2	CO3	5M
	b	In a steam turbine steam at 20 bar, 360°C is expanded to 0.08 bar. It then enters a condenser, where it is condensed to saturated liquid water. The pump feeds back the water into the boiler. Assume ideal processes; find per kg of steam the network and the cycle efficiency.	L4	CO3	5M
3	a	List out the methods of increasing the thermal efficiency of Rankine cycle.	L1	CO3	4M
	b	A simple Rankine cycle works between pressures 28 bar and 0.06 bar,	L4	CO3	6M

		the initial condition of steam being dry saturated. Calculate the cycle efficiency, work ratio and specific steam consumption.			
4	a	Explain with the help of neat diagram about Regenerative Cycle.	L2	CO3	5M
	b	Calculate the fuel oil consumption required in a industrial steam plant to generate 5000 kW at the turbine shaft. The calorific value of the fuel is 40000 kJ/kg and the Rankine cycle efficiency is 50%. Assume appropriate values for isentropic turbine efficiency, boiler heat transfer efficiency and combustion efficiency.	L4	CO3	5M
5	a	Summarize the advantages of Regenerative cycle over Rankine cycle, and explain effect of operating conditions on Rankine cycle efficiency	L2	CO3	5M
	b	In a steam power cycle, the steam supply is at 15 bar and dry and saturated. The condenser pressure is 0.4 bar. Calculate the Rankine efficiencies of the cycle. Neglect pump work.	L4	CO3	5M
6	a	The adiabatic enthalpy drop across the prime mover of the Rankine cycle is 540 kg. The enthalpy of steam supplied is 2940 kJ/kg. If the back pressure is 0.1 bar, find the specific steam consumption and thermal efficiency.	L4	CO3	5M
	b	Construct the expression for efficiency of Rankine cycle	L2	CO3	5M
7	a	Show the P-V, T-S Diagrams for Simple Rankine cycle.	L5	CO3	5M
	b	Steam is supplied to a turbine at a pressure of 30 bar and a temperature of 400°C and is expanded adiabatically to a pressure of.0.04 bar. At a stage of turbine where the pressure is 3 bar a connection is made to a surface heater in which the feed water is heated by bled steam to a temperature of 130°C. The condensed steam from the feed heater is cooled in a drain cooler to 27°C. The feed water passes through the drain cooler before entering the feed heater. The cooled drain water combines with the condensate in the well of the condenser. Assuming no heat losses in the steam, calculate the following: a. Mass of steam used for feed heating per kg of steam entering the turbine. b. Thermal efficiency of the cycle.	L4	CO3	5M
8		Steam at a pressure of 15 bar and 250°C is expanded through a turbine at first to a pressure of 4 bar. It is then reheated at constant pressure to the initial temperature of 250°C and is finally expanded to 0.1 bar. Using mollier chart, estimate the work done per kg of steam and amount of heat supplied.	L4	CO3	10M
9		A steam power plant operates on a theoretical reheat cycle. Steam at boiler at 550°C, 150 bar expands through the high pressure turbine. It is reheated at a constant pressure of 40 bar to 550°C and expands through the low pressure turbine to a condenser at 0.1 bar. Draw T-S and h-s diagrams. Find (i) Quality of steam at turbine exhaust (ii) Cycle Efficiency (iii) Steam rate in Kg/ Kw-hr.	L4	CO3	10M
10		In a single heater regenerative cycle the steam enters turbine at 30 bar, 400^0C and the exhaust pressure is 0.10 bar. The feed water heater operates at 5 bar. Calculate (i) Efficiency and steam rate of cycle. (ii) Also compare efficiency with cycle without regeneration. Pump work may be neglected.	L4	CO3	10M

UNIT-IV

1	a	Define the term Steam Nozzle.	L1	CO4	2M
	b	Classify the various types of nozzles.	L2	CO4	2M
	c	Recall term a steam condenser.	L1	CO4	2M
	d	State the organs of a steam condensing plant.	L1	CO4	2M
	e	Classify the types of condenser and list it.	L1	CO4	2M
2		Define Steam nozzle and also explain about expansion of steam in nozzle with neat sketch.	L2	CO4	10M
3	a	Explain various types of nozzles with neat sketches.	L2	CO4	6M
	b	What are the effects of friction on flow through nozzle.	L1	CO4	4M
4		Steam having pressure of 10.5 bar and 0.95 dryness is expanded through a convergent-divergent nozzle and the pressure of steam leaving the nozzle is 0.85 bar. Find the velocity at the throat for maximum discharge conditions. Index of expansion may be assumed as 1.135. calculate mass rate of flow of steam through the nozzle.	L4	CO4	10M
5		Steam initially dry and saturated is expanded in a nozzle from 15 bar at 300^{o}C to 1.0 bar. If the frictional loss in the nozzle is 12% of the total heat drop calculate the mass of steam discharged when exit diameter of the nozzle is 15 mm.	L4	CO4	10M
6		Construct an expression for discharge through the nozzle and condition for maximum discharge.	L3	CO4	10M
7		Dry saturated steam enters a steam nozzle at a pressure of 15 bar and is discharged at a pressure of 2 bar. If the dryness fraction of discharge steam is 0.96, what will be final velocity of steam? Neglect initial velocity. If 10% of heat drop is lost in friction, find the percentage reduction in the final velocity.	L4	CO4	10M
8		A delaval type impulse turbine is a develop 150 kW with a portable consumption of 7.5 kg of steam per kWh with initial pressure being 12 bar and the exhaust 0.15 bar. Taking the diameter at the throat of each nozzle as 6 mm, find the number of nozzles required. Assuming that 10 per cent of the total drop is lost in diverging part of the nozzle, find the diameter at exit of the nozzle and the quality of steam which is to be fully expanded as it leaves the nozzles.	L4	CO4	10M
9		Explain about Surface condenser and discuss its types with neat sketches.	L2	CO4	10M
10		Express about jet condenser and various types of jet condenser with neat sketches.	L2	CO4	10M

UNIT-V

1	a	Define a steam turbine and its fields of application.	L1	CO5	2M
	b	What are the advantages of steam turbine over steam engine?	L1	CO5	2M
	c	Classify the steam turbine with respect to the action of the steam	L2	CO5	2M
	d	What are the methods of steam turbine governing?	L1	CO5	2M
	e	Compare the throttle and Nozzle control governing	L5	CO5	2M
2	a	Explain the working process of impulse turbine.	L2	CO5	5M
	b	Show the velocity triangle diagram of impulse turbine.	L2	CO5	5M
3	a	Explain the working process of reaction turbine.	L2	CO5	5M
	b	Show the velocity triangle diagram of reaction turbine	L2	CO5	5M
4		A stage of a steam turbine is supplied with steam at a pressure of 50 bar and 350°C, and exhausts at a pressure of 5 bar. The isentropic efficiency of the stage is 0.82 and the steam consumption is 2270 kg/min. Determine the power output of the stage	L4	CO5	10M
5		The velocity of steam exiting the nozzle of the impulse stage of a turbine is 400 m/s. The blades operate close to the maximum blading efficiency. The nozzle angle is 20%. Considering equiangular blades and neglecting blade friction, calculate for a steam flow 0.6. kg/s, the diagram power and the diagram efficiency.	L4	CO5	10M
6		In a single stage reaction turbine, both the fixed and moving blades have the same tip angles of 35° and 20° for inlet and outlet respectively. Determine the power required if the isentropic heat drop in both fixed and moving rows is 23.5 kJ/kg. The mean blade speed is 80 m/s and the steam consumption is 22,500 kg/hr.	L4	CO5	10M
7		The following data refer to a particular stage of a Parson's reaction turbine Speed of the turbine = 1500 r.p.m. Mean diameter of the rotor = 1 metre, Stage efficiency = 80 per cent, Blade outlet angle = 20°, Speed ratio= 0.7 Determine the available isentropic enthalpy drop in the stage.	L4	CO5	10M
8		Explain about the various methods of Governing steam turbines with neat sketches.	L2	CO5	10M
9		In a reaction turbine, the blade tips are inclined at 35° and 20° in the direction of motion. The guide blades are of the same shape as the moving blades, but reversed in direction. At a certain place in the	L4	CO5	10M

		turbine, the drum diameter is 1 metre and the blades are 10 cm high. At this place, the steam has a pressure of 1.75 bar and dryness 0.935. If the speed of this turbine is 250 r.p.m. and the steam passes through the blades without shock, find the mass of steam flow and power developed in the ring of moving blades.			
10	a	Distinguish between impulse and reaction turbines.	L4	CO5	5M
	b	List out the various losses in steam turbines? Explain them Briefly	L2	CO5	5M