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QUESTION BANK (DESCRIPTIVE)

Subject with Code: Thermal Engineering (16ME312) **Course & Branch: B. Tech - ME**
Year &Sem: III-B. Tech & I-Sem **Regulation:** R16

UNIT –I

1	a	Explain any six classifications of Internal Combustion engines.	6M
	b	With a neat sketch explain any three parts in Internal Combustion engine	6M
2	a	Explain the working of 4-stroke Diesel engine. Draw theoretical and actual valve-timing diagram for diesel engine.	6M
	b	Draw Theoretical and actual port timing diagrams of a 2 stroke petrol engine.	6M
3	a	Explain the Working Principle of 2-Stroke Diesel Engine.	6M
	b	Brief the Working Principle of 2-Stroke SI Engine.	6M
4	a	Compare 2-stroke engine with 4-stroke engine.	6M
	b	What are the important basic components of an internal combustion engines? Explain them briefly.	6M
5		A four stroke four cylinder diesel engine running at 300 rpm produces 25 kW of brake power. The cylinder dimensions are 30 cm bore and 25 cm stroke. Fuel consumption rate is 1 kg/min while air fuel ratio is 10. The average indicated mean effective pressure is 0.8 MPa. Determine indicated power, mechanical efficiency, and brake thermal efficiency of engine. The calorific value of fuel is 43 MJ/kg. The ambient conditions are 1.013 bar, 27°C.	12M
6	a	A gasoline engine works on Otto cycle. It consumes 8 litres of gasoline per hour and develops power at the rate of 25 kW. The specific gravity of gasoline is 0.8 and its calorific value is 44000kJ/kg. Find the indicated thermal efficiency of the engine.	6M
	b	A single cylinder engine operating at 2000 rpm develops a torque of 8 N-m. The indicated power of the engine is 2.0 kW. Find loss due to friction as the percentage of brake power.	6M
7		A 4-cylinder, 4-stroke cycle engine having cylinder diameter 100 mm and stroke 120 mm was tested at 1600 rpm and the following readings were obtained. Fuel consumption = 0.27 litres/minute, Specific gravity fuel = 0.74, B.P. = 31.4 kW Mechanical efficiency	12M

		= 80%, Calorific value of fuel = 44000 kJ/kg. Determine: (i) BSFC (ii) IMEP, and (iii) Brake thermal efficiency.	
8		A single cylinder and stroke cycle I.C. engine when tested, the following observations available :Area of indicator diagram = 3 sq.cm, Length of indicator diagram = 4 cm, Spring constant = 10 bar/cm, Speed of engine = 400 rpm, Brake drum diameter = 120 cm, Dead weight on brake = 380 N, Spring balance reading = 50 N, Fuel consumption = 2.8 kg/hr., Cv = 42000 kJ/kg, Cylinder diameter = 16 cm, Piston stroke = 20 cm. Find : (i) F.P (ii) Mechanical efficiency (iii) BSFC and (iv) Brake thermal efficiency	12M
9		The following observations were recorded during a trial on a 4-stroke diesel engine: Power absorbed by non-firing engine when Driven by an electric motor = 10 kW ; Speed of the engine = 1750 rpm Brake torque = 327.4 Nm ; Fuel used = 15 kg/hr. Calorific value of fuel = 42000 kJ/kg ; Air supplied = 4.75 kg/min. Cooling water circulated = 16 kg/min. Outlet temperature of cooling water = 65.8°C Temperature of exhaust gas = 400°C ; Room temperature = 20.8°C Specific heat of water = 4.19 kJ/kgK ; Specific heat of exhaust gas = 1.25 kJ/kgK Find (i) BP (ii) Mechanical efficiency (iii) BSFC Draw the heat balance sheet on kW basis.	12M
10	a	Explain the phenomenon of knocking in SI engines	6M
	b	Describe in detail about the factors effecting the knocking	6M

UNIT-II

1	a	Derive an expression for minimum work required for two stage reciprocating air compressor with perfect inter-cooling and neglect clearance volume.	6M
	b	A single stage single acting air compressor has an effective swept volume of $5m^3$/min and delivers to a receiver pressure of 6.5 bar. The index of compression is 1.25.Calculate work done.	6M
2	a	With the help of neat sketch explain the working principle of single stage reciprocating air compressor.	6M
	b	With the help of neat sketch explain the working principle of multi stage reciprocating air compressor with effect of intercooler.	6M
3	a	With the help of neat sketch, explain the working of vane type compressor.	6M
	b	A single stage reciprocating air compressor is required to compress 80 m^3 of air from 1 bar abs to 10 bar abs. Find the work to be supplied if the law of expansion is $PV^{1.25}$=Constant.	6M
4	a	A two stage air compressor compresses air from 1 bar and 20°C to 42 bar. If the law of compression is pv1.3 = constant and the inter cooling is perfect. Find per kg of air (i) The work done in compression.	6M
	b	Derive the relation for work done on single stage reciprocating compressor without clearance.	6M
5		Derive the relation for Volumetric efficiency of a single stage reciprocating compressor.	12M
6	a	What are the various classifications of air compressors	6M
	b	Explain the working of any two Rotary compressors with neat sketch.	6M
7		An air compressor cylinder has 150mm bore and 150mm stroke and the clearance is 15%. It operates between 1 bar, 27^0C and 5 bar. Take polytropic exponent n=1.3 for compression and expansion processes. Find (i). Cylinder volume at the various salient points of in cycle. (ii). Flow rate in m3/min at 720 rpm. (iii). Volumetric efficiency.	12M
8		A single –stage double –acting air compressor is required to deliver 14 m3 of air per Minute measured at 1.013 bar and 150^0C. 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;	12M

(ii). The delivery temperature;

(iii). Indicated power.

9		Air from an initial conditions of 25°C and 1 bar abs is compressed in 2 stage according to law $PV^{1.25}$=constant and with complete intercooling to a pressure of 36 bar abs. Estimate the minimum work required and heat rejected in the intercooler per kg of air. Assume C_P=1.05KJ/Kg and R=0.29KJ/Kg K.	12M
10		Derive an expression for minimum work for two single stage reciprocating air compressors.	12M

UNIT-III

1	a	Describe the different operations of Rankine cycle and also derive the expression for its efficiency.	6M
	b	A steam power plant works between 40 bar and 0.05 bar. If the steam supplied is dry saturated and the cycle of operation is Rankine, Find: (i) Cycle efficiency, (ii) Specific steam consumption.	6M
2	a	State the methods of increasing the thermal efficiency of Rankine cycle.	6M
	b	In a Rankine cycle, the steam at inlet to turbine is saturated at a pressure of 30 bar and the exhaust pressure is 0.2 bar. Determine. (i) The pump work, (ii) Turbine work, (iii) Rankine efficiency, (iv) Condenser heat flow, (v) Dryness fraction at end of expression. Assume flow rate of 12kg/s.	6M
3	a	Explain with the help of neat diagram about Regenerative Cycle.	6M
	b	In a regenerative cycle inlet conditions are 40 bar and 400°C. Steam is bled at 10 bar in regenerative heating. The exit pressure is 0.8 bar. Neglecting the pump work. Determine the efficiency of the cycle.	6M
4	a	State the advantages of Regenerative cycle over Rankine cycle, and explain effect of operating conditions on Rankine cycle efficiency	6M
	b	A Steam power plant operates on a theoretical reheat cycle. Steam in boiler at 150 bar, 550°C 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/kWh.	6M
5	a	A steam power plant works between 40 bar and 0.05 bar. If the steam supplied is dry saturated and the cycle of operation is Rankine, Find (i) cycle efficiency, (ii) Specific steam consumption	6M

	b	Derive the expression for efficiency of Rankine cycle with P-V, T-S Diagrams.	6M
6	a	State the advantages and disadvantages of a Reheat cycle	6M
	b	A Steam power plant operates at a pressure of 15 bar, 300^0C expands through a high pressure turbine. It is reheated at a pressure of 4 bar to 300^0 C and expands through the low pressure turbine to a condenser pressure of 0.1 bar. Determine work done and cycle efficiency.	6M
7	a	Write the followings a) Enthalpy of Water b) Enthalpy of Wet steam c) Enthalpy of Dry steam d) Enthalpy of super-heated steam	6M
	b	Explain the followings a) dryness Fraction b) saturated water c) latent heat and d) sensible heat.	6M
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.	12M
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.	12M
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.	12M

UNIT-IV

1		Define Steam nozzle and also explain about expansion of steam in nozzle with neat sketch.	12M
2	a	Explain various types of nozzles with neat sketches.	8M
	b	What are the effects of friction on flow through nozzle.	4M
3		What is the effect of friction on the flow through a nozzle? Explain it with the help of h-s diagram.	12M
4	a	Derive an expression for velocity of steam at exit of nozzle.	8M
	b	Derive pressure ratio relation for various flows involves in nozzle	4M
5		Derive an expression for discharge through the nozzle and condition for maximum discharge.	12M

6		Dry saturated steam enters a frictionless adiabatic nozzle with negligible velocity at a temperature of 300^0C.It is expanded to a pressure of 5000KPa.The mass flow rate is 1Kg/s. Calculate the exit velocity of steam.	12M
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?	12M
8		Explain about super saturated flow in nozzles with neat sketch. And represent in H-S diagram.	12M
9		Explain about Surface condenser and discuss its types with neat sketches.	12M
10		Explain about jet condenser and various types of jet condenser with neat sketches.	12M

UNIT-V

1	a	Draw and explain the velocity triangle of impulse turbine.	8M
	b	Derive an expression for work done in impulse turbine.	4M
2	a	Draw and explain the velocity triangle of reaction turbine.	8M
	b	Derive an expression for work done in reaction turbine.	4M
3		Draw the combined velocity triangle of Impulse turbine and explain the salient features.	12M
4		Draw the combined velocity triangle of Parson's reaction turbine and explain the salient features.	12M
5		In a De-laval turbine, the steam enters the wheel through a nozzle with a velocity of 350m/s at an angle of 20^o to direction of motion of the blade. The blade speed is 250m/s and exit angle of moving blade is 35^o. Find the inlet angle of moving blade, exit velocity of steam & its direction and work done per kg of steam.	12M
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.	12M
7		What are the various losses in steam turbines? Explain them Briefly.	12M
8		Explain about the various methods of Governing steam turbines with neat sketches.	12M
9		Distinguish between impulse and reaction turbines.	12M
10	a	Explain various efficiencies that are associated with turbines.	6M
	b	The velocity of steam leaving the nozzle of a impulse turbine is 200m/s and nozzle angle is 20^o blade velocity is 375m/s, blade velocity coefficient 0.75. Assume no loss	6M

at inlet. Calculate the following for mass flow of 0.5kg/s symmetrical blading.

a. blade inlet angle b. driving force on wheel

c. axial thrust on wheel d. power developed by turbine.