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Reg. No.								

## B.Tech. DEGREE EXAMINATION, JANUARY 2024

Fourth Semester

## 18MEC107T - APPLIED THERMAL ENGINEERING

(For the candidates admitted from the academic year 2021 - 2022)

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- Part A should be answered in OMR sheet within first 40 minutes and OMR sheet should be handed (i) over to hall invigilator at the end of 40<sup>th</sup> minute.

(ii)	Part - B & Part - C should be answered	l in an	swer booklet.				
Time: 3	hours			Max. 1	Marl	ks: 1	00
	PART – A (20 × 1 =	= 20	Marks)	Marks	BL	со	РО
	Answer ALL Q	uesti	ons				
1.	The compression ratio in a diesel eng	gine i	s of the order of	1	1	1	2
	(A) 5 to 8	(B)	10 to 15				
	(C) 15 to 25	(D)	25 to 30				
2.	The heat addition and heat rejection i	in Bra	ayton cycle takes place at	1	2	1	2
	(A) Constant volume		Constant temperature				
	(C) Constant pressure	(D)	Constant entropy				
3.	For the same compression ratio, otto cycle.	the	efficiency of diesel cycle is	s <sup>1</sup>	2	1	2
	(A) Greater than	(B)	Less than				
	(C) Equal to	(D)	Cannot say				
4.	The thermal efficiency of dual cycle equal to unity.	le is	equal to that of diesel cycle a	t <sup>1</sup>	2	1	2
	(A) Cut-off ratio	(B)	Pressure ratio				
	(C) Expansion ratio	(D)	Compression ratio				
5.	A chemical fuel is a substance which	relea	ses on combustion.	1	1	2	2
	(A) Chemical energy	(B)	Heat energy				
	(C) Sound energy	(D)	Magnetic energy				
6.	Stoichiometric air-fuel ratio by mass	1	1	2	2		
	(A) 5	(B)	_				
	(C) 12	(D)	15.05				
7.	An analysis which includes the steam	in th	e exhaust is called	1	2	2	2
	(A) Dry analysis		Wet analysis				
	(C) Dry and wet analysis		Water vapour analysis				
8.	Bomb calorimeter is used to find the	calori	fic value of fuels.	1	1	2	2
	(A) Solid	(B)	Gaseous				
	(C) Solid and gaseous	(D)	Dispersion				

9.		ratio of indicated thermal efficie efficiency is called	ncy t	to the corresponding air standard	I	1	2	2
	` '	•	` ′	Efficiency ratio				
	(C)	Relative efficiency	(D)	Overall efficiency				
10.	If the	e speed of the engine is increased	, the	indicated power will	1	2	2	2
	` /	Increase	` /	Decrease				
	(C)	Remain same	(D)	None of the mentioned				
11.		brake power of a diesel engine, k	сееріг	ng other parameters constant, can	1	2	2	2
	(A)	Deceasing the density of intake air	(B)	Increasing the temperature of intake air				
	(C)		(D)	Decreasing the pressure of				
		intake air		intake air				
12.	A ca	rbuattor is used to supply_			1	2	2	2
		Petrol, air and lubricating oil	(B)	Air and diesel			ř.	
		Petrol and lubricating oil		Petrol and air				
13.	The	intercooling in multistage compre	essor	s is done	1	2	3	2
		To cool the air during						
	(C)	compression  To apple compression in two	(D)	To minimize the work of				
	(C)	stages	(D)	To minimize the work of compression				
1.4	The	compressor mostly used for supe	rchar	aina of IC anaina is	1	2	3	2
17.		Radial flow compressor						
		Roots blower		Reciprocating compressor				
15.	The	rotary compressors are used for o	lelive	ering	1	2	4	2
		-		Large quantities of air at high				
	(0)	pressure	(D)	pressure				
	(C)	Small quantities of air at low pressures	(D)	Large quantities of air at low pressure				
1.0	0			11	1	1	4	2
10.	_	erators in compressor installations  Before intercooler		After intercooler	1	1	7	2
	` '	After receiver		Between after cooler and air				
	(0)	Anter receiver	(1)	receiver				
17.	The	condition of refrigerant after	passi	ng through the condenser in a	1	1	5	2
		our compression system is	<b>.</b>					
	(A)	Saturated liquid	(B)	Wet vapour				
	(C)	Dry saturated vapour	(D)	Super heated vapour				
18.		-	vapo	ur compression cycle uses the	1	1	5	2
		owing type of expansion device	(D)	Manualla agrant day t				
	(A)	Electrically operated throttling value	(R)	ivianually operated valve				
	(C)	Thermostatic valve	(D)	Capillary tube				

19.	The ratio of actual mass of water vapour in a given volume of moist air to the mass of water vapour in the same volume of saturated air at the same temperature and pressure is called	1	4	J	2
	<ul><li>(A) Humidity ratio</li><li>(B) Relative humidity</li><li>(C) Absolute humidity</li><li>(D) Degree of saturation</li></ul>				
20.	During sensible cooling, well bulb temperature  (A) Decreases (B) Increases (C) Remains constant (D) Can decrease or increase	l	2	5	2
	PART – B ( $5 \times 4 = 20$ Marks) Answer ANY FIVE Questions	Marks	BL	со	PO
21.	What are the assumptions in air standard?	4	1	1	2
22.	Explain the concept of regeneration which has been used in Brayton cycle with neat sketch.	4	2	1	2
23.	The percentage analysis of a gas by volume is given as $CO_2 = 5.5\%$ $CO = 38.3\%$ , $CH_4 = 0.4\%$ , $O_2 = 0.1\%$ , $H_2 = 52.8\%$ $N_2 = 2.9\%$ . Find the percentage analysis by mass.	4	2	2	2
24.	Draw the theoretical and actual P-V diagrams for SI engine and discuss briefly.	4	2	3	2
25.	Classify air compressors.	4	2	4	2
26.	Draw the layout of a vapour compression refrigeration system and state the function of each of the component.	4	2	5	2
27.	Name any four phychrometric processes and represent them in the phychrometric chart.	4	2	5	2
	$PART - C (5 \times 12 = 60 Marks)$				
	Answer ALL Questions	Marks		со	
28. a.	An ideal Otto cycle has a compression ratio of 8. At the beginning of the compression process, air is at 95 kPa and 27°C and 750 kJ/kg of heat is transferred to air during the constant volume heat addition process. Taking into account the variation of specific heats with temperature, determine	12	3	1	2
	<ul><li>(i) The pressure and temperature at the end of the heat addition process</li><li>(ii) The network output</li></ul>				
	(iii) The thermal efficiency and (iv) The mean effective pressure				
	(OR)				
b.	With neat Pv and Ts diagrams derive an expression for an air standard efficiency of dual cycle.	12	2	1	2
29. a.	carbon = 85%, hydrogen = 15%. Calculate the ratio of air to petrol consumption by weight if volumetric analysis of the dry exhaust gas is: $CO_2 = 11.5\%$ , $CO = 1.2\%$ , $O_2 = 0.9\%$ , $N_2 = 86\%$ . Also find the	12	3	2	2
	percentage of excess air.				

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b.	Explain the following in detail with neat sketch  (i) Exhaust gas analysis by Orsat's apparatus  (ii) Determination of calorific value using bomb calorimeter	12	2	2	•
30. a.	A four cylinder four stroke petrol engine has a bore of 57 mm and a stroke of 90mm. Its rated speed is 2800 rpm, torque is 55.2 Nm. The fuel consumption is 6.74 litre/hour. The density of petrol is 735kg/m³ and petrol has a calorific value of 44200 kJ/kg. Calculate brake power, brake mean effective pressure, brake thermal efficiency and brake fuel consumption.	12	3	3	
	(OR)				
b.	In a trail of a single cylinder oil engine working on dual cycle, the following observations were made: compression ratio =15, oil consumption = $10.2 \text{ kg/h}$ , CV of fuel = $43890 \text{ kJ/kg}$ , air consumption = $3.8 \text{ kg/min}$ , speed =1900 rpm, torque on brake drum = $186 \text{ Nm}$ , quantity of cooling water used = $15.5 \text{ kg/min}$ , temperature rise = $36^{\circ}\text{C}$ , exhaust gas temperature = $410^{\circ}\text{C}$ , room temperature = $20^{\circ}\text{C}$ , $C_p$ for exhaust gasses =	12	3	3	2
	1.17kJ/kg. Calculate brake power, brake specific fuel consumption, brake thermal efficiency. Draw the heat balance sheet on minute basis.				
31. a.i.	Derive an expression for the minimum work required for a two-stage reciprocating air compressor.	6	2	4	2
ii.	Explain the concept of multi-stage air compression with intercooling with neat sketches.	6	2	4	2
	(OR)				
b.	A single stage double acting air compressor operating at a delivery	12	3	4	2
	pressure of 7.5 bar delivers $5m^3$ of free air per minute at 1 atm and 20°C. Speed = 300 RPM, mechanical efficiency = 0.9, pressure loss in passing through intake valve= 0.04 bar, temperature rise of air during suction stroke=12°C, clearance volume = 5% of stroke volume, index of compression and expansion, n =1.3, length of the stroke = 1.3 times of the	¥			
	cylinder diameter. Calculate:  (i) Power input to the shaft  (ii) Volumetric efficiency and  (iii) The cylinder diameter				
32. a.	Explain the following in detail with neat sketch  (i) Vapor compression refrigeration system  (ii) Vapour absorption refrigeration system	12	2	5	2
b.	(OR) A psychrometer reads 40°C DBT, and 36°C WBT. Find the humidity ratio, relative humidity, dew point temperature, specific volume of air, density of air, density of water vapour and enthalpy of air.  *****	12	3	5	2
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