28. a. A trial on a single cylinder four stroke oil engine provides the following readings — 10 | 3 | 3 | 1,2

Cylinder diameter = 250 mm
Stroke length = 400 mm
Gross m.e.p = 7 bar
Pumping mep = 0.5 bar

Engine speed 250 rpm, net load on the brake 1080 N, effective brake diameter 1.5 m, fuel used per hour 10 kg, calorific value of fuel 44300 kJ/kg.
Calculate

(i) Indicated power
(ii) Brake power
(iii) Mechanical efficiency
(iv) Indicated thermal efficiency

(OR)

b. The following observation were required in a test of one hour duration on a single cylinder oil engine working on four stroke cycle. — 10 | 3 | 3 | 1,2

Bore 300 mm, stroke 450 mm, fuel used 8.8 kg, calorific value of fuel 41,8000 kJ/kg, average speed 200 rpm mep 5.8 bar, brake friction load 1860 N, quantity of cooling water 650 kg, temperature rise 22°C, diameter of brake wheel 1.22 m. Calculate mechanical efficiency, brake thermal efficiency and draw the heat balance sheet.

29. a. A single acting, single stage reciprocating air compressor of 250 mm bore and 350 mm stroke runs at 200 rpm. The suction and delivery pressures are 1 bar and 6 bar respectively. Calculate the theoretical power required to run the compressor under — 10 | 3 | 4 | 1,2

(i) Isothermal compression
(ii) Polytrophic compression with index n = 1.3
(iii) Isentropic compression ($\gamma = 1.4$)

Neglect the effect of clearance and also calculate isothermal efficiency in each case.

(OR)

b. With suitable sketches explain the working of two stage reciprocating air compressor. Derive an expression for the work required to compress air using the above compressor with perfect intercooling. — 10 | 3 | 4 | 1,2

30. a. With a neat schematic diagram explain the working of vapour absorption refrigeration system. — 10 | 3 | 5 | 1,2

(OR)

b. An air conditioning system is designed under the following conditions: — 10 | 4 | 5 | 1,2

Out door conditions: 30°C dbt, 75% RH
Indoor conditions required: 22°C dbt, 70% RH
Amount of free air circulated: 3.33 m^3/s

The required condition is achieved by first cooling and dehumidification and then heating. Estimate

(i) Capacity of cooling coil in tonnes
(ii) Capacity of heating coil in kW
(iii) Amount of water vapour removed in kg/s.

* * * * *

Reg. No.														

B.Tech. DEGREE EXAMINATION, MAY 2022
Fourth Semester

18MEC107T – APPLIED THERMAL ENGINEERING
(For the candidates admitted from the academic year 2018-2019 to 2019-2020)

Note:
(i) **Part - A** should be answered in OMR sheet within first 40 minutes and OMR sheet should be handed over to hall invigilator at the end of 40th minute.
(ii) **Part - B** should be answered in answer booklet.

Time: 2½ Hours — Max. Marks: 75

PART – A (25 × 1 = 25 Marks)
Answer **ALL** Questions

	Marks	BL	CO	PO

1. Determine the compression ratio of an Otto cycle with air standard efficiency of 60% — 1 | 2 | 1 | 1
(A) 9.88 (B) 5.86
(C) 8.56 (D) 7.88

2. If the pressure ratio is equal to one, then the efficiency of dual cycle is reduced to that of _____ — 1 | 2 | 1 | 1
(A) Otto cycle (B) Diesel cycle
(C) Brayton cycle (D) Rankine cycle

3. Compression ratio is equal to — 1 | 1 | 1 | 1,2
(A) Swept volume/(swept volume +clearance volume) (B) (swept volume +clearance volume)/clearance volume
(C) (swept volume +clearance volume)/swept volume (D) Swept volume / clearance volume

4. With increasing cut off ratio, the efficiency of diesel cycle_____ — 1 | 2 | 1 | 1,2
(A) Decreases (B) Increases
(C) Remains constant (D) Can either increase or decrease

5. For the same compression ratio, the Brayton cycle efficiency is _____ — 1 | 1 | 1 | 1,2
(A) Equal to that of otto cycle (B) Equal to that of diesel cycle
(C) More than that of otto cycle (D) Less than that of otto cycle

6. A chemical reaction accompanied by liberation of heat is called _____reaction. — 1 | 1 | 2 | 1,2
(A) Isothermal (B) Endothermic
(C) Exothermic (D) Adiabatic

7. The mass of oxygen required to convert 1 kg of carbon to CO_2 will be _____ — 1 | 1 | 2 | 1,7
(A) $\frac{3}{11} kg$ (B) $\frac{11}{3} kg$
(C) $\frac{3}{8} kg$ (D) $\frac{8}{3} kg$

8. The proximate analysis of fuel is the determination of percentage of — 1 | 1 | 2 | 1
(A) C, H_2, N_2, S and moisture (B) Fixed carbon, ash, volatile matter and moisture
(C) Higher calorific value (D) Lower calorific value

9.	In the orsat apparatus (A) CO_2 is absorbed in cuprous chloride (B) CO is absorbed in caustic potash solution (C) O_2 is absorbed in pyrogallic acid (D) N_2 is absorbed in hot nickel chrome compound	1	2	2	1
10.	If methane undergoes combination with the stoichiometric quantity of air, the basis would be _____ (A) 15:22:1 (B) 12:30:1 (C) 14:56:1 (D) 9:52:1	1	2	2	1,7
11.	The required air fuel ratio of a petrol engine is controlled by (A) Fuel injector (B) Fuel pump (C) Inlet valve (D) Carburetor	1	1	3	1
12.	In a four stroke diesel engine, during suction stroke _____ is inducted. (A) Air-fuel mixture (B) Fuel (C) Air (D) Either air or fuel	1	1	3	1,2
13.	The operation of forcing additional air under pressure into the engine cylinder is known as (A) Scavenging (B) Turbulence (C) Supercharging (D) Pre ignition	1	1	3	1,2
14.	A four stroke engine having a brake power of 105 kW is supplied with fuel at the rate of 4.4 kg per 10 minutes. The brake specific fuel consumption of the engine is _____ (A) 0.18 kg/kWh (B) 0.25 kg/kWh (C) 0.36 kg/kWh (D) 0.42 kg/kWh	1	2	3	1
15.	A spark ignition engine with compression ratio 8, volume before compression $0.9m^3/kg$ has a net heat interaction of 1575 kJ/kg. What is the mean effective pressure? (A) 20 kPa (B) 20 bar (C) 2000 Pa (D) 2 bar	1	2	3	1,2
16.	The work input to an air compressor is minimum, if the law of compression is _____ (A) $PV = C$ (B) $PV^{\gamma} = C$ (C) $PV^{1.3} = C$ (D) $PV^{1.2} = C$	1	1	4	1,2
17.	To achieve isothermal compression, an air compressor should run at _____ (A) Very high speed (B) Very low speed (C) Constant speed (D) High speed initially and then at low speed	1	1	4	1,2
18.	Which one of the following is a non positive type rotary compressor? (A) Vane blower (B) Roots blower (C) Centrifugal compressor (D) Lysholm compressor	1	1	4	1,2
19.	The clearance volume of a reciprocating compressor directly affects (A) Piston speed (B) Noise level (C) Volumetric efficiency (D) Temperature of air after compression	1	1	4	1
20.	A two stage compressor takes in air at 1.1 bar and discharges at 20 bar. For minimum work input, the intermediate pressure must be _____ (A) 10.55 bar (B) 7.33 bar (C) 5.5 bar (D) 4.7 bar	1	2	4	1,2

21.	One tonne of refrigeration is equal to _____ (A) $211kJ/min$ (B) $220kJ/min$ (C) $420kJ/min$ (D) $620\ kJ/min$	1	1	5	1
22.	The ratio of high temperature to lower temperature for a reversed cannot refrigerator is 1.25. The COP will be _____ (A) 2 (B) 3 (C) 4 (D) 5	1	2	5	1,2
23.	How is the condensation process in vapour compression refrigeration cycle carried out? (A) At constant volume (B) At constant pressure (C) At constant enthalpy (D) At constant entropy	1	1	5	1,2
24.	The difference between dry bulb temperature and dew point temperature is called _____ (A) Dry bulb depression (B) Wet bulb depression (C) Dew point depression (D) Degree of saturation	1	2	5	1
25.	The specific humidity during heating and humidification process _____ (A) Remains constant (B) Increases (C) Decreases (D) First increases and the decreases	1	2	5	1,2

PART – B (5 × 10 = 50 Marks)

Answer **ALL** Questions

		Marks	BL	CO	PO
26. a.i	Compare the efficiencies of Otto and diesel cycles for the same compression ratio and for same engine capacity.	4	4	1	1,2
ii.	With suitable flow diagram and TS diagram explain the concept of regeneration in gas turbines and highlight its importance.	6	4	1	1,2
	(OR)				
b.	The swept volume of a diesel engine working on dual cycle is 0.0053 m^3 and the clearance volume is 0.00035 m^3. The maximum pressure is 65 bar. Fuel injection end at 5% of the stroke. The temperature and pressure at the start of compression are 80°C and 0.9 bar. Determine the air standard efficiency of the cycle. Take $\gamma = 1.4$.	10	3	1	1,2
27. a.i.	Illustrate how lower calorific valve of a fuel is different from higher calorific valve.	3	3	2	1,7
	The ultimate analysis of a sample coal gave the following gravimetric analysis: C = 65%, H2 = 6%, S = 1.5%, O_2 = 18%. Apply Dulong's formula to find the calorific valve.	3	3	2	1,7
ii.	Discuss how an Orsat apparatus is useful to analyze the constituents of exhaust gas emitted by an engine.	4	3	2	1,7
	(OR)				
b.	During a boiler trial, dry flue gas analysis by volume was reported as CO_2-13%, CO-0.3%, O_2-6%, N_2-80.7%. The coal analysis by mass was reported as C-62.4%, H_2-4.2%, O_2-4.5%, moisture 15% ash 13.9%. Estimate (i) Minimum air required to burn 1 kg of coal (ii) Mass of air actually supplied per kg or coal (iii) Amount of excess air supplied per kg of coal	10	4	2	1,7