Zeal Education Society's

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THIRD YEAR (TY)

DIPLOMA IN MECHANICAL ENGINEERING

SCHEME: I **SEMESTER: V**

NAME OF SUBJECT: POWER ENGINEERING & REFIRGERATION

Subject Code: 22562

MSBTE QUESTION PAPERS & MODEL ANSWERS

1. **MSBTE SAMPLE QUESTION PAPER**
2. **MSBTE WINTER-19 EXAMINATION**

Scheme - I

Sample Question Paper

Program Name : **Diploma in Mechanical Engineering**
Program Code : **ME**
Semester : **Fifth**
Course Title : **Power Engineering and Refrigeration**
Marks : **70**

22562

Time : 3 Hrs.

Instructions:
(1) All questions are compulsory.
(2) Illustrate your answers with neat sketches wherever necessary.
(3) Figures to the right indicate full marks.
(4) Assume suitable data if necessary.
(5) Preferably, write the answers in sequential order.
(6) Use of psychrometry chart is allowed

Q.1) Attempt any FIVE of the following. 10 Marks

a) Name the Diagnostic Tools used for fault finding of MPFI Engine.

b) State the Unit of Refrigeration.

c) State the functions of Catalytic Converter.

d) Define the term “Compressor capacity’.

e) Name the essential components used in Gas turbine.

f) List the different Solid Propellant used in Rocket engine.

g) State the any two advantages of ‘Turbo Charging’.

Q.2) Attempt any THREE of the following. 12 Marks

a) Represent Diesel Cycle on P-V and T-S Diagram.

b) State the effect of ‘Air-Fuel Ratio’ on exhaust emission.

c) Explain the working of ‘Lobe type Air Compressor’ with neat sketch.

d) Represent Brayton Cycle on P- V and T- S diagram.

Q.3) Attempt any THREE of the following. 12 Marks

a) List the Methods of reducing Pollution in diesel engine as per BS6 .

b) Explain the term

1. Octane Number
2. Knock Resistance

c) Explain with neat sketch the working of Household Refrigerator.

d) Differentiate between Two Stroke and Four Stroke I. C .Engine (any four points).

Q.4) Attempt any Three of the following. 12 Marks

a) Explain the term "Exhaust Gas Recirculation' with neat sketch.

b) Draw the labeled Valve Timing Diagram of typical 4- stroke Diesel Engine.

c) Explain the concept of following terms with respect to refrigerants

1. GWP
2. ODP

d) Explain the effect of clearance volume on multi stage Air compressor without intercooling by using P V diagram.

e) Explain the working of 'Turbo Prop' with neat sketch.

Q.5) Attempt any TWO of the following. 12 Marks

a) Following observations were recorded during a trial on single cylinder four stroke oil engine :

Cylinder bore = 15 cm

Length of stroke = 25 cm

Mean effective pressure = 7.35 bar

Engine speed = 400 rpm

Brake torque = 225 N.m.

Fuel consumption = 3 kg/hr

Calorific value of fuel = 44200 kJ/kg

Determine:

i) Mechanical efficiency

ii) Brake thermal efficiency

iii) Brake specific fuel consumption

b) A single stage reciprocating air compressor has swept volume of 2000 $cm^3$and runs at 600 rpm. It operates on pressure ratio of 8 and clearance 5% of swept volume. Assume NTP room condition at inlet (P = 101.3kPa, T = 15°C) and polytropic compression and expansion with n = 1.25 calculate :

i) Indicated power ii) volumetric efficiency iii) Mass flow rate iv) Isothermal efficiency

c) A simple saturation vapour compression cycle using R-12 is designed for 10 TR capacity. The vapour is dry saturated at the start of compression. For the 268° K evaporator temperature and 308° K condenser temperature, Represent process on P-H and T-S diagram

.Find: (i) Mass flow rate of refrigerant (ii) Power required in kW. (iii) C.O.P.

Given enthalpy values:

(i) at the start of compression = 185 kJ/kg

(ii) at the end of compression = 206 kJ/kg

(iii) at the start of expansion = 70 kJ/kg

Q.6) Attempt any TWO of the following. 12 Marks

a) An IC engine uses 6 kg of fuel per hour having

CV of 43,000 kJ/kg.

The brake power developed is 21 kW.

The temperature rise of cooling water is 23˚C.

Rate of water flow is 11 kg/min.

The temperature rise of exhaust gas is 250˚C

Rate of flow of exhaust gases is 4.6 kg/min

specific heat of water 4.187 kJ/kg K

specific heat of exhaust gas are 1 kJ/kg K

Prepare heat balance sheet on minute basis.

b) State the methods to improve efficiency of air compressor. Explain working of Two stage air compressor with perfect intercooling with the help of P-V diagram

c) The air is at 24 ˚C DBT and40 % Relative humidity.

With the help of psychrometric chart find following properties of air with units and plot the same on psychrometric chart.

(i) Dew point temperature (ii) Wet bulb temperature

(iii) SP volume of air (iv) Enthalpy of air (v) SP humidity of air

Scheme - I

Sample Test Paper - I

Program Name : **Diploma in Mechanical Engineering**
Program Code : **ME**
Semester : **Fifth**
Course Title : **Power Engineering and Refrigeration**
Marks : **20**

22562

Time : 1 Hour

Instructions:
(1) All questions are compulsory.
(2) Illustrate your answers with neat sketches wherever necessary.
(3) Figures to the right indicate full marks.
(4) Assume suitable data if necessary.
(5) Preferably, write the answers in sequential order.

Q.1 Attempt any FOUR. **08 Marks**

a. Name the different components of I C Engine
b. List advantages of MPFI engine
c. State the purpose of Piezoelectric injector
d. Define term- BSFC
e. State the effect of I C engine pollution on Environment
f. Explain term ECU

Q.2 Attempt any TWO **12 Marks**

a. The following data is collected during a trial of four cylinder petrol engine.
   B.P. with all cylinder working = 15.8 kW
   B.P. with cylinder No. 1 cutoff = 11.14 kW
   B.P. with cylinder No. 2 cutoff = 11.2 kW
   B.P. with cylinder No. 3 cutoff = 11.36 kW
   B.P. with cylinder No. 4 cutoff = 11.3 kW
   Find mechanical efficiency of engine
b. Explain with neat sketch the construction of Two Stroke Petrol Engine with neat sketch
c. A four stroke petrol engine develops 5kW at 2000 R.P.M. When its mean effective pressure is 7.5 bar. If for the engine, L = 1.25 D, find its dimensions

Scheme - I

Sample Test Paper - II

Program Name : **Diploma in Mechanical Engineering**
Program Code : **ME**
Semester : **Fifth**
Course Title : **Power Engineering and Refrigeration**
Marks : **20**

22562

Time : 1 Hour

Instructions:
(1) All questions are compulsory.
(2) Illustrate your answers with neat sketches wherever necessary.
(3) Figures to the right indicate full marks.
(4) Assume suitable data if necessary.
(5) Preferably, write the answers in sequential order.

Q.1 Attempt any FOUR. **08 Marks**

a. Explain term- FAD w.r.t Air compressor
b. List different types of Rotary Compressor
c. List the applications of Gas Turbine
d. Define – Comfort Air conditioning
e. State the significance of Psycromentric Chart
f. Name different Psycrometric Processes

Q.2 Attempt any TWO. **12 Marks**

a. A single stage reciprocating air compressor has swept volume of 2000 cm3 and runs at 600 rpm. It operates on pressure ratio of 8 and clearance 5% of swept volume. Assume NTP room condition at inlet (P = 101.3 kPa, T = 15 degree C) and polytropic compression and expansion with h = 1.25 calculate :
i) Indicated power ii) Volumetric efficiency iii) Mass flow rate iv) Isothermal efficiency

b. A refrigeration system works on vapour compression cycle. Enthalpies at various points are given below.
Compressor inlet – 1460 kJ/kg.
Compressor outlet – 1796 kJ/kg.
Inlet to expansion valve – 322 kJ/kg.
Calculate:
(i) COP (ii) Power required for 1 kg of refrigerant circulated per min.

The refrigerant is superheated by 15degree C before it enters the compressor and sub cooled by 3degree C before expansion. Sketch the cycle on p-h & T-S diagram.

c. List the methods to improve thermal efficiency of gas turbine and explain any one of themin detail.

22562

11920

3 Hours / 70 Marks Seat No. | | | | | | | | |

Instructions :
(1) All Questions are *compulsory.*
(2) Illustrate your answers with neat sketches wherever necessary.
(3) Figures to the right indicate full marks.
(4) Assume suitable data, if necessary.
(5) Use of Non-programmable Electronic Pocket Calculator is permissible.
(6) Use of psychrometric chart is allowed.

Marks

1. Attempt any FIVE of the following : **10**

(a) List diagnostic tools used in fault finding of MPFI engines.
(b) Define SEER & EER.
(c) State purpose of Selective Catalytic Reduction (SCR).
(d) Define Pressure Ratio in air compressors.
(e) List at least six components of a jet engine.
(f) List different liquid propellants used in rocket engines.
(g) State four objectives of supercharging.

2. Attempt any THREE of the following : **12**

(a) Draw actual indicator diagram for 4 stroke petrol engine.
(b) Draw a typical graph indicating changes in pollutants level (HC, CO_2 & CO) with respect to changes in air fuel ratio.
(c) Describe in brief working of axial flow compressor with sketch.
(d) Explain in brief aero derivative & heavy frame engine. State their applications separately.

3. Attempt any THREE of the following : **12**

(a) List changes made by automobile manufactures in achieving BS VI norms in diesel engines.
(b) Discuss in brief process of combustion in SI engines with a sketch.
(c) Explain working of a storage type water cooler with a sketch.
(d) In otto cycle compression ratio is 8. Calculate air standard efficiency. Will it be grater than Carnot Cycle ? Justify your answer.

4. Attempt any THREE of the following : 12

(a) Draw inline fuel injection pump. Name different components.

(b) With sketch, justify use of Variable Geometry Turbocharger as compared to fixed geometry turbocharger.

(c) State formulae to calculate TEWI & LCCP.

(d) Draw PV diagram for working of two stage reciprocating air compressor when inter-cooling in perfect and imperfect.

(e) Compare turbojet & turboprop engines (at least four parameters).

5. Attempt any TWO of the following : 12

(a) A two stroke cycle internal combustion engine has a mean effective pressure of 5.8 bar. The speed of the engine is 940 rpm. If the diameter of piston and stroke are 120 mm and 130 mm respectively, find the indicated power developed and piston speed.

(b) A single acting reciprocating air compressor has cylinder diameter and stroke of 201 mm & 301 mm respectively. The compressor sucks air at 1 bar and 27 °C and delivers at 8 bar while running at 101 rpm. Find indicate power of compressor, mass of air delivered by compressor per minute. Compression follows law $PV^{1.25} = C$ Take R = 287 J/kg K.

(c) In a typical refrigeration system refrigerating effect of 9.5 Tons of refrigeration is expected. Enthalpy values of refrigerant per kg at various locations are 185 kJ (compressor inlet), 206 kJ (compressor outlet), 70 kJ (condenser exit). Assuming no under cooling & superheating find mass of refrigerant per second required to be circulated. Also find COP of the system.

6. Attempt any TWO of the following : 12

(a) A 4 cylinder, 4 stroke petrol engine has 5 cm bore and 8 cm stroke. It was tested at constant speed. Fuel consumption was 0.13 kg/min. Spark plugs for four cylinders were cut one after other. Brake Power was measured and was found as follows :

When all cylinders working = 16.25 kW, first cylinder cutoff = 11.55 kW, second cylinder cutoff = 11.65 kW, third cylinder cutoff = 11.70 kW, fourth cylinder cutoff = 11.50 kW. Find IP & Mechanical Efficiency.

(b) Compare reciprocating and rotary air compressor (at least six points).

(c) Expected room conditions are 20 °C & 55% RH. Outdoor conditions are 39 °C and RH 70%. Locate both points on psychrometric chart and find how much enthalpy per kg of air and moisture content per kg of dry air need to be changed to achieve room conditions. Draw skeleton of psychrometric chart and show both points.

WINTER – 19 EXAMINATION

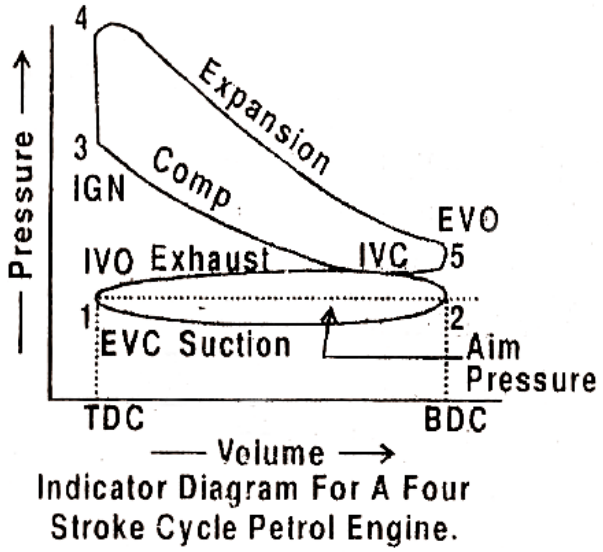
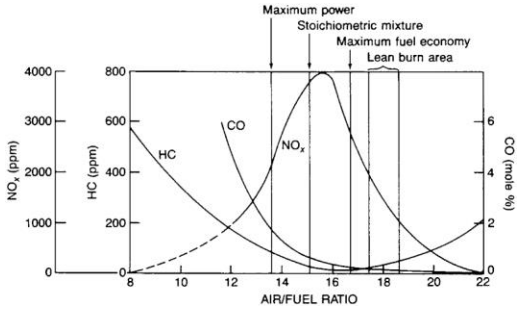
Subject Name: Power Engg. & Refrigeration **Model Answer** Subject Code: 22562

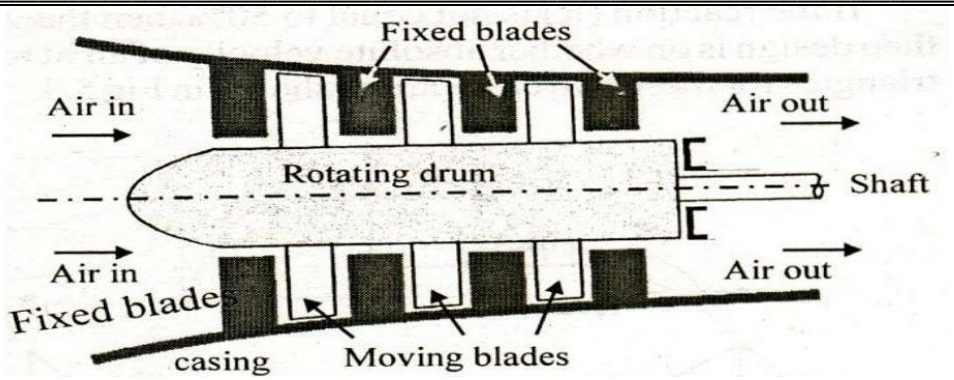
Important Instructions to examiners:

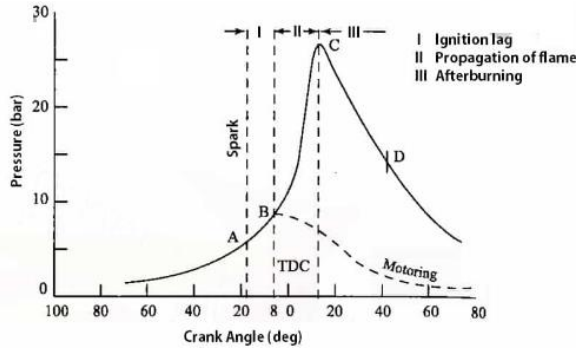
1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given more Importance (Not applicable for subject English and Communication Skills.
4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.
6) In case of some questions credit may be given by judgement on part of examiner of relevant answer based on candidate's understanding.
7) For programming language papers, credit may be given to any other program based on equivalent concept.

Q. No.	Sub Q. N.	Answer	Marking Scheme
Q.1 (A)	a)	Following are the diagnostic tools used in fault finding of MPFI engines 1. Engine Code Readers 2. Compression Testers 3. Spark Plug Testers 4. Mechanic's Stethoscope 5. Scan Tool 6. Battery Tester 7. Power Probe III	**Any 4** **2M**
	b)	SEER: Seasonal Energy Efficiency Ratio (**SEER**), is most commonly used to measure the efficiency of a central air conditioner. The higher the SEER, the more efficient the system OR It is the ratio of cooling Capacity to energy consumed in watts-hours. EER: Energy Efficiency Ratio (**EER**) is a measure of how efficiently a cooling system will operate when the outdoor temperature is at a specific level (95 degrees F). The higher the EER, the more efficient the system. In technical terms,(Correction) OR It is the ratio of total capacity to the total KW energy usage at specific humidity and temperature condition.	1M each
	c)	Purpose of Selective Catalytic Reduction (SCR) : 1. It reduces Nox 75% to 90% 2. Converts it in to molecular nitrogen and water vapor 3. It reduces HC emission up to 80% 4. It reduces PM emission 20 to 25%.	**2M** **Any 2 Point**
	d)	Compressor pressure ratio (CPR), is the ratio of the air total pressure exiting the compressor to	2M

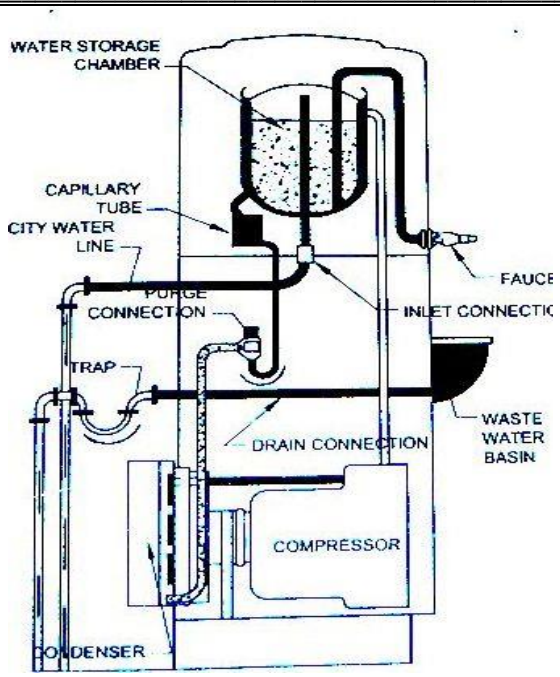
		the air pressure entering the compressor. This number is always greater than 1.0.	
	e)	Following are the components of jet engine: 1. Air intakes 2. Compressors 3. Combustors 4. Turbines 5. Afterburners (reheat) 6. Nozzle 7. Bypass duct 8. Shaft	Any Six For 2M
	f)	Following are the different liquid propellants used in rocket engines 1. kerosene, Liquid oxygen and Liquid Hydrogen similar to kerosene 2. Alcohol and its derivatives (Ethyl Alcohol) 3. hydrazine and its derivatives 4. Hydrogen peroxide 5. liquid hydrogen	2m ½ M Each Any 4 Point
	g)	Following are the objectives of supercharging 1. To compensate for loss of power due to high altitudes for air craft engines 2. To obtain better performance from the existing engine 3. For a given weight and bulk of the engine, super charging increase power output. This is important in air craft, marine and automotive engines where weight and space are considered 4. Super charging is done to induct more amount of air into cylinder per unit times and hence to burn more amount of fuel to increase power output	**2m** **½ M** **Each** **Any 2 Points**

Q.2	a)	 Actual Indicator diagram for 4 stroke petrol engine	4M
	b)	Graph indicating changes in pollutants level w.r.t air fuel ratio 	4M
	c)	Axial flow compressor : Working Principle: As the fluid enters and leaves in the axial direction, the centrifugal component in the energy equation does not come into play. Here the compression is fully based on diffusing action of the passages. The diffusing action in stator converts absolute kinetic head of the fluid into rise in pressure. The relative kinetic head in the energy equation is a term that exists only because of the rotation of the rotor. The rotor reduces the kinetic head of the fluid and adds it to the absolute kinetic head of the fluid i.e. the impact of the rotor on the fluid particles increases its velocity (absolute) and thereby reduces the relative velocity between the fluid and the rotor. In short increases the absolute velocity of the fluid and the stator converts this into pressure rise.	2M

			2M
	d)	Heavy frame industrial gas turbines compared to aero derivative gas turbines are usually slower in speed, narrower in operating speed range, heavier, larger, have higher air flow, slower in start-up and need more time and spare parts for maintenance. Heavy frame industrial gas turbines use hydrodynamic bearing. Aero derivative gas turbines use anti-friction bearing. Advanced aircraft engine and space technologies have been used to provide maintainable, flexible, light weight and compact aero derivative gas turbines. The key to maintainability is the modular concept which provides for removal of components and replacement without removing the gas turbine from its support mounts. The heavy frame industrial units, by contrast, require more amount of effort to remove and replace components (especially combustor parts) and more effort to inspect or repair the sections. The user should weigh needs and requirements against the variety of gas turbines offered. Applications- Traditionally, preference has been to place the aero derivative units in remotely located applications (including offshore) and to place heavy frame industrial units in easily accessible base-load applications. The heavy frame industrial gas turbines consume more fuel and more air than the aero derivative units. They are exposed to a greater quantity of the contaminants in air that cause corrosion.	2M 2M
Q.3	a)	Following are Changes in automobile manufacturers in achieving BS6 norms of diesel engines 1. Reduction in HC emission by 45% 2. Reduction in NO_X emission by 70% 3. Reduction in PM emission by 80% 4. Use of Lean NO_X traps 5. Use selective catalytic reduction (SCR) 6. Use of Diesel particulate filter 7. Five times reduction in Sulpher %	**Any Four Changes 1M each**

		8. OBD for all diesel vehicles 9. Real Driving Emission introduced in vehicles 10. Fumigation 11. Catalytic converter monitoring 12. Misfire detection	
	b)	Combustion In S I Engine  According to Ricardo, There are three stages of combustion in SI Engine as shown in figure above 1. Ignition lag stage 2. Flame propagation stage 3. After burning stage 1. Ignition lag stage: There is a certain time interval between instant of spark and instant where there is a noticeable rise in pressure due to combustion. This time lag is called IGNITION LAG. 2. Flame propagation stage: Once the flame is formed at “b”, it should be self sustained and must be able to propagate through the mixture. This is possible when the rate of heat generation by burning is greater than heat lost by flame to surrounding. After the point “b”, the flame propagation is abnormally low at the beginning as heat lost is more than heat generated. 3.After burning: Combustion will not stop at point “c” but continue after attaining peak pressure and this combustion is known as after burning. This generally happens when the rich mixture is supplied to engine.	Fig. 2M Stages 2M

c)



OR

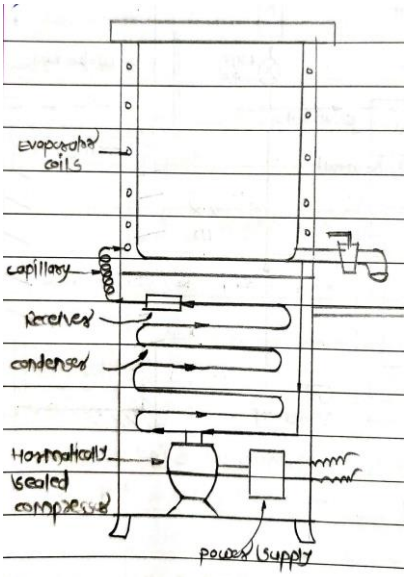
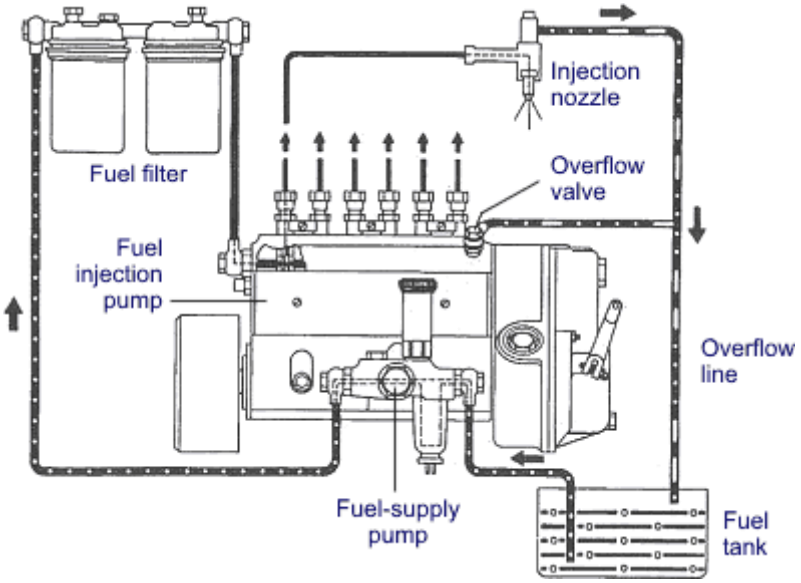


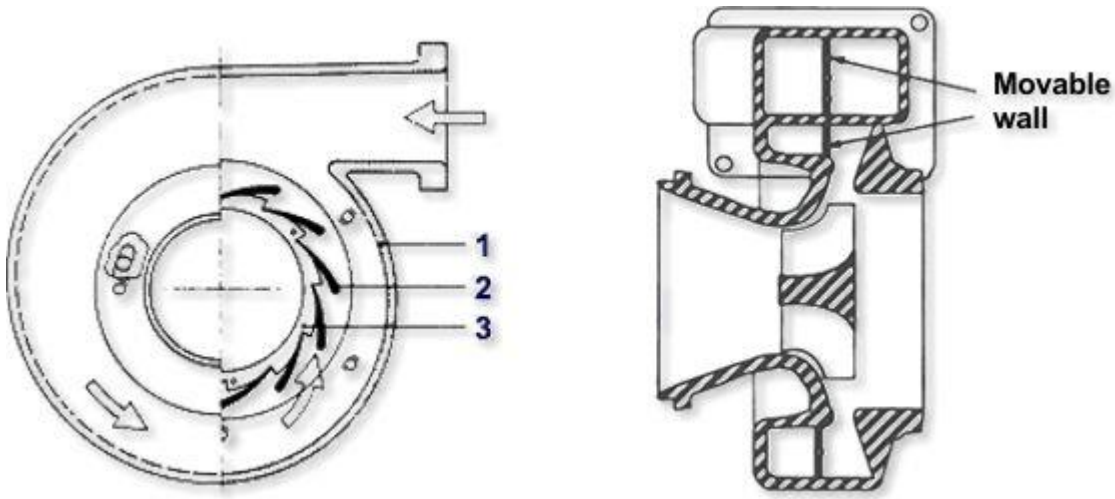
Fig. 2M

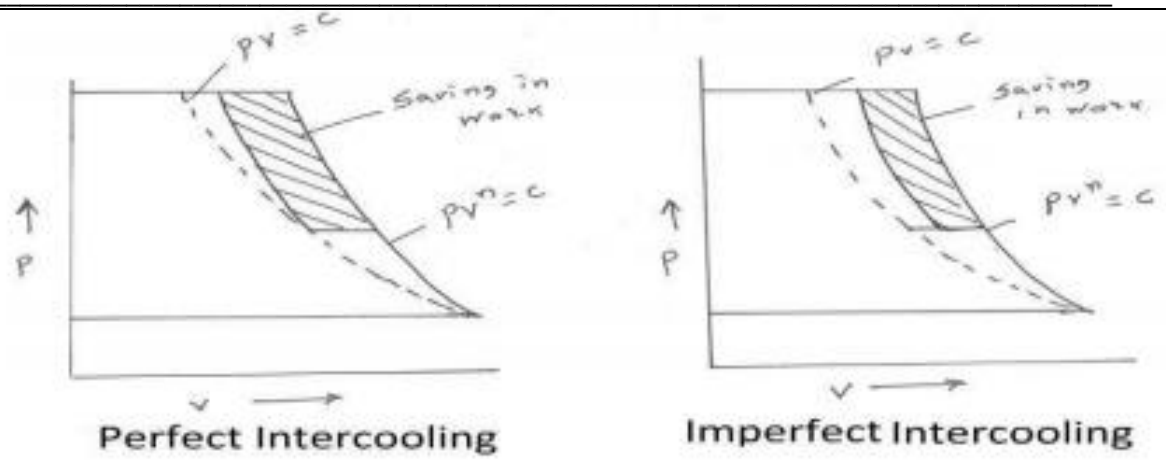
Storage type Water Cooler

The storage type cooler has the evaporator coil soldered on to the walls of the storage tank of the cooler, generally on to the outside surface of the walls. The tank could be of the galvanized steel or stainless steel sheets. Water level is maintained in the tank by a float wall.

Push type water taps are generally provided for drawing cold water in both the types, to minimize the wastage of refrigerated water. Thermostat controls the operation of the compressor to maintain the water temperature at the desired level. The feeler bulb of the thermostat is clamped on to the water coil just at its outlet end in the instantaneous cooler. In the storage type, the bulb is kept immeresed in water in the tank or clamped to the wall of the storage tank on the outside at a lower level, much below the lower most evaporator refrigerant tube soildered on to the tank. 2M

	d)	Q3 (d) Compression ratio = 8 $\eta_{air\ std.} = 1 - \frac{1}{r_c^{\gamma-1}}$ $= 1 - \frac{1}{8^{1.4-1}}$ $= 0.5647$ $= 56.47\%$	2M
		No, the Otto cycle efficiency 56.47% will always be lower than Carnot cycle efficiency.	1M
		Justification: Carnot theorem states that keeping operating conditions same, Carnot engine is more efficient than any other engine. So, Otto cycle efficiency is lower than Carnot cycle efficiency.	1M
Q.4	a)	 **Inline Fuel Injection Pump**	Fig. 3M Naming 1M

	b)	 **Variable Geometry Turbocharger** Variable Turbine Geometry technology is the next generation in turbocharger technology where the turbo uses variable vanes to control exhaust flow against the turbine blades. The problem with the fixed geometry turbocharger that big turbochargers do not work well at slow engine speeds, while small turbochargers are fast to spool but run out of steam pretty quick. A turbocharger equipped with Variable Turbine Geometry has little movable vanes which can direct exhaust flow onto the turbine blades. The vane angles are adjusted via an actuator. The angles of the vanes vary throughout the engine RPM range to optimize turbine behaviour.	Sketch 2M Justification 2M
	c)	**TEWI (Total equivalent warming impact)** TEWI = GWP· L · n + GWP·m·(1−α) + n · E · β (1) where, GWP - Refrigerant Global Warming Potential (equivalent to CO2) [kg CO2/kg refrigerant] L - Annual leakage rate [kg/year] n - System operating life time [years] m - Refrigerant charge [kg] α - Recycling factor [%] E - Annual energy consumption [kWh/year] β - CO2 emissions on energy generation [kg CO2/kWh] **LCCP (Life-cycle climate performance)** LCCP = TEWI + GWP (Indirect) [energy consumption expressed as CO_2- eq emissions from chemical production & transport, manufacturing components & vehicle assembly and end-of-life] + GWP (direct) [chemical refrigerant emissions including atmospheric reaction products, manufacturing leakage, and end-of- -life]	2M 2M

	d)		2 M each
	e)	**Turbojet Engine** / **Turboprop Engine** • Power produced by the turbine is used to drive the compressor / • Power produced by the turbine is used to drive the compressor and propeller. • Low Takeoff thrust / • High Takeoff thrust • Low Propulsive efficiency / • Propulsive efficiency is good. • Less space is needed compared to turboprop engine. / • More space is needed • Reduction gear is not needed / • Reduction gear needed - Engine is noisy / - Engine is less noisy - Engine consist of Diffuser, Compressor, Combustion Chamber, Turbine, Nozzle. / - Engine consist of Diffuser, Compressor, Combustion Chamber, Turbine, Nozzle with Propeller	Any four points 1M each

Q.5	a)	Q5 (a) Indicated Power $= P_m \cdot L \cdot A \cdot N$ $= 5.8 \times 10^5 \times 0.13 \times \frac{\pi}{4} \times (0.12)^2 \times \frac{940}{60}$ $= 13365.2$ W $= 13.365$ kW — (4) m Piston speed $= 2LN$ $= 2 \times 0.13 \times \frac{940}{60}$ $= 4.073$ m/sec. — (2) m Speed in terms of m/min Piston speed = 244.38 m/min	

b)

Q5 (b) $V_1 = V_s \times N$

$= \frac{\pi}{4} d^2 l \times N$

$= \frac{\pi}{4} \times (0.301)^2 \times 0.301 \times \frac{101}{60}$

$= 0.0161 \ m^3/sec.$ — (2) M

$P_1 V_1 = m R T_1$

$m = \frac{P_1 V_1}{R T_1} = \frac{1 \times 10^5 \times 0.0161}{287 \times 300}$

$= 0.0187 \ kg/sec.$ — (2) M

$W = \frac{n}{n-1} m R T_1 \left[\left(\frac{P_2}{P_1} \right)^{\frac{n-1}{n}} - 1 \right]$

$= \frac{1.25}{1.25-1} \times 0.0187 \times 287 \times 300 \left[\left(\frac{8}{1} \right)^{\frac{1.25-1}{1.25}} - 1 \right]$

$= 4151.69 \ W$

$= 4.152 \ kW$ — (2) M

c)

Q5 (c) $C.O.P. = \frac{h_1 - h_4}{h_2 - h_1}$

$= \frac{185-70}{206-185} = 5.476$ — (2) M

Ref. effect = 9.5 Tons

$= 9.5 \times 210$

$= 1995$ kJ/min

Ref. effect $= m(h_1 - h_4)$ — (2) M

$m = \frac{1995}{185-70}$

$= 17.35$ kg/min

$= 0.289$ kg/sec. — (2) M

Q.6 a)

Q6 (a)

B.P. with all cylinder working = 16.25 kW

$I.P_1 = (B.P.)_{\text{all cylinder working}} - (B.P.)_{2,3,4}$

$= 16.25 - 11.55 = 4.7\ kW$

$I.P_2 = 16.25 - 11.65 = 4.6\ kW$

$I.P_3 = 16.25 - 11.70 = 4.55\ kW$

$I.P_4 = 16.25 - 11.50 = 4.75\ kW$

(2) marks

Total $I.P. = I.P._1 + I.P._2 + I.P_3 + I.P_4$

$= 4.7 + 4.6 + 4.55 + 4.75$

$= 18.6\ kW$ — (2) marks

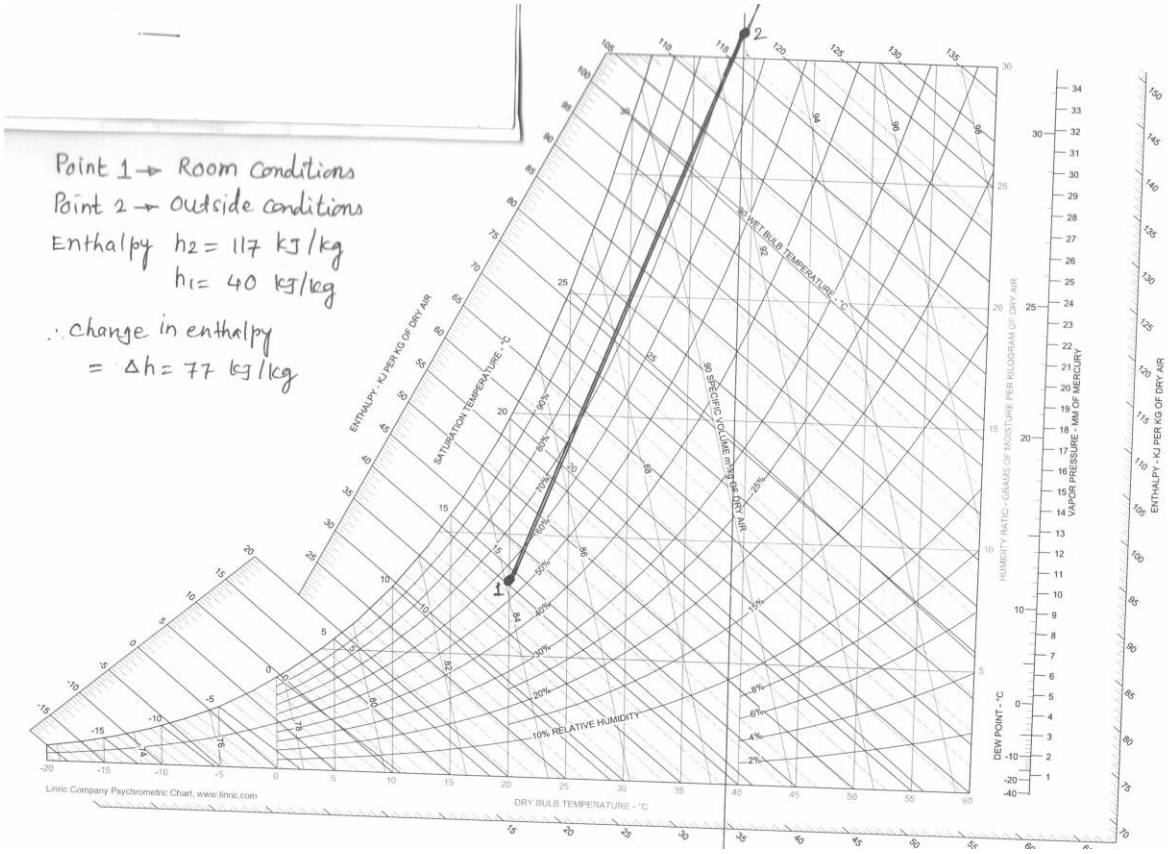
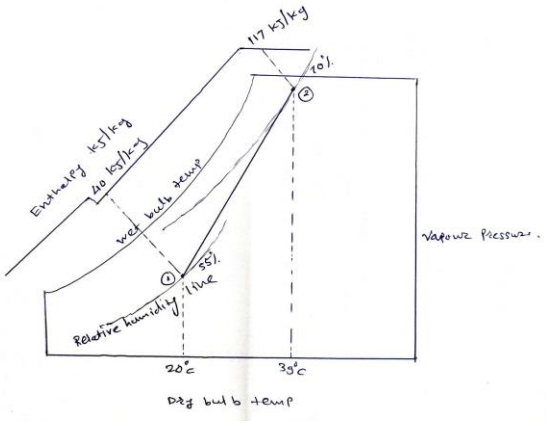
$\eta_{mech.} = \frac{B.P.}{I.P.} = \frac{16.25}{18.6} =$

$= 87.36\%$ — (2) marks

b)

Reciprocating compressor	Rotary compressor
1. Compression of air takes place with help of piston and cylinder arrangement with reciprocating motion of piston.	1. Compression of air takes place due to rotary motion of blades.
2. Delivery of air intermittent.	2. Delivery of air is continuous.
3. Delivery pressure is high i.e. pressure ratio is high.	3. Delivery pressure is low, i.e. pressure ratio is low.
4. Flow rate of air is low.	4. Flow rate of air is high.
5. Speed of compressor is low because of unbalanced forces.	5. Speed of compressor is high because of perfect balancing.
6. Reciprocating air compressor has more number of moving parts.	6. Rotary air compressor has less number of moving part.
7. It needs proper lubrication and more maintenance.	7. It required less lubrication and maintenance.

Any Six points 1M each

		8. Due to low speed of ration it can't be directly coupled to prime mover but it requires reduction of speed.	8. Rotary air compressor can be directly coupled to prime mover.	
		9. It is used when small quantity of air at high pressure is required. 10. Receiver Compulsory 11. Mechanical Efficiency Low 12. More Starting torque required	9. It is used where large quantity of air at lower pressure is required. 10. Receiver not compulsory 11. Mechanical Efficiency High 12. Less Starting torque required	
	c)	 Skelton diagram - 		3 Marks for calculation 3 Marks for dig.