INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

MECHANICAL ENGINEERING
TUTORIAL QUESTIONBANK

Course Name	APPLIED THERMODYNAMICS-I
Course Code	AMEB09
Semester	IV
Branch	Mechanical Engineering
Year	2019 –2020
Course Faculty	Mr. Aravind Reddy, Assistant Professor ,ME

OBJECTIVES:
The course should enable the students to:

I	Visualize the construction and working of internal combustion engines, compressors and refrigeration systems.
II	Compare the ideal and real working of thermodynamic cycles for performance evaluation.
III	Understand the subsystems of internal combustion systems.

COURSE OUTCOMES:

CO 1	Understand the working related to 2S & 4S and injection systems for SI and CI engines
CO 2	Explore the concept on working of combustion in SI and CI engines
CO 3	Classification of various testing performance balance sheet and compressors
CO 4	Understand the concept related to rotary dynamic and axial compressors
CO 5	Understand the working related to Mechanical refrigeration, COP, refrigerants and use of p-h charts.

COURSE LEARNING OUTCOMES:
Students, who complete the course, will have demonstrated the ability to do the following:

AMEB09.01	Understand main idea and importance behind the 2 - S and 4 - S IC engines.
AMEB09.02	Analyze the working of the basic components in the IC engines.
AMEB09.03	Understand the combustion process and also how it does affect the performance of the IC engines.
AMEB09.04	Apply the thermodynamic principles in the design of an IC engines.
AMEB09.05	Formulate and perform the procedures required for the maintenance and operation of IC engines.
AMEB09.06	Compare different IC engines and develop a system which meets the requirements.
AMEB09.07	Knowledge of Fuel Requirements and Fuel Rating.
AMEB09.08	Testing and Performance of I.C Engines.
AMEB09.09	Analyze the working of the basic components in the Compressors and Refrigeration systems.
AMEB09.10	Apply the thermodynamic principles in the design of Compressors and refrigeration system.
AMEB09.11	Formulate and perform the procedures required for the maintenance and operation of compressors and refrigeration systems.
AMEB09.12	Compare different compressors and refrigeration systems and develop a system which meets the requirements.
AMEB09.13	Understand the process of pressure enthalpy charts that are used in the Refrigeration systems.
AMEB09.14	Introduction to concepts of power and refrigeration cycles. Their efficiency and coefficients of performance.
AMEB09.15	Ability to use modern engineering tools, software and equipment to analyze energy transfer in required air-condition application.
AMEB09.16	Explore the use of modern engineering tools, software and equipment to prepare for competitive exams, higher studies etc.

MODULE – I			
I C ENGINES			
PART - A (SHORT ANSWER QUESTIONS)			
S. No	**Question**	**Blooms Taxonomy Level**	**Course Learning Outcomes**
1	What is valve timing diagram why the inlet valve is opened before TDC and closed after BDC?	Remember	AMEB09.01
2	What is combustion efficiency and combustion back duration?	Understand	AMEB09.01
3	What is fluid friction in an engine?	Remember	AMEB09.01
4	What are the products formed during combustion process?	Remember	AMEB09.01
5	What is an internal combustion engine?	Understand	AMEB09.01
6	What is scavenging?	Remember	AMEB09.01
7	What is meant by compression ratio?	Understand	AMEB09.01
8	Define firing order.	Remember	AMEB09.01
9	What do you mean by SFC?	Remember	AMEB09.02
10	Define mean effective pressure.	Understand	AMEB09.03
11	Obtain the expression for mean effective pressure of an Otto cycle.	Remember	AMEB09.02
12	List the three principal factors that influence engine performance.	Understand	AMEB09.03
13	What are the different kinds of fuels used in an IC?	Remember	AMEB09.02
14	Briefly explain the petroleum refining process.	Remember	AMEB09.03
15	What are the important qualities of SI and CI engine fuel?	Remember	AMEB09.02
16	How are SI and CI engine fuels rated?	Understand	AMEB09.03
17	What are the functional requirements of an injection system?	Remember	AMEB09.01
18	How the injection system classified?	Remember	AMEB09.01
19	Define carburetion.	Understand	AMEB09.01
20	With a neat sketch explain an induction coil.	Understand	AMEB09.01
PART - B (LONG ANSWER QUESTIONS)			
S. No	**Question**	**Blooms Taxonomy Level**	**Course Learning Outcomes**
1	Give classification of IC Engines.	Understand	AMEB09.01
2	Distinguish between SI engines and CI engines?	Understand	AMEB09.01
3	Sketch and explain the valve timing diagram of a four stroke Otto cycle engine?	Understand	AMEB09.01
4	In what respect two stroke engines differs from 4-stroke engine Discuss.	Understand	AMEB09.01
5	Explain fuel injection system of an SI engine?	Remember	AMEB09.01
6	What are the different lubrication systems available for IC engines?	Understand	AMEB09.02
7	Discuss the importance of cooling system for an IC engines. Describe different cooling systems?	Understand	AMEB09.03
8	List out the properties of fuel for (i) SI engine (ii) CI engine.	Understand	AMEB09.02
9	Explain lubrication system for IC engines?	Understand	AMEB09.03
10	Explain cooling system for IC engines?	Remember	AMEB09.02
11	What is the main difference between an Otto cycle and Diesel cycle? Derive the expression for mean effective pressure of the Diesel cycle.	Remember	AMEB09.02
12	Explain with a neat sketch the working principle of a mechanical governor.	Remember	AMEB09.03
13	Explain why a rich mixture is required for the following i. Idling ii. Maximum power iii. Sudden acceleration	Understand	AMEB09.02
14	Describe the essential part of a modern carburetor.	Understand	AMEB09.02
15	What is the purpose of using a governor in CI engines? What are the two major types of governors?	Understand	AMEB09.03
16	Draw a schematic diagram of fuel feed pump and explain its working principle.	Remember	AMEB09.02
17	What are the different kinds of fuels used in an IC engine?	Understand	AMEB09.03
18	How are SI and CI engine fuels rated?	Remember	AMEB09.02
19	Explain reversible and irreversible processes. Is it possible to realize these processes.	Understand	AMEB09.02
20	Explain briefly the Diesel cycle with the help of p-v and T-S diagrams and derive an expression for the ideal efficiency of a Diesel cycle.	Understand	AMEB09.03
PART - C (ANALYTICAL QUESTIONS)			

S. No	Question	Blooms Taxonomy Level	Course Learning Outcomes
1	What are the homogeneous and heterogeneous mixtures? In which engines these mixtures are used? Explain.	Remember	AMEB09.02
2	What is the importance of additives in lubricants?	Understand	AMEB09.03
3	Basic energy requirements for spark ignition engine.	Remember	AMEB09.02
4	What are the different variables that effects knocking in a CI engine can an operator usually able to control hose effects explain.	Remember	AMEB09.03
5	Explain the process of ignition delay of CI engine while representing on pressure time diagram.	Remember	AMEB09.02
6	Illustrate with diagram the effect of ignition delay on the rate of pressurized in the CI engine.	Remember	AMEB09.02
7	What is meant by crank case ventilation? Explain the details?	Remember	AMEB09.03
8	Give a brief account of air pollution due to engine exhaust.	Remember	AMEB09.04
9	What are the causes and problems of improper combustion of IC engines?	Remember	AMEB09.05
10	What are the different variables that effects knocking in an SI engine can an operator usually able to control hose effects explain?	Remember	AMEB09.04

MODULE-II

COMBUSTION IN S I ENGINES AND CI ENGINES

PART - A (SHORT ANSWER QUESTIONS)

S. No	Question	Blooms Taxonomy Level	Course Learning Outcomes
1	What is the normal combustion and abnormal combustion in SI engine?	Understand	AMEB09.04
2	What is called flame front and flame velocity?	Understand	AMEB09.05
3	What is knocking in both SI and CI engines?	Remember	AMEB09.04
4	What decides severity of knocking in both SI and CI Engines?	Remember	AMEB09.05
5	What is pre ignition and optimum ignition timing?	Remember	AMEB09.04
6	What is ignition delay period?	Remember	AMEB09.05
7	Define suction induced swirl and combustion induced swirl?	Remember	AMEB09.04
8	What is mixture strength? How it influences the combustion?	Remember	AMEB09.05
9	What are anti-knock agents? Main difference between working of anti-knock agent in SI and CI Engines?	Remember	AMEB09.04
10	What is a combustion chamber? What are the different combustion zones in combustion chamber?	Understand	AMEB09.06
11	What are the types of ignition systems	Remember	AMEB09.07
12	Give the two methods of cooling systems?	Remember	AMEB09.06
13	List the properties of lubricants?	Remember	AMEB09.07
14	Factors affecting normal combustion in SI system?	Understand	AMEB09.06
15	What are the properties of liquid fuels?	Remember	AMEB09.07
16	What are the tests for identifying pre-ignition?	Understand	AMEB09.06
17	Differentiate auto ignition and detonation	Understand	AMEB09.07
18	What are the effects of detonation?	Understand	AMEB09.06
19	How to control detonation?	Understand	AMEB09.07
20	How to control detonation?	Understand	AMEB09.06

PART - B (LONG ANSWER QUESTIONS)

S. No	Question	Blooms Taxonomy Level	Course Learning Outcomes
1	State and explain different combustion stages in SI engine.	Remember	AMEB09.06
2	State and explain different combustion stages in CI engine.	Understand	AMEB09.07
3	Explain knocking, properties and its effects in CI engine.	Understand	AMEB09.06
4	Explain different types of combustion chambers in SI and CI engines.	Understand	AMEB09.07
5	Explain the need for air motion and types. Factors influencing knocking in SI and CI engine.	Understand	AMEB09.06
6	What are the requirements of fuel for a diesel engine?	Understand	AMEB09.07
7	Differentiate between normal combustion and abnormal combustion phenomena in case of SI Engine.	Understand	AMEB09.06
8	What is the importance of variables like flame speed flame front in case of delay period.	Remember	AMEB09.07
9	Explain knocking additives	Understand	AMEB09.06

10	Discuss air flow movements in CI engines	Understand	AMEB09.07
11	Explain the Splash lubrication system with the diagram	Remember	AMEB09.06
12	Explain the carburetor working principle with diagram	Understand	AMEB09.07
13	What are the types of fuel injection systems? Explain anyone with a neat sketch?	Understand	AMEB09.06
14	How to tell a two stroke cycle engine from a 4 stroke cycle engine?	Remember	AMEB09.07
15	Explain the Pressure feed system with a diagram?	Remember	AMEB09.06
16	In what respect four-stroke diesel cycle (compression Ignition) engine differs from four stroke cycle spark ignition engine?	Remember	AMEB09.07
17	What do you mean by Pre-ignition? How can it be detected?	Understand	AMEB09.06
18	Explain the difference between Pre-ignition, auto-ignition and detonation.	Remember	AMEB09.06
19	What is meant by ignition delay? Explain the steps in SI engines ignition delay?	Understand	AMEB09.07
20	Why do we feel the necessity of cooling an IC engine? Explain briefly the following methods of cooling IC engines: Air-cooling and Liquid - cooling?	Understand	AMEB09.06
PART - C (ANALYTICAL QUESTIONS)			
S. No	**Question**	**Blooms Taxonomy Level**	**Course Learning Outcomes**
1	What are the harmful effect of overheating of an engine explain.	Understand	AMEB09.06
2	Why battery ignition system is preferred in most of the engines.	Understand	AMEB09.07
3	What are the effects of super charging on engine performance?	Understand	AMEB09.06
4	How does scavenging takes place in 2 stroke petrol engine?	Understand	AMEB09.07
5	What are the undesirable effects if an engine under cool?	Understand	AMEB09.06
6	How liquid cooling system is better than air cooling system in an IC engine.	Understand	AMEB09.07
7	Find the mean effective pressure and torque developed by the engine in the previous problem if its rating is 4 kW at 1500 rpm.	Remember	AMEB09.06
8	What do u mean by charge? What type of charge to be sent for petrol engine for better performance?	Understand	AMEB09.07
9	Why firing order is important to run an IC engine. Mention firing order of four - stroke four cylinders, six cylinder engines.	Remember	AMEB09.06
10	Why the actual efficiency much lower than air standard efficiency explain with major losses.	Remember	AMEB09.06
MODULE-III			
TESTING AND PERFORMANCE			
PART - A (SHORT ANSWER QUESTIONS)			
S. No	**Question**	**Blooms Taxonomy Level**	**Course Learning Outcomes**
1	Define brake power?	Remember	AMEB09.06
2	Define mechanical efficiency?	Remember	AMEB09.06
3	List the devices used to measure the cylinder pressure.	Understand	AMEB09.06
4	What is an indicated power?	Understand	AMEB09.06
5	What are the various losses of IC Engine?	Understand	AMEB09.06
6	How do you determine heat losses explain with sankey diagram?	Understand	AMEB09.06
7	Define clearance ratio.	Understand	AMEB09.06
8	What is specific fuel consumption?	Remember	AMEB09.06
9	Define volumetric efficiency?	Understand	AMEB09.06
10	What is the use of heat balance sheet of an engine	Understand	AMEB09.06
11	Classify positive displacement compressors.	Remember	AMEB09.06
12	State the basic function of an air dryer in a compressor.	Remember	AMEB09.06
13	Write the capacity range of a vertical type reciprocating compressors.	Understand	AMEB09.06
14	Define a compressor.	Understand	AMEB09.06
15	Classify non-positive displacement compressors	Remember	AMEB09.06

16	Mention the primary element of a centrifugal compressor.	Remember	AMEB09.06
17	Classify different types of compressors.	Remember	AMEB09.06
18	When are the rotary compressors employed?	Understand	AMEB09.06
19	Classify rotary type compressors.	Remember	AMEB09.06
20	Mention the primary element of an axial compressor.	Remember	AMEB09.06
PART - B (LONG ANSWER QUESTIONS)			
S. No	**Question**	**Blooms Taxonomy Level**	**Course Learning Outcomes**
1	Explain the Morse test to fins the frictional power.	Understand	AMEB09.06
2	What is William's line .how do you measure frictional power using this.	Remember	AMEB09.06
3	Discuss different types of dynamometers.	Understand	AMEB09.06
4	Write short notes on Exhaust gas analysis.	Remember	AMEB09.06
5	Define the following terms: Indicated Power, Brake power, Friction Power, Mechanical efficiency, Mean effectiveness.	Understand	AMEB09.06
6	What is the significance of heat balance sheet? Discuss the procedure to draw heat balance sheet for CI engine.	Understand	AMEB09.06
7	Explain Isothermal work done	Understand	AMEB09.06
8	Derive equation for work done of reciprocating air compressor with T-S and p-V diagrams.	Understand	AMEB09.06
9	Explain about intercooling.	Understand	AMEB09.06
10	Explain the phenomenon of knocking in SI engines? What are the different factors influencing the knocking?	Understand	AMEB09.06
11	Explain multistage compression	Understand	AMEB09.09
12	Derive volumetric efficiency of air compressor	Understand	AMEB09.10
13	Classify compressors	Remember	AMEB09.11
14	What is the condition for maximum efficiency in multistage compression?	Understand	AMEB09.09
15	Enumerate the applications of compressed air? How are air compressors classified?	Understand	AMEB09.09
16	Classify dynamic compressors. Explain the working of a axial compressor.	Remember	AMEB09.11
17	State how the air compressors are classified?	Remember	AMEB09.09
18	Explain the working of a reciprocating compressor	Remember	AMEB09.10
19	Classify rotary compressors. Explain the working of a rotary compressor	Remember	AMEB09.11
20	Classify dynamic compressors. Explain the working of a centrifugal compressor.	Remember	AMEB09.09
PART - C (ANALYTICAL QUESTIONS)			
S. No	**Question**	**Blooms Taxonomy Level**	**Course Learning Outcomes**
1	The data recorded during the trial of a two stroke diesel engine are as follows: Engine speed =1500rpm Load on brakes =110kg brake arm =900mmDetermine the following: (a) Brake torque, (b) Power available at the brakes of the engine.	Understand	AMEB09.06
2	During testing a two stroke, diesel engine with rope brake dynamometer, the following were recorded: Engine speed =700rpm Diameter of brake drum =600mm Diameter of rope =50mm Dead load on the brake drum=35kg Spring balance reading =4.5kg Find the power available at the brakes, in KW.	Remember	AMEB09.06
3	During the trial on a single cylinder, four stroke, diesel engine the following are noted: Load on hydraulic dynamometer=950N Dynamometer constant =7500 Fuel used per hour = 10.5kg/hr Calorific values of fuel =50000kJ/Kg Engine speed =400rpm. Calculate brake thermal efficiency of the engine	Remember	AMEB09.06
4	An Otto cycle four stroke gas engine has a cylinder 25cm in diameter and the stroke of the piston is 40cm. It operates under the following conditions: Speed =200rpm misfires per minute =10 Mean effective pressure=6.2kg/cm2 Mechanical efficiency =80% Determine (a) IHP, (b) BHP and (c) Friction horse power.	understand	AMEB09.06
5	Calculate the volumetric efficiency of a petrol engine of 6cm bore and 9cm stroke if each cylinder sucks 0.0025kg of charge during suction stroke. Assume R as 29.27.	Remember	AMEB09.06
6	A four cylinder engine running at 1200rpm developed 25.3BHP. The	Remember	AMEB09.06

	average torque when one cylinder was cut out was 10.5kg_m. Determine the indicated thermal efficiency, if the calorific value of the fuel used is 10000kcal/kg, and the engine uses 0.25kg of petrol per BHP hour.		
7	In the Morse test with a four cylinder four stroke petrol engine, the following data were obtained for a particular setting and speed. BHP with all cylinders working =32.0 BHP with No 1 cylinder cut off=21.6 BHP with No 2 cylinder cut off=22.3 BHP with No 3 cylinder cut off=22.5 BHP with No 4 cylinder cut off=23.0 Estimate the IHP of the engine and its mechanical efficiency.	Remember	AMEB09.06
8	During the trial of a single cylinder, four stroke oil engine, the following observations were recorded: Bore and Stroke =300mm x 450mm Engine speed=220rpm Duration of trial =60minutesFuel consumption =7.0kgCalorific valve of fuel=45000kJ/kg Area of indicator diagram =320mm^{2}Length of indicator diagram=60mmSpring index=1.1bar/mm Net load on brakes =130kgBrake drum diameter =1650kgTotal weight of jacket cooling water =500kgTemperature rise of jacket cooling water=400 Temperature of exhaust gases=300air Consumption=300kgAssume specific heat of exhaust gases= 1.004 kJ/kg K, specific heat of water =4.185kJ/kg k and room temperature =25^{0}C Determine the followinga Power available at brakes. b. Indicated power developed, c. Mechanical efficiency, d. Thermal efficiency, e. Heat balance sheet.	Remember	AMEB09.06
9	The following readings are observed during the trial of a single cylinder, four stroke diesel engine. Fuel used per hour=11kg;mass analysis of fuel is carbon 85%, oxygen 14%, non-combustibles 1%;calorific value of fuel is 50000kJ/kg. The volumetric analysis of the exhaust gases is carbon dioxide 8.5%, oxygen 10%, and nitrogen 81.5%. Temperature of exhaust gases is 400c. Specific heat of Exhaust gases is 1.05kJ/kg. Partial pressure of steam in the exhaust gases is 0.030bar.Ambient temperature is 20^{0}c.Calculate the percentage of heat carried away by the exhaust gases.	Remember	AMEB09.06
10	During the trial on a single cylinder, four stroke, diesel engine the following are noted: Load on hydraulic dynamometer=950N Dynamometer constant =5500 Fuel used per hour = 10.5kg/hr Calorific values of fuel =20000kJ/Kg Engine speed =400rpm. Calculate brake thermal efficiency of the engine.	Remember	AMEB09.06

MODULE-IV

ROTARY, DYNAMIC AND AXIAL FLOW

PART - A (SHORT ANSWER QUESTIONS)

S. No	Question	Blooms Taxonomy Level	Course Learning Outcomes
1	What is volumetric efficiency in case of compressor?	Understand	AMEB09.09
2	Define slip factor?	Understand	AMEB09.10
3	Define pressure coefficient.	Understand	AMEB09.11
4	What is the difference between reciprocating and rotary compressors?	Understand	AMEB09.09
5	What is stalling?	Understand	AMEB09.10
6	Draw p-v and T-S diagram of a MULTI stage reciprocating compressors?	Understand	AMEB09.11
7	What is the function of an intercooler in compressors?	Remember	AMEB09.09
8	What are rotary compressors?	Remember	AMEB09.10
9	What is the difference between positive displacement and non-positive displacement compressors?	Remember	AMEB09.11
10	What do you mean by Choking?	Remember	AMEB09.09
11	Specify the function of a diffuser.	Remember	AMEB09.10
12	Mention the primary component of a rotary compressor.	Remember	AMEB09.11
13	Write the function of a rotor in rotary compressors.	Remember	AMEB09.09
14	Define stage in a Axial flow Compressor.	Remember	AMEB09.11
15	Mention the definition of ‘Degree of Reaction”.	Understand	AMEB09.12
16	Write the formula for Blade loading coefficient in a Axial flow compressor.	Remember	AMEB09.13
17	State or define Volumetric efficiency of a reciprocating compressor.	Remember	AMEB09.11
18	How an Air compressor may be controlled?	Remember	AMEB09.12
19	Why the clearance volume of a air compressor is kept minimum?	Remember	AMEB09.13

20	Mention the types of rotary compressors.	Remember	AMEB09.11
PART - B (LONG ANSWER QUESTIONS)			
S. No	**Question**	**Blooms Taxonomy Level**	**Course Learning Outcomes**
1	State how the air compressors are classified.	Understand	AMEB09.09
2	Explain the working of roots blower.	Remember	AMEB09.10
3	Explain the working of vane blower and also draw the actual p -v diagram of a compressor.	Remember	AMEB09.11
4	What is rotary compressor? How are they classified?	Remember	AMEB09.09
5	Draw the velocity diagram of an axial flow compressor.	Understand	AMEB09.10
6	What do you mean by multistage compression? And state its advantages?	Understand	AMEB09.11
7	Draw velocity diagrams of centrifugal compressors.	Understand	AMEB09.11
8	Compare between reciprocating and rotary compressors.	Understand	AMEB09.12
9	Compare between axial flow and centrifugal compressors.	Understand	AMEB09.13
10	Discuss of working centrifugal compressors.	Remember	AMEB09.11
11	Describe with a neat sketch the construction and working of a single-stage single-acting reciprocating air compressor.	Understand	AMEB09.12
12	Describe briefly an axial flow compressor.	Remember	AMEB09.13
13	Write short notes on a) clearance in compressors b) free air delivered and displacement c)compressor performance	Understand	AMEB09.11
14	Explain with a neat sketch actual p-V diagram for a single stage compressor.	Understand	AMEB09.12
15	What is a centrifugal compressor? How does it differ from an axial flow compressor?	Understand	AMEB09.13
16	Write short notes on a) control of compressors b) intercooler c)compressed air motors	Understand	AMEB09.11
17	Explain the working of a reciprocating compressor with its sectional view diagram.	Understand	AMEB09.11
18	Explain with a neat sketch actual p-V diagram for a two- stage compressor.	Understand	AMEB09.12
19	Define the following efficiencies as applied to reciprocating air compressors: a) compressor Efficiency b) Isothermal Efficiency c) Adiabatic Efficiency d) Mechanical Efficiency	Remember	AMEB09.13
20	Mention the advantages and disadvantages of multi stage compression.	Understand	AMEB09.11
PART - C (ANALYTICAL QUESTIONS)			
S. No	**Question**	**Blooms Taxonomy Level**	**Course Learning Outcomes**
1	An air compressor takes in air at 1 bar and 20 ^{0} C and compresses it according to law pv $^{1.2}$ = constant .It is then delivered to a receiver at a constant pressure of 10 bar. R=0.287 KJ/Kg Determine: (i) Temperature at the end of compression (ii) Work done and heat transferred during compression per kg of air.	Remember	AMEB09.09
2	A single–stage, double-acting compressor has a free air delivery (FAD) of 14 m3/min. measured at 1.013 bar and 150C. The pressure and temperature in the cylinder during induction are 0.95 bar 320 C. The delivery pressure is 7 bar and index of compression and expansion, n=1.3.The clearance volume is 5 % of the swept volume. Calculate (i) Indicated power required (ii) Volumetric efficiency.	Remember	AMEB09.10
3	Air at 103 K Pa and 27 ^{0}C is drawn in LP cylinder of a two stage air compressor and is isentropic ally compressed to 700 KPa. The air is then cooled at constant pressure to 37 ^{0}C in an intercooler and is then again compressed isentropic ally to 4 MPa in the H.P cylinder, and is then delivered at this pressure Determine the power required to run the compressor if it has to deliver 30 m^3 of air per hour measured at inlet conditions.	Remember	AMEB09.11

4	A roots blower compresses 0.08 m^3 of air from 1.0 bar to 1.5 bar per revolution .Calculate the compressor efficiency.	Remember	AMEB09.12
5	A centrifugal compressor delivers 16.5 kg/s of air with a total head pressure ratio of 4:1 .The speed of the compressor is 1500 r.p.m. Inlet total head temperature is 20^0 C, slip factor 0.9 Power input factor 1.04 and 80 % isentropic efficiency. Calculate: Overall diameter of the impeller ii. Power input	Remember	AMEB09.13
6	A multi stage axial flow compressor delivers 20 kg/sec of air. The inlet stagnation condition is 1 bar and 17 ^{0} C. The power consumed by the compressor is 4350 kW .Calculate (i) The delivery pressure (ii)Number of stages (iii) Overall isentropic efficiency of the compressor.	Understand	AMEB09.11
7	An axial flow compressor with an overall isentropic efficiency of 85 % draws air at 20^0 C and compresses it in the pressure ratio 4:1.The mean blade speed and flow velocity are constant throughout the compressor. Assuming 50 % reaction blading and taking blade velocity as 180 m/sec. and work input factor as 0.82.calculate (i) Flowvelocity (ii) Number of stages.	Understand	AMEB09.13
8	A Centrifugal compressor used as a super charger for aero-engines handles 150 kg/min of air. The suction pressure and temperature are 1bar and 290K. the suction velocity is 80 m/s. after compression in the impeller the conditions are 1.5bar 345K and 220 m/s. Calculate: a) Isentropic efficiency b) power required to drive the compressor c) The overall efficiency of the unit. It may be assumed that K.E. gained in the impeller is entirely converted into pressure in the diffuser.	Understand	AMEB09.14
9	Air at a temperature of 300K flows in a centrifugal compressor running at 18000 r.p.m. Isentropic total head efficiency= 0.76, outer diameter of blade tip= 550mm, slip factor= 0.82. calculate A) the temperature rise of air passing through the compressor B) the static pressure ratio.	Remember	AMEB09.15
10	A multi stage axial flow compressor delivers 20 kg/sec of air. The inlet stagnation condition is 1 bar and 19^0 C. The power consumed by the compressor is 5350 kW .Calculate (i) The delivery pressure (ii)Number of stages (iii) Overall isentropic efficiency of the compressor	Remember	AMEB09.13

MODULE - V

REFRIGERATION

PART - A (SHORT ANSWER QUESTIONS)

S. No	Question	Blooms Taxonomy Level	Course Learning Outcomes
1	Define refrigeration?	Understand	AMEB09.11
2	Define (i) actual COP (ii) Theoretical COP.	Understand	AMEB09.12
3	What is the difference between wet compression and dry compression?	Understand	AMEB09.11
4	Write short notes on p-h chart.	Understand	AMEB09.12
5	What is unit of refrigeration	Remember	AMEB09.13
6	What is the function of capillary tube in vapour compression refrigeration system?	Remember	AMEB09.11
7	What are the different components of vapour compression system	Remember	AMEB09.12
8	What is the effect of sub cooling	Understand	AMEB09.13
9	State demerits of air refrigeration system	Understand	AMEB09.11
10	What is the function of Expansion valve?	Understand	AMEB09.12
11	Define (i) COP(iii) Relative COP	Understand	AMEB09.13
12	Mention a reversed heat engine cycle and its function.	Understand	AMEB09.11
13	Write the operations in a vapour refrigeration cycle.	Understand	AMEB09.11
14	Why is wet compression not preferred.	Remember	AMEB09.12
15	Define refrigerating system?	Remember	AMEB09.13
16	Specify the main characteristic feature of an air refrigeration system	Remember	AMEB09.11
17	State elements of refrigerating system.	Remember	AMEB09.12
18	Why an analyzer-rectifier combination is used in absorption refrigeration cycle.	Remember	AMEB09.13

19	State merits of air refrigeration system.	Understand	AMEB09.11
20	Mention the Effect of superheating.	Understand	AMEB09.12

PART - B (LONG ANSWER QUESTIONS)

S. No	Question	Blooms Taxonomy Level	Course Learning Outcomes
1	Describe a simple vapour compression cycle giving clearly its flow diagram.	Remember	AMEB09.11
2	Show the vapour compression cycle on T-S diagram when the vapour is dry saturated, super-heated.	Remember	AMEB09.12
3	What are the factors that affect the performance of a vapour compression system and explain?	Remember	AMEB09.13
4	What are desired properties of refrigerants?	Understand	AMEB09.11
5	Explain with neat sketch the working of a vapour absorption system.	Understand	AMEB09.12
6	Compare between vapour compression and vapour absorption systems.	Understand	AMEB09.13
7	Explain air refrigeration system.	Understand	AMEB09.11
8	Explain reversed Carnot cycle on T-S diagram,	Understand	AMEB09.12
9	What are the different components of vapour compression system and explain with neat sketch	Remember	AMEB09.13
10	Classify and explain refrigerants.	Understand	AMEB09.11
11	Differentiate clearly between open and closed air refrigeration systems.	Understand	AMEB09.11
12	State merits and demerits of 'vapour compression system' over 'air refrigeration system'.	Understand	AMEB09.12
13	Enumerate the properties and uses of commonly used refrigerants.	Understand	AMEB09.13
14	Write the important refrigeration applications. Elements of refrigeration system.	Understand	AMEB09.11
15	State the functions of the following parts of a simple vapour compression system: compressor, condenser, expansion valve and evaporator.	Remember	AMEB09.12
16	Give the comparison between a vapour compression system and a vapour absorption system.	Remember	AMEB09.11
17	Briefly explain pressure enthalpy chart.	Remember	AMEB09.12
18	Explain practical vapour absorption system.	Understand	AMEB09.13
19	Write the functions of parts of a simple vapour compression system.	Understand	AMEB09.11
20	Show the vapour compression cycle on T-S diagram when the vapour is super-heated and wet after compression.	Understand	AMEB09.12

PART - C (ANALYTICAL QUESTIONS)

S. No	Question	Blooms Taxonomy Level	Course Learning Outcomes
1	An air refrigeration system operates between 1 MPa and 100 K Pa is required to produce a cooling effect of 2000 KJ/min. Temperature of the air leaving the cold chamber is -5 ^{0} C and at leaving the cooler is 30 ^{0} C. Neglect losses and clearance in the compressor and expander determine (i) Mass of air circulated per min (ii) Compressor work ,expander work ,cycle work(iii) COP and power in KW required	Understand	AMEB09.13
2	28 tonnes of ice from and at 0 ^{0} C is produced per day in an ammonia refrigerator. The temperature range in the compressor is from 25 ^{0}C to -15 ^{0}C.The vapour is dry and saturated at the end of compression and an expansion valve is used. Assuming a co efficient of performance of 62 % of the theoretical, calculate the power required to drive the compressor. take latent heat of ice is 335 KJ/kg.	Remember	AMEB09.14
3	A refrigerator operating on stand vapour compression cycle has a coefficient performance of 6.5 and is driven by a 50 KW compressor. The enthalpies of saturated liquid and saturated vapour refrigerant at the operating condensing temperatures of 35 ^{0} C are 62.55 KJ/Kg and 201.45 KJ/Kg. The standard refrigerant vapour leaving evaporator has an enthalpy of 187.53kJ/kg. Find the refrigeration temperature at compressor discharge. The Cp of refrigerant vapour may be taken to be 0.6155 kJ/kg.^{0}C.	Remember	AMEB09.15
4	In a simple vapour compression cycle the piston displacement volume for compressor is 1.5 liters per stroke and its volumetric efficiency is 80 %.The speed of compressor is 1600 rpm. Find the power rating of compressor and refrigerating effect.	Understand	AMEB09.13
5	Ice is formed at 0°C from water at 20°C. The temperature of the brine is –	Remember	AMEB09.14

<table>
<tr><td></td><td>8°C. Find out the kg of ice formed per kWh. Assume that the refrigeration cycle used is perfect reversed Carnot cycle. Take latent heat of ice as 335 kJ/kg.</td><td></td><td></td></tr>
<tr><td>6</td><td>A refrigerating machine of 6 tonnes capacity working on Bell-Coleman cycle has an upper limit of pressure of 5.2 bar. The pressure and temperature at the start of the compression are 1.0 bar and 16°C respectively. The compressed air cooled at constant pressure to a temperature of 41°C enters the expansion cylinder. Assuming both expansion and compression processes to be adiabatic with γ= 1.4, calculate :
(i)Co-efficient of performance.
(ii)Quantity of air in circulation per minute.
(iii)Piston displacement of compressor and expander.
(iv)Bore of compressor and expansion cylinders. The unit runs at 240 r.p.m. and is double-acting. Stroke length = 200 mm.
(v)Power required to drive the unit
For air take γ= 1.4 and c_p= 1.003 kJ/kg K.</td><td>Remember</td><td>AMEB09.15</td></tr>
<tr><td>7</td><td>A simple vapour compression plant produces 5 tonnes of refrigeration. The enthalpy values at inlet to compressor, at exit from the compressor, and at exit from the condenser are 183.19, 209.41 and 74.59 kJ/kg respectively. Estimate :
(i)The refrigerant flow rate,
(ii)The C.O.P.,
(iii)The power required to drive the compressor, and
(iv)The rate of heat rejection to the condenser.</td><td>Remember</td><td>AMEB09.13</td></tr>
<tr><td>8</td><td>A vapour compression heat pump is driven by a power cycle having a thermal efficiency of 25%. For the heat pump, refrigerant-12 is compressed from saturated vapor at 2.0 bar to the condenser pressure of 12 bar. The isentropic efficiency of the compressor is 80%.Saturated liquid enters the expansion valve at 12 bar. For the power cycle 80% of the heat rejected by it is transferred to the heated space which has a total heating requirement of 500 kJ/min. Determine the power input to the heat pump compressor. The following data for refrigerant-12may be used :
<table>
<tr><td rowspan="2">Pressure, bar</td><td rowspan="2">Temperature, °C</td><td colspan="2">Enthalpy, kJ/kg</td><td colspan="2">Entropy, kJ/kg K</td></tr>
<tr><td>Liquid</td><td>Vapour</td><td>Liquid</td><td>Vapour</td></tr>
<tr><td>2.0</td><td>– 12.5</td><td>24.57</td><td>182.0</td><td>0.0992</td><td>0.7035</td></tr>
<tr><td>12.0</td><td>49.31</td><td>84.21</td><td>206.24</td><td>0.3015</td><td>0.6799</td></tr>
</table></td><td>Remember</td><td>AMEB09.14</td></tr>
<tr><td>9</td><td>A refrigeration machine is required to produce i.e., at 0°C from water at 20°C. The machine has a condenser temperature of 298 K while the evaporator temperature is268 K. The relative efficiency of the machine is 50% and 6 kg of Freon-12 refrigerant is circulated through the system per minute. The refrigerant enters the compressor with a dryness fraction of0.6. Specific heat of water is 4.187 kJ/kg K and the latent heat of ice is 335 kJ/kg. Calculate the amount of ice produced on 24 hours.</td><td>Remember</td><td>AMEB09.15</td></tr>
<tr><td>10</td><td>An air refrigeration system operates between 1 MPa and 200 K Pa is required to produce a cooling effect of 3000 KJ/min. Temperature of the air leaving the cold chamber is -5 ^{0}C and at leaving the cooler is 40 ^{0} C. Neglect losses and clearance in the compressor and expander determine (i) Mass of air circulated per min (ii) Compressor work ,expander work ,cycle work(iii) COP and power in KW required</td><td>Remember</td><td>AMEB09.13</td></tr>
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HOD, ME