Code No: R1632033 **R16** SET - 1

III B. Tech II Semester Regular Examinations, April/May- 2019

REFRIGERATION & AIR CONDITIONING

(Mechanical Engineering)

Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B)**
2. Answer **ALL** the question in **Part-A**
3. Answer any **FOUR** Questions from **Part-B**

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PART –A

1.	a)	Define tonne of refrigeration?	[2M]
	b)	List out the advantages of vapour refrigeration system over air refrigeration system.	[2M]
	c)	Give the designation for Dichloro-tetrafluro-ethane refrigerant.	[2M]
	d)	Which component of the simple vapour-absorption system replaces the compressor of a vapour-compression system?	[3M]
	e)	How do SHF and GSHF differ from one another?	[2M]
	f)	Explain why 'heat pump' is most efficient when used for heating purposes?	[3M]

PART -B

2.	a)	Discuss the advantages and disadvantages of air-refrigeration system. Explain the necessity of cooling aircrafts?	[5M]
	b)	An ice plant is working on a reversed Carnot cycle produces 15 tons of ice per day. The ice is formed at 0^0 C and water supplied is also at 0^0 C. The heat is rejected to atmosphere at 25^0C. The heat pump used to run the plant is coupled to a Carnot engine receives heat from a source at 220^0 C and it rejects the heat to atmosphere. The fuel Calorific value, 44.5 MJ/kg is used for supplying the heat. Determine the following (i) power developed by the engine and (ii) fuel used/hr. Take enthalpy of fusion of ice=334.5 kJ/kg.	[9M]
3.	a)	Draw the refrigerator cycle on T-s diagram when the refrigerant is dry and saturated at the end of compression and find an expression for the COP in terms of temperature and entropies.	[6M]
	b)	A vapour compression machine is used to maintain a temperature of -23^0 C in a refrigerated space. The ambient temperature is 37^0 C. The compressor takes in dry saturated vapour of F-12 refrigerant. A minimum 10^0 C temperature difference is required at the evaporator as well as the condenser. There is no sub-cooling of the liquid. If the refrigerant flow rate is 1 kg/min, find (i) Tonnage of the refrigerant; (ii) Power requirement and (iii) COP of the cycle.	[8M]
4.	a)	Discuss the essential properties of a good refrigerant?	[5M]
	b)	What points are considered in selecting a condenser for a refrigeration system?	[4M]
	c)	Where air-cooled condensers are preferred over water-cooled condensers? Give examples with specific reasons.	[5M]
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5. a) Make a comparative list between vapour absorption system and a compression system. [5M]
   b) For a steam jet refrigeration system, the steam enters the nozzle at 8 bar just dry saturated state. The condenser pressure is 0.07 bar and flash chamber is to be maintained at 5^0 C. The make-up water enters the flash chamber at 35^0 C. Taking nozzle, entrainment and compressor efficiencies are η_n=0.94, η_e=0.75 and η_c=0.65 respectively, compute (i) amount of steam per kg of vapour formed in the flash chamber, (ii) COP, and (iii) volume of vapour leaving the flash chamber per ton per hour. [9M]

6. a) Define the term 'effective temperature' and explain its importance in air-conditioning system. Describe the factors which affect effective temperature? [5M]
   b) A mini-cold storage is required to preserve 20 tons of fish at 260 K. There are two attendants, four 40 W bulbs and one 200 W blower. The meat is to be processed to the storage condition in 36 hours. The cold storage size is 8 x 4 x 3 m high. The overall heat transfer coefficients for the walls and ceiling are 4 and 2 kJ/m^2-h-K. The ambient condition is T_{db}=318 K and T_{wb}=302 K. The heat release due to respiration is 60 kJ/ton-h. The ventilation air is 20 m^3/ton-h. Calculate the capacity of the refrigeration system to be procured. Make suitable assumptions. [9M]

7. a) Explain the importance of `throw` and `drop` in locating the grill. [7M]
   b) Write short notes on axial flow fans and centrifugal fans. [7M]

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(Mechanical Engineering)

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2. Answer **ALL** the question in **Part-A**
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PART –A

1. a) Discuss the necessity and application of refrigeration. [2M]
   b) Discuss the effect of superheating on the performance of vapour compression refrigeration cycle. [2M]
   c) Give the designation for Defluro-monochloro-methane refrigerant. [2M]
   d) What type of refrigeration system is commonly used in ships and why? [3M]
   e) Show the humidification and heating processes on a psychrometric chart. [3M]
   f) Discuss the factors affecting grill performance. [2M]

PART -B

2. a) Explain the factors considered in selecting the refrigeration system for aircrafts. [5M]
   b) An aircraft flying at a speed of 900 km/hr at an altitude 8000 m where the ambient pressure and temperature are 0.341 bar and 263 K. The pressure ratio of the main compressor is 5. The cabin pressure maintained is 1.01325 bar and temperature is 27^0 C. Determine the following if the air flow rate is 2 kg/sec. (i) power required for pressurization of cabin excluding ram work. (ii) Additional power to run the refrigeration plant. (iii) Refrigeration capacity in TOR. Assume ramming, compression and expansions are isentropic. [9M]

3. a) Why a throttle valve is used in vapour compression refrigerator rather than an expansion cylinder to reduce the pressure between the condenser and evaporator? [4M]
   b) A simple saturation cycle using F-12 refrigerant is designed for taking a load of 10tons. The refrigerator and ambient temperatures are 0^0 C and 30^0C respectively. A minimum temperature difference of 5^0 C is required in evaporator and condenser for heat transfer. Find (i) mass flow rate through the system, (ii) power required in kW, (iii) cylinder dimensions assuming L/D=1.2 for a single cylinder, single acting compressor if it runs at 300 rpm with volumetric efficiency=0.9. [10M]

4. a) Discuss briefly the factors affecting the choice of refrigerants commonly used in refrigerating plants. [5M]
   b) Explain the working of Flooded evaporator with neat sketch. Specify the fields of their applications. [9M]
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5. a) Compare between a two-fluid and three-fluid vapour absorption system. [5M]
   b) In a steam jet refrigeration the dry saturated motive steam is supplied at 6 bar. The amount of motive steam per unit mass of flash vapour is 2 kg/kg. The quality of vapour at the beginning of compression is 0.90. The condensing and flash vapour temperatures are 40^0 C and 5^0 C, respectively. The compression efficiency is 0.78. Obtain the tonnage of the system for 0.8 kg/s of motive steam and volume of vapour handled by the ejector. [9M]

6. a) Define the ``human comfort`` and explain the factors which affect human comfort. [6M]
   b) A window air conditioner is required for an office size 5 x 3 x 4 m high. The structure load is estimated to be 6000 kJ/h. There are 10 persons doing moderate work. There is no smoking. The ambient and inner conditions are T_{db}=310 K, Ø=50% and T_{db}=395 K and T_{wb}=290 K, respectively. There are five 40 W tube lights. Obtain the capacity of the air conditioner. [8M]

7. a) Explain the use of ``heat-pump`` for heating and cooling cycle with neat diagrams. [7M]
   b) Discuss different methods of humidifying the air? [7M]

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Code No: R1632033 **R16** SET - 3

III B. Tech II Semester Regular Examinations, April/May- 2019

REFRIGERATION & AIR CONDITIONING

(Mechanical Engineering)

Time: 3 hours Max. Marks: 70

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2. Answer **ALL** the question in **Part-A**
3. Answer any **FOUR** Questions from **Part-B**

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PART –A

1.	a)	Draw the p-v and T-s diagram of Bell-coleman cycle.	[2M]
	b)	Distinguish between dry and wet compression. What are the advantages of one over the other?	[2M]
	c)	Give the designation for Monochloro-tetrafluro ethane refrigerant.	[2M]
	d)	What are the advantages and limitations of steam-jet refrigeration system?	[3M]
	e)	Show the cooling of the dehumidification processes on the psychrometric chart.	[3M]
	f)	What are the advantages and disadvantages of the backward-blade fan over forward blade fan?	[2M]

PART -B

2.	a)	With the help of a neat sketch, explain Boot-strap air cycle refrigeration system.	[7M]
	b)	An air refrigeration system working on Bell-coleman cycle operates between 1 bar and 7 bar. The temperature maintained in the cooler is 13^0 C. The air leaving the compressor is cooled to 37^0 C. The compression follows the law $pv^{1.3}$=C and the expansion follows the law $pv^{1.35}$=C. Find (i) theoretical COP (ii) Mass flow rate of air required to manufacture ice at 0^0 C when water supplied at 30^0 C at a rate of 5 tons/day. Take latent heat of ice=335 kJ/kg.	[7M]
3.	a)	Under what circumstances the superheating of vapour before coming to compressor is more objectionable? Mention the ways to prevent it.	[5M]
	b)	A NH_3 vapour compression refrigerator has a single cylinder, single acting compressor with bore 12.7 cm and stroke 15.2 cm and speed of 240 rpm. The cycle is working between 1.6 bar and 13.9 bar. The volumetric efficiency of the compressor is 80% and mechanical efficiency of the system is 90%. The vapour is dry saturated leaving the evaporator and liquid has 32^0 C leaving the condenser. Find the mass flow rate, COP and power required to run the compressor.	[9M]
4.	a)	Differentiate between physical and thermodynamic properties of a refrigerant. Explain what are more important properties in giving specific examples?	[6M]
	b)	Explain the working of evaporative condenser with neat diagram and explain its advantages and disadvantages over others. Give three examples of its use with proper reasoning.	[8M]
5.	a)	Draw a neat compact diagram of lithium bromide water absorption refrigeration system and explain its working. List out the major fields of applications of this refrigeration system?	[6M]

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b) A steam jet system is meant for air conditioning a conference room for 50 persons. Each person releases about 600 kJ/h of energy. The heat transfer through the structure is given to be 60,000 kJ/h. Obtain the amount of vapour evaporated from the chiller if this is maintained at 281 K(=8^0C) and make-up water is available at 308 K(=35^0C). Assume the quality of vapour leaving the chiller to be 0.95. [8M]

6. a) A room whose size is 4 x 3 x 4 m is at a temperature 298 K. The wet bulb temperature of the room was found to be 293 K. Find the amount of water vapour associated with the air. [6M]

b) A cold storage ware-house dimensions are 10m x 15m x 10m high. It is used to store 50 tons of potato at 274 K. There are six persons doing moderate work. There are ten 60 W bulbs. Obtain the refrigeration system capacity for the same for 20 hour operation. The ventilation air is 30 m^3/h. [8M]

7. a) Make the arrangement of ``heat-pump`` when it is used for year-round air-conditioning. [7M]

b) Write short notes on grills and registers. [7M]

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Code No: R1632033 **R16** SET - 4

III B. Tech II Semester Regular Examinations, April/May- 2019

REFRIGERATION & AIR CONDITIONING

(Mechanical Engineering)

Time: 3 hours Max. Marks: 70

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2. Answer **ALL** the question in **Part-A**
3. Answer any **FOUR** Questions from **Part-B**

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PART –A

1. a) Discuss the advantages of dense air refrigerating systems over open air refrigerating systems. [2M]
   b) Discuss the effect of sub-cooling on the performance of vapour compression refrigeration cycle? [3M]
   c) Give the designation for Trifluro-dichloro-ethane refrigerant. [2M]
   d) Is it proper to compare COP's of the vapour-absorption and vapour-compression systems obtained on the basis of different forms of energy? [3M]
   e) What is a by-pass factor? Explain its usefulness? [2M]
   f) Explain the advantages and disadvantages of viscous filters over dry filters. [2M]

PART -B

2. a) With the help of a neat sketch, explain Boot-strap evaporative cooling air cycle refrigeration system. [7M]
   b) In a Bell- coleman cycle, air is drawn into the compressor at -5^0 C and 1 bar and compressed isentropically to 5 bar and then cooled to 15^0 C and then expanded in the expansion cylinder to 1 bar pressure following the law $pv^{1.2}$=C. Find the capacity of the refrigeration plant in TOR and COP of the system? [7M]

3. a) In a vapour compression refrigerator, the working fluid is superheated at the end of compression and is under cooled in the condenser before throttling. Sketch a working cycle on temperature entropy diagram. [5M]
   b) It is proposed to replace R-12 by R-134 a refrigerant to reduce the green house effect in a refrigeration plant of 9 TOR capacity when it is running between 0^0 C and 40^0 C and on a standard refrigeration cycle. Compare (i) mass flow (ii) compressor input and (iii) COP for the two refrigerants suggested. [9M]

4. a) Write short note on ozone layer depletion and global warming. [7M]
   b) Where centrifugal compressors are preferred over reciprocating compressors in refrigeration systems? Describe the advantages and disadvantages of centrifugal over reciprocating compressors. [7M]

5. a) Explain the Electrolux refrigeration system with a neat sketch. What is the purpose of hydrogen in it? [7M]
   b) A steam jet refrigeration system receives dry saturated steam at 6 bar. It expands through a nozzle down to flash chamber pressure meant to chill water at 5^0 C. Taking nozzle, entrainment and compressor efficiencies as η_n=0.92, η_e=0.6 and η_c=0.75, obtain (i) amount of water to be evaporated, and motive steam per ton of cooling and (ii) COP. Assume the condenser temperature 35^0 C and make-up water at 30^0 C. [7M]
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6. a) Air with $T_{db}=30^0$ C contains 15 grams of moisture/kg of dry air. Calculate (i) dew point, (ii) relative humidity, (iii) degrees of saturation and (iv) specific humidity. Also find as to what would be the enthalpy of this air. [7M]
   b) 1,000 m^3 of air at $T_{db}=40^0$ C and relative humidity, Ø=40% is processed to $T_{db}=20^0$ C and Ø=50%. Obtain cooling load and moisture removed/hr. [7M]

7. a) Give few industrial examples where heating and cooling is simultaneously required and explain why ``heat-pump`` is more suitable for such applications. [7M]
   b) Discuss different methods of humidifying the air? [7M]

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