Code No: RT32037A | R13 | SET - 1

III B. Tech II Semester Regular/Supplementary Examinations, April - 2017

REFRIGERATION & AIR CONDITIONING

(Mechanical Engineering)

Time: 3 hours | Maximum Marks: 70

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

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(Refrigeration and Psychrometric tables and charts allowed)

PART –A

1	a)	What is the difference between Refrigeration & Air Conditioning?	[3M]
	b)	Draw the line diagram of simple vapour compression refrigeration system.	[4M]
	c)	What are the advantages of multistage compressor?	[4M]
	d)	Explain the see beck and peltier effects.	[3M]
	e)	Explain the following terms briefly **:** i)Refrigerating effect ii)Wet bulb temperature	[4M]
	f)	Classify Air conditioning systems.	[4M]

PART -B

2	a)	Derive an equation of COP for Bell-Coleman Air-refrigerator show different processes on P-V and T-S Diagram	[4M]
	b)	The atmospheric air at 30^0C dry bulb temperature and 75 % relative humidity enters a cooling coil at the rate of 200 m^3/min. The coil dew point temperature is 14^0C and the by-pass factor of the coil is 0.1. Determine: i)The temperature of air leaving the cooling coil; ii)The capacity of the cooling coil in tonnes of refrigeration iii) The sensible heat factor for the process.	[8M]
	c)	Describe briefly an aircraft refrigeration system.	[4M]
3	a)	Under what circumstances super heating of refrigerant vapour before compression is objectionable?	[3M]
	b)	A single compressor using R-12 as refrigerant has three evaporators of capacity 30TR, 20TR and10TR.The temperature in the three evaporators is to be maintained at -10^oC, 5^oC and 10^oC respectively. The condenser pressure is 9.609 bar. The liquid refrigerant leaving the condenser is sub-cooled to 30^oC. The vapour leaving the evaporators is dry and saturated. Assuming isentropic compression, calculate i) the mass of refrigerant flowing through each evaporator; ii) the power required to drive the compressor; and iii) C.O.P. of the system.	[8M]
	c)	Explain the different method of improving the COP of simple compression refrigeration cycle.	[5M]
4	a)	Explain Ozone depleting potential and global warming potential.	[8M]
	b)	State various evaporators in use. Compare Flooded and DX (dry expansion) type evaporators.	[8M]

5 a) Briefly explain with constructional features and working of Practical vapour absorption refrigeration system. [8M]

b) Explain the working principle of vortex tube. Prove that the energy exchange phenomenon in vortex tube is not a violation of second law of thermodynamics. [8M]

6 a) State and explain various heat loads to be considered for cooling load calculations of a typical building [6M]

b) A small office hall of 25 persons capacity is provided with summer air conditioning system with the following data: [10M]
Outside conditions = 34^0 C DBT and 28^0 C WBT
Inside conditions = 24^0 C DBT and 50 % RH
Volume of air supplied = 0.4 m^3/min/person
Sensible heat load in room = 125600 kJ/h
Latent heat load in the room = 42000 kJ/h. Find the sensible heat factor of the plant.

7 a) Classify Fan used in air-conditioning system. Explain selection of the Fan using fan characteristic curve. [8M]

b) A circular duct of 40 cm is selected to carry air in an air conditioned space at a velocity of 440 m/min to keep the noise level at desired level. If this duct is replaced by a rectangular duct of aspect ratio of 1.5, find out the size of rectangular duct for equal friction method when [8M]
i) the velocity of air in two ducts is same,
ii) the discharge rate of air in two ducts is same.

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Code No: RT32037A **R13** SET - 2

III B. Tech II Semester Regular/Supplementary Examinations, April – 2017

REFRIGERATION & AIR CONDITIONING

(Mechanical Engineering)

Time: 3 hours Maximum Marks: 70

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

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(Refrigeration and Psychrometric tables and charts allowed)

PART –A

1 a) What is Mechanical Refrigeration? [3M]

b) Distinguish between Dry and Wet compression. [4M]

c) State desirable properties of ideal refrigerant. [4M]

d) What are the various applications of thermo-electric refrigerator? [3M]

e) Explain the following terms briefly **:** [4M]
i) Dew point temperature
ii)Psychometric

f) What do you mean by humidification? [4M]

PART -B

2 a) Define refrigeration. State the Name of different types of system used for cooling of aircraft cabin. [4M]

b) An air refrigerator working on Bell-Coleman cycle takes in air at 1 bar and at a temperature of 10^0 C. The air is compressed to 5 bar abs. The same is cooled to 25^0 C in the cooler before expanding in the expansion cylinder to cold chamber pressure of 1 bar. The compression and expansion laws followed are $pv^{1.35} = C$ and $pv^{1.3} = C$ respectively. Determine C.O.P of the plant and net refrigeration effect per kg of air. Take Cp = 1.009 kJ/kg K and R = 0.287 kJ/kg K for air. [8M]

c) Show that the coefficient of performance of an air cycle system is only a function of pressure ratio. [4M]

3 a) Explain how you would detect whether a refrigerant is under charged or over charged? [3M]

b) A Two stage ammonia refrigeration system operates between overall pressure limits of 15 bar and 2 bar respectively. The liquid is sub-cooled to 30^oC. The temperature of de-superheated vapour leaving the water intercooler is also 30^oC. The flash chamber separates the dry vapour at 5 bar pressure. The liquid refrigerant then expands to 2 bar, the evaporator pressure. The load on the evaporator is 50 kW. Calculate
i) Mass flow rate in different lines
ii) Power required
iii) COP [8M]

c) What is the effect of sub-cooling on the performance of vapour compression refrigeration system? [5M]

4 a) Explain multiple evaporators at different temperature with individual expansion valve with neat sketch and P-H diagram. [8M]

b) Explain construction, working, advantages and disadvantages of Thermostatic Expansion valve with neat sketch. [8M]

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5 a) Explain Steam jet refrigeration system with neat system diagram and T-S or P-H diagram. [8M]

b) What are desirable characteristics of absorbent and absorbent refrigerant combination in vapour absorption refrigeration cycle? [8M]

6 a) Define Air-conditioning. Classify air-conditioning system Explain Central air conditioning system [6M]

b) Following data is available for an air conditioning system comprising of filter, cooling coil, fan and distribution system using only fresh air for the purpose of maintaining comfort conditions in summer. RSH = 11.63 KW, RLH = 2.33 KW. Outside design condition: 28°C DBT, 20°C WBT. Inside design condition: 21°C DBT, 50% RH. Temperature of air entering the room = 11°C. Calculate [10M]
i) RSHF
ii) Coil bypass factor
iii) Rate of flow of air kg/hr.
iv) Load on cooling coil
v) Coil ADP

7 a) What are different methods used for design of the ducts and explain advantages of each over other. [8M]

b) Discuss about the performance of heat pump when used with different sources of heat. State advantages and disadvantages in each case. [8M]

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Code No: RT32037A **R13** SET - 3

III B. Tech II Semester Regular/Supplementary Examinations, April – 2017

REFRIGERATION & AIR CONDITIONING

(Mechanical Engineering)

Time: 3 hours Maximum Marks: 70

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

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(Refrigeration and Psychrometric tables and charts allowed)

PART –A

1	a)	In refrigeration system why heat rejected is more than heat absorbed?	[3M]
	b)	Carnot refrigerator has highest COP? Prove.	[4M]
	c)	Write a short note on screw compressor.	[4M]
	d)	Explain the working principle of practical ammonia refrigeration.	[3M]
	e)	Explain the following terms briefly **:** i)Comfort Air conditioning ii) Relative humidity	[4M]
	f)	What do you mean by dehumidification?	[4M]

PART -B

2	a)	Explain Boot-strap air refrigeration system with neat diagram.	[4M]
	b)	A Refrigerator working on Bell-Coleman cycle takes air into the compressor at 1 bar and – 5^{0}C. It is compressed in compressor to a 5 bar and cooled to 25^{0}C at the same pressure. It is further expanded in the expander to 1 bar and discharged to take cooling load. The isentropic efficiency of the compressor = 85% and the isentropic efficiency of the Expander = 90% find the following: i) Refrigerating capacity of the system if air circulation is 40kg/min. ii) KW capacity of motor required to run the compressor iii) COP of the system. Take γ =1.4 C_p =1kJ/kg C_v = 0.7 kJ/kg for air	[8M]
	c)	A machine working on a Carnot cycle operates between 305K and 260 K. Determine the COP when it is operated as i) Refrigerator ii) Heat pump and iii) Heat engine	[4M]
3	a)	Explain the effect of sub cooling on COP.	[3M]
	b)	A vapor compression machine is used to maintain a temperature of - 23^{0}C in refrigerated space. The ambient temperature is 37^{0}C.The compressor takes in dry saturated vapor of F -12. Aminimum10^{0}C temperature difference is required at the evaporator as well as condenser. There is no sub-cooling of liquid. If refrigerant flow is rate is 1kg/min Find (i)Tonnage of refrigeration. (ii)Power requirement (iii)Ratio of COP of this cycle to COP of Carnot cycle.	[8M]
	c)	Explain standard vapour compression refrigeration cycle with T-S and P-H diagram.	[5M]
4	a)	What are desirable characteristics of ideal refrigerant? Explain how refrigerants are designated.	[8M]
	b)	State different types of compressors used in refrigerators. Explain any two compressors with their salient features.	[8M]

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5 a) Explain the principle and operation of thermo-electric refrigerator with neat sketches. [8M]

b) Explain with neat sketch working of Electrolux Refrigerator also explain significance of Hydrogen used in system. [8M]

6 a) Define Effective Temperature. Explain various factors governing effective temperature. [8M]

b) A circular duct of 40cm is selected to carry in air-conditioned space at a velocity of 440 m/min to keep noise level at a desired level. If this duct is to be replace by a rectangular duct of aspect ratio of 1.5 find out size of a rectangular duct for equal friction method [8M]

i) When velocity of air in two duct is same

ii) The discharge rate of air in two duct is same

7 a) With neat sketch explain construction and working of any one type of humidifier. [8M]

b) Fan gives a static pressure of 290 Pa with a velocity of 800 m/min at its outlet while delivering a quantity of 120 m^3/ min of air. The inlet static pressure and velocity are 200 Pa and 500m/min respectively. [8M]

Calculate i) Total head developed

ii) Power required if fan mechanical efficiency = 75%.

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III B. Tech II Semester Regular/Supplementary Examinations, April – 2017

REFRIGERATION & AIR CONDITIONING

(Mechanical Engineering)

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2. Answering the question in **Part-A** is compulsory
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(Refrigeration and Psychrometric tables and charts allowed)

PART –A

1 a) Which thermodynamic cycle is implied in refrigeration system? [3M]

b) Explain the concept of year around refrigeration and how it works. [4M]

c) Write note on shell and tube condenser. [4M]

d) Compare absorption refrigeration system with simple vapor compression refrigeration system. [3M]

e) Explain the procedure to construct a RSHF line on a psychometric chart. [4M]

f) Write the major functions of grills and registers in air conditioning systems. [4M]

PART –B

2 a) State main applications of Refrigeration. Explain Ice making plant with a suitable diagram. [4M]

b) A dense air refrigeration machine operating on Bell-Coleman cycle works between 3.4 bar and 17 bar. The temperature of air after the cooler is 15^{o}C and after refrigeration is 6^{o}C, for a refrigeration capacity of 6 tons [8M]
Calculate:
i)Temperature after compression and expansion
ii)Air circulation required in cycle per minute
iii)Work of compression and expansion
iv)Theoretical COP
v)Rate of water circulation required in the cooler in Kg/min if rate of temperature rise is limited to 30^{o}C

c) The speed of an air craft flying at an altitude of 8000m, where the ambient air is at 0.341 bar pressure and 263K temperature is 900km/h. The compression ratio of the air compressor is 5. The cabin pressure is 1.01325 bar and the temperature is 27^{0}C. For 1kg/s flow of air ,determine following [4M]
i) Power requirement for pressurization excluding ram work
ii) Refrigerating effect
iii) power required for refrigeration excluding ram work

3 a) Mention the advantages of vapour compression refrigeration system over air refrigeration system. [3M]

b) A R-12 vapour compression system has saturated suction temperature of -5°C and saturated discharge temperature of 40°C. The refrigerant vapour is dry-saturated at the suction of compressor and becomes superheated after compression. For one ton of refrigeration capacity, Calculate [8M]
i)Refrigerating effect ii)mass flow rate iii)Power and iv)COP of the system

c) Explain the working of Vapour compression refrigeration system with the help of a neat sketch. [5M]

4 a) Mention the limitations of Simple vapour compression refrigeration cycle. [8M]
b) Briefly explain the working of Two stage compression with water intercooler and liquid sub-cooler employed for vapour compression system. [8M]

5 a) Mention the advantages of the vapour absorption refrigeration system. [8M]
b) Describe with neat sketch Li-Br and water system. What are its limitations? [8M]

6 a) Explain the procedure for calculating cooling load due to infiltration air. [6M]
b) A summer air –conditioning system for a small office building is to be designed. The design is to be based on the following information: [10M]
Outside design condition 35°C T_{db} ,28°C T_{wb}
Inside design condition 26°C T_{db}, 50% RH
Room sensible heat gain 45 kW
Room latent heat gain 9 kW
Ventilation air 0.95 m^3/s
A four row direct expansion refrigerant 134a coil with bypass factor of 0.2 is to be used. Analyze the problem on a psychometric chart and determine the following:
i)The room apparatus dew point(ADP)
ii)The temperature of the air leaving the coil
iii)The total quality of air required(m^3/s)

7 a) Explain in brief the following **:** [8M]
i) Filters ii) Humidifiers used in air conditioning systems.
b) With line diagram explain Central Air-conditioning system of any multi storey building [8M]

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