Code No: **R41031** **R10** **Set No. 1**

IV B.Tech I Semester Regular/Supplementary Examinations, Nov/Dec - 2015

REFRIGERATION & AIR CONDITIONING

(Mechanical Engineering)

Time: 3 hours **Max. Marks: 75**

Answer any FIVE Questions

All Questions carry equal marks

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1 a) A Bell-Coleman cycle operates between the pressure limits of 1 bar and 8 bar. Air is drawn from the cold chamber at 9^oC, compressed and then it is cooled to 29^oC before entering the expansion cylinder. Expansion and compression follow the law $pV^{1.35}$= C. Calculate i) theoretical C.O.P of the system. For air γ = 1.4 and C_p = 1.003 kJ/kg-K. ii) Instead of polytropic processes of compression or expansion, if the process is carried out in adiabatic, what could be the theoretical C.O.P of system? [8]

b) What are the applications of Refrigeration? [7]

2 a) A simple vapor compression refrigerator uses methyl chloride (R40) and operates between the temperature limits of 45^oC and -10^oC respectively. At entry to the compressor, the refrigerant is dry saturated and after compression it acquires a temperature 60^oC. Find C.O.P of the system. Use the following table for the properties of the refrigerant C_{pl} = 0.94 kJ /kg-K and C_{pv} = 0.64 kJ /kg-K

Temperature (^oC)	Liquid heat (kJ/kg)	Latent heat (kJ/kg)	Vapor entropy (kJ/kg-K)
45	133.0	483.6	1.587
-10	45.4	460.7	1.637

[8]

b) Explain the working principle of simple vapor compression cycle with necessary diagrams. [7]

3 a) Explain the working principle of thermostat expansion device with a neat sketch. [8]

b) What are the desirable properties of refrigerant? [7]

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4 a) Explain the working principle of Li-Br refrigeration system [8]

b) Derive an expression of COP of absorption refrigeration system in terms of Carnot engine efficiency, Carnot COP. [7]

5 a) Explain the working principle of steam jet refrigeration and derive an expression of ratio of mass of vapor to mass of steam in terms of nozzle efficiency, compressor efficiency and entrainment efficiency [8]

b) Explain the working principle of vortex tube along with its applications [7]

6 a) Explain psychrometric process for summer air conditioning. [8]

b) Define relative humidity, specific humidity, DBT, WBT, DPT. [7]

7 a) How latent head load and sensible heat load are estimated? [8]

b) Locate RSHF and GSHF lines with and without re-circulated air. [7]

8 a) What is the effect of sub-cooling with liquid on performance of vapor compression cycle? [8]

b) Write short notes on global warming with context to refrigeration. [7]

Code No: **R41031** **R10** **Set No. 2**

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REFRIGERATION & AIR CONDITIONING

(Mechanical Engineering)

Time: 3 hours **Max. Marks: 75**

Answer any FIVE Questions

All Questions carry equal marks

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1 a) A refrigerating machine of 6 tons capacity working on Bell-Coleman cycle has an upper limit of pressure 5.2 bar. The pressure and temperature at the start of compression are 1.0 bar and 289 K respectively. The compressed air cooled at constant pressure to a temperature of 314 K enters the expansion cylinder. Assuming both expansion and compression processes to be adiabatic with γ = 1.4, calculate i) C.O.P, ii) Quantity of air in circulation per minute, iii) Piston displacement of compressor and expander, iv) Bore of compressor and expansion cylinder The unit runs at 240 rpm and is double acting. Stroke length is 200mm and v) Power required to drive the unit. For air γ = 1.4 and C_p = 1.003 kJ/kg-K [8]

b) Explain Bootstrap aircraft refrigeration system. [7]

2 a) A simple vapor compression refrigerator uses R12 as refrigerant and operates between the temperature limits of 10^{o}C and – 15^{o}C respectively. After compression the refrigerant acquires a temperature 15^{o}C. Find C.O.P of the system if the liquid is cooled by 5^{o}C before expansion by throttling. Use the following table for the properties of the refrigerant. Take specific heat at constant pressure for the superheated vapor as 0.64 k J/kg-K and that for liquid as 0.94 k J/kg-K

Temperature (^{o}C)	Enthalpy in k J/kg		Specific entropy in k J/kg-K	
	Liquid (h_f)	Vapor (h_g)	Liquid (s_f)	Vapor (s_g)
10	45.4	191.76	0.1750	0.6921
-15	22.3	180.88	0.0904	0.7051

[8]

b) How actual cycle is different from theoretical cycle of vapor compression refrigeration cycle. [7]

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3 a) List out differences between rotary compressors and reciprocating compressors. [7]

b) How water, Freon-11, Freon-12 and CCl4 are designated as refrigerants? [8]

4 a) Explain the working principle of practical ammonia refrigeration with neat sketch. [8]

b) Explain the working principle of Electrolux refrigeration system with neat sketch. [8]

5 a) Explain the merits and demerits of thermo electric refrigeration system and derive an expression of its COP. [8]

b) What is the principle of steam jet refrigeration and list out its merits and demerits along with applications. [7]

6 a) Define effective temperature and what factors it depend on? [8]

b) Define sensible heating and sensible cooling psycrometric processes [7]

7 a) It is required to design an air conditioning Plant, for a small office for following winter conditions; Outlet conditions: 12^oC DBT, 10^oC WBT: Required conditions: 20^oC DBT and 60% RH: Amount of air circulation –0.30 m^3/min/person. Seating capacity of office-60: The required condition is achieved first by heating and then by adiabatic humidifying. Determine- i) Heating capacity of the coil, ii) Surface temperature required for coil if BPF is 0.4 and iii) Capacity of the humidifier [8]

b) What are the parameters to be considered for design of air conditioning of a room? [7]

8 a) Define one tone of refrigeration, COP, COP of heat pump. [7]

b) Ice is formed at 273 K from water at 293 K. The temperature of the brine is 265 K. Find out the kg of ice formed per kWh. Assume the refrigeration cycle is perfect reversed Carnot cycle. Take latent heat of ice is 335 k J/kg. [8]

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(Mechanical Engineering)

Time: 3 hours **Max. Marks: 75**

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1 a) A refrigeration system operates on the reversed Carnot cycle. The temperature of the refrigerant in the system is 308 K and lower temperature is 258 K. The capacity is to be 12 tons. Neglect all losses. Determine: i) C.O.P, ii) Heat rejected from the system per hour and iii) Power required [8]

b) Explain regenerative aircraft refrigeration system. [7]

2 a) The temperature limits of an ammonia refrigerating system operating on simple vapor compression cycle are 25^{o}C and – 10^{o}C respectively. If the gas is dry at the end of compression, calculate the C.O.P of the system, assuming no under cooling of the liquid ammonia. Use the following table for the properties of ammonia.

Temperature (^{o}C)	Liquid heat (kJ/kg)	Latent heat (kJ/kg)	Liquid entropy (kJ/kg-K)
25	298.9	1166.94	1.1242
-10	135.37	1297.58	0.5443

[8]

b) What is the effect of decreasing suction pressure and increasing delivery pressure on performance of simple vapor compression cycle? [7]

3 a) Write shot notes on condensers and evaporators used for refrigeration industry. [7]

b) How refrigerators are responsible for depletion of ozone layer? Suggest some suitable remedies [8]

4 a) Explain the working principle of simple ammonia absorption system and what are its demerits? [8]

b) Compare absorption refrigeration system with simple vapor compression refrigeration system. [7]

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5 a) Define Peltierlaw Sebeck law and Thompson coefficient and how they are useful for refrigeration. [8]

b) List out merits and demerits of non-conventional refrigeration over conventional refrigeration. [7]

6 a) Draw and explain psychrometric chart useful for winter air conditioning process. [8]

b) Explain the concept of year around refrigeration and how it works. [7]

7 a) In a Bell-Coleman cycle working between pressures of 1 and 6 bar., and temperatures at the beginning of compression and expansion of 8^{o}C and 35^{o}C, air flow rate is 30 kg/ min. If the compression and expansion indices in the polytropic process are 1.3 and 1.35 respectively. Determine i) COP, ii) tonnage of the plant, iii) determine the heat transfer rates per kg of air during each process. [8]

b) Represent sub-cooling process and superheating process on simple vapor compression refrigeration [7]

8 a) It is required to design an air conditioning plant for a small office for following hot and wet summer conditions: Outlet conditions: 32^{o}C DBT, 65%RH, Required conditions: 22^{o}C DBT and 60%. Amount of air circulation –250 m^3/min, Coil dew temperature is 15^{o}C. The required condition is achieved by first cooling and dehumidifying: Calculate the i) Cooling capacity of cooling coil and its bypass factor, ii) Heating capacity of the heating coil and surface temperature of the heating coil if by pass factor is 0.3 and iii) The mass of water vapor removed per hour. [8]

b) Write short notes on classification of refrigeration. [7]

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REFRIGERATION & AIR CONDITIONING

(Mechanical Engineering)

Time: 3 hours **Max. Marks: 75**

Answer any FIVE Questions

All Questions carry equal marks

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1 a) The cold storage plant is required to store 20 tonnes of fish. The temperature of the fish when supplied is 298 K. Storage temperature of fish required is 265 K. Specific heat of fish above freezing point is 2.93 kJ/kg-^{o}C. The specific heat of fish below freezing point is 1.25 kJ/kg-^{o}C. Freezing point of fish is 270 K. Latent heat of fish is 232 k J/kg. If the cooling is achieved within 8 hours, determine: i) capacity of the refrigerating plant, ii) Carnot cycle C.O.P between this temperature range and iii) If the actual C.O.P is one third of the Carnot C.O.P, find out the power required to run the plant. [8]

b) How many ways aircraft refrigeration systems are classified? Explain the working principle of reduced ambient refrigeration system. [7]

2 a) The temperature limits of an ammonia refrigerating system operating on simple vapor compression cycle are 30^{o}C and – 10^{o}C respectively. The vapor is 95% dry at the end of compression. Assuming the actual C.O.P as 60% of the theoretical, calculate the ice produced in kg per kW-hour at 0^{o}C from water at 10^{o}C. Latent heat of ice is 335 kJ/kg. Use the following table for the properties of ammonia.

Temperature (^{o}C)	Liquid heat (kJ/kg)	Latent heat (kJ/kg)	Liquid entropy (kJ/kg-K)
30	323.08	1145.80	1.2037
-10	135.37	1297.58	0.5443

[8]

b) What is the effect of accumulator on thermodynamic performance of simple vapor compression cycle. [7]

3 a) Write short notes on automatic expansion valve for refrigerator. [8]

b) List out advantages and disadvantages of axial flow compressor and centrifugal compressors. [7]

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4 a) Compare Electrolux refrigeration system and ammonia refrigeration system. [8]

b) Compare simple ammonia absorption system over practical absorption system. [7]

5 a) List out merits and demerits of vortex tube refrigeration along with its working principle. [8]

b) Define nozzle efficiency, compressor efficiency and entrainment efficiency with the help of temperature-entropy diagram. [7]

6 a) How to minimize sensible heat load and latent load on air conditioning. [8]

b) Define humidification, dehumidification and dehumidification with sensible heating with examples. [7]

7 a) An air-conditioned auditorium is to be maintained at 27^{o}C DBT and 60% RH. The ambient condition is 40^{o}C DBT and 30^{o}C WBT. The total sensible heat load is 100 000 kJ/h and total latent heat load is 40 000 kJ/h. 60% of the return air is re-circulated and mixed with 40% of makeup air after cooling coil. The condition of air leaving the cooling coil is at 18^{o}C. Determine i) RSHF, ii) The condition of air entering the auditorium, iii) The amount of make-up air, iv) ADP and v) BPF of cooling coil. [8]

b) Define bypass factor and deduce an expression for it. [7]

8 a) Prove that Carnot refrigerator has highest COP. [8]

b) Draw psychrometric chart and mention different parameters on it. [7]