KATHMANDU UNIVERSITY
End Semester Examination
February, 2025

Marks Scored:

Level : B.E.
Year : IV
Course : MEPP 403
Semester : I

Exam Roll No. :
Time: 30 mins.
F. M. : 20

Registration No.:
Date : 21 FEB 2025

SECTION "A"
[12 Q. × 1 = 12 marks]

Choose the most appropriate answer and **encircle**.

1. Which type of compressor is commonly used in residential air conditioning systems?
   a. Reciprocating b. Centrifugal c. Scroll d. Screw

2. The coefficient of performance (COP) of a vapor compression refrigeration system is maximized when:
   a. The compressor operates at the highest possible pressure ratio
   b. The temperature difference between the evaporator and condenser is minimized
   c. The refrigerant is superheated significantly before compression
   d. The condenser operates at the highest possible temperature

3. Using a throttle valve instead of a turbine in a vapor compression cycle will:
   a. Increase refrigeration effect and COP
   b. Decrease refrigeration effect but increase COP
   c. Increase refrigeration effect but decrease COP
   d. Decrease both refrigeration effect and COP

4. In an air-conditioning system, the reheat method is primarily used to:
   a. Reduce energy consumption b. Improve dehumidification
   c. Increase COP d. Reduce fan power consumption

5. In a vapor compression refrigeration system, increasing the superheat at the evaporator outlet will:
   a. Increase the refrigerating effect but decrease the COP
   b. Increase both the refrigerating effect and COP
   c. Decrease both the refrigerating effect and compressor work
   d. Have no effect on the refrigeration cycle

6. The intermediate heat exchanger in a cascade system must be designed to:
   a. Prevent direct mixing of refrigerants in both cycles
   b. Allow refrigerant leakage from high to low cycle
   c. Increase the temperature of the low-stage refrigerant
   d. Act as a condenser for the low-stage cycle and an evaporator for the high-stage cycle

7. The main purpose of a rectifier in an ammonia-water absorption system is to:
   a. Separate ammonia from water before entering the condenser
   b. Increase the pressure of the refrigerant
   c. Improve the solubility of ammonia in water
   d. Reduce the power consumption of the generator

8. The relative humidity of air increases when:
   a. The dry-bulb temperature increases while the moisture content remains constant
   b. The wet-bulb temperature decreases
   c. The specific humidity of air increases while the dry-bulb temperature remains constant
   d. The absolute humidity decreases

9. When a stream of air is passed over a cooling coil without condensation, the process follows a line of:
   a. Constant enthalpy
   b. Constant humidity ratio
   c. Constant relative humidity
   d. Constant wet bulb temperature

10. In a multi-stage refrigeration system, the intercooler between compressors serves the primary function of:
   a. Superheating the refrigerant
   b. Increasing the refrigeration effect
   c. Reducing the work required by the second-stage compressor
   d. Raising the condenser pressure

11. Which of the following refrigerants is considered the most environmentally friendly with zero ozone depletion potential and very low global warming potential?
   a. R-290 (Propane) b. R-134a c. R-22 d. R-410A

12. A bootstrap air refrigeration system differs from a simple air refrigeration system due to:
   a. The use of an additional heat exchanger for cooling
   b. The presence of an auxiliary compressor to boost pressure
   c. Higher operating pressures in the evaporator
   d. The ability to operate at sub-zero temperatures

SECTION "B"

[8 Q. × 1 = 8 marks]

Fill in the blanks with appropriate information.

13. The six primary factors affecting thermal comfort are air temperature, humidity, air velocity, radiant temperature, metabolic rate, and _____.

14. The wet-bulb temperature is always _____ than or equal to the dry-bulb temperature.

15. The cooling coil in an AHU helps in the process of cooling and _____ of air.

16. The refrigerant commonly used in modern HVAC systems to replace R-22 due to environmental concerns is _____.

17. The cooling effect produced per unit of electrical power input in an air conditioning system is known as _____.

18. The vertical line on a psychrometric chart represents the _____.

19. The _____ is the rate at which heat is transferred through the surface area of a wall, roof, or window and is expressed in watts per square meter per degree Celsius.

20. The factor used to represent the temperature difference between indoor and outdoor air with the inclusion of the heating effects of solar radiation is _____.

KATHMANDU UNIVERSITY
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February, 2025

Level : B.E.
Year : IV
Time : 2 hrs. 30mins.

21 FEB 2025

Course : MEPP 403
Semester : I
F. M. : 55

SECTION "B"
[5 Q. × 11 = 55 marks]

Attempt ANY FIVE questions. *Tables and charts will be supplied.*

1.
a. Demonstrate that the throttling process of a refrigeration cycle is isenthalpic process. Justify properly the assumptions you make. [3]
b. Explain why throttling valves are used instead of turbine in vapor compression refrigeration cycles. [3]
c. Refrigerant-134a is throttled from the saturated liquid state at 700 kPa to a pressure of 160 kPa. Determine the temperature drop during this process and the final specific volume of the refrigerant. [5]

2.
a. Explain with proper illustration how two different temperature zones are obtained in a double door household refrigerator. Why is a two-door refrigerator more efficient than a single door refrigerator. [5]
b. Refrigerant-134a enters the compressor of a refrigerator as superheated vapor at 0.20 MPa and -5°C at a rate of 0.07 kg/s, and it leaves at 1.2 MPa and 70°C. The refrigerant is cooled in the condenser to 44°C and 1.15 MPa, and it is throttled to 0.21 MPa. Disregarding any heat transfer and pressure drops in the connecting lines between the components, show the cycle on a T-s diagram with respect to saturation lines, and determine (a) the rate of heat removal from the refrigerated space and the power input to the compressor, (b) the isentropic efficiency of the compressor, and (c) the COP of the refrigerator. [6]

3.
a. Explain, with a necessary diagram, the working principle of an air handling unit (AHU). Discuss various methods to enhance the efficiency of AHU. [5]
b. How positive and negative pressure can be maintained in specific spaces that uses AHU and the purpose of doing so. [3]
c. Outline the basic parameter for human thermal comfort. [3]

4.
a. Describe how the air-conditioning of a modern aircraft works. [4]
b. Write codes in Engineering Equation Solver to design and to perform parametric study of a cascade refrigeration system. You can choose your own parameters including temperature, heat flow rates, refrigerants. What parametric study would be your interest? Represent that in the program as well. [7]

P.T.O.

5.

a. Describe the process of heating and cooling load calculations in air conditioning system design. Discuss the various factors influencing these loads and their significance in system sizing. Provide a step-by-step approach to calculating cooling and heating loads, highlighting the role of internal and external heat gains. Use relevant equations and examples to illustrate your answer. [6]
b. Explain how the control system of a residential air-conditioning works. Elaborate this keeping in mind the energy saving in heating and cooling. [5]

6.

a. What is evaporative cooling? Show the process of evaporative cooling in your sketch of psychrometric chart. How is it different from sensible cooling with dehumidification? [5]
b. Air enters a window air conditioner at 1 atm, 32°C, and 70 percent relative humidity at a rate of 2 m^3/min, and it leaves as saturated air at 15°C. Part of the moisture in the air that condenses during the process is also removed at 15°C. Determine the rates of heat and moisture removal from the air. [6]

KATHMANDU UNIVERSITY
End Semester Examination
January/February, 2025

Marks Scored:

Level : B.E.
Year : IV

Course : COMP 407
Semester : I

Exam Roll No. :

Time: 30 mins.

F. M. : 10

Registration No.:

Date : 25 FEB 2025

SECTION "A"
[20Q. × 0.5 = 10 marks]

Choose the most appropriate answer and **encircle**.

1. If the output of the system is $y[n] = \sum_{k=-\infty}^{\infty} x[k]$, with an input of x[n] then the system will work as:
   a. Accumulator b. Adder c. Subtractor d. Differentiator

2. A discrete-time signal $x[n] = e^{j0.1n}$ is
   a. Conditionally periodic b. Periodic
   c. Aperiodic d. Not enough information to check

3. The system described by the input-output equation $y[n] = nx[n] + x^2[n]$ is
   a. Static system b. Dynamic System c. Identical System d. Stable System

4. The convolution sum is given by:
   a. $y(n) = \sum_{n=0}^{N-1} x(n)h(n-k)$ b. $y(n) = \sum_{n=-\infty}^{\infty} x(n)h(n-k)$
   c. $y(n) = \sum_{k=0}^{N-1} x(n)h(k-n)$ d. $y(n) = \sum_{k=-\infty}^{\infty} x(n-k)h(k)$

5. What is the highest frequency that is contained in the sampled signal?
   a. $2F_s$ b. $F_s/2$ c. F_s d. $1/F_s$

6. Consider the analog signal $x(t) = 3\cos 100\pi t$. Suppose that the signal is sampled at the rate $F_s = 150$ Hz. What is the frequency of discrete time signal obtained after sampling?
   a. ¼ b. 2/3 c. 1/3 d. ½

7. If C_k represent the Fourier series coefficient of a periodic signal x(t), then the coefficient C_1 representing the component with frequency Ω_0 gives .....
   a. DC component c. Fundamental frequency
   b. Second harmonic d. Spectral component

8. What is the set of all values of z for which X(z) attains a finite value?
   a. Region of cover b. Range of cover
   c. Region of convergence d. Reason of convergence

9. What is the z-transform of the signal defined as x[n] = u[n] – u[n-N]?
   a. $\frac{1+z^N}{1-z^{-1}}$ b. $\frac{(1-z^{-N})}{1-z^{-1}}$ c. $\frac{(1-z^N)}{1-z^{-1}}$ d. $\frac{(1+z^{-N})}{1-z^{-1}}$

10. If X(z) is the z-transform of the signal x[n], then the z-transform of $a^n x[n]$ is
    a. X(az) b. $X(a^{-1}z)$ c. $X(az^{-1})$ d. $X(a^{-1}z^{-1})$

11. A linear time-invariant system is characterized by the system function

$$H(z) = \frac{3 - 4z^{-1}}{1 - 3.5z^{-1} + 1.5z^{-2}}$$

a. The system has poles at z=-3.5 and z= 1.5.
b. The system has poles at z=3.5 and z= 1.5.
c. The system has poles at z=-0.5 and z= -3.
d. The system has poles at z=0.5 and z= 3

12. The value of twiddle factor is given as

a. $e^{\frac{j2\pi}{N}}$ b. $e^{-\frac{j2\pi}{N}}$ c. $e^{\frac{j4\pi}{N}}$ d. $e^{\frac{-j4\pi}{N}}$

13. Which of the following is true regarding the number of computations require to compute an N-point DFT?

a. N^2 complex multiplications and N(N-2) complex additions
b. N^2 complex additions and N(N-1) complex multiplications
c. (N^2 -1) complex multiplication and N(N-1) complex additions
d. N^2 complex multiplication and (N^2-N) complex additions

14. If the arrangement is of the form in which the first row consists of the first M elements of x[n], the second row consists for the next M elements of x[n], and so on upto L^{th} row, then which of the following mapping represents the above arrangement

a. n = l + mL b. n = Ml + m c. n = Ml + L d. n = L + lM

15. How many complex multiplications are performed in computing the N-point DFT of a sequence using divide and conquer approach if N = LM

a. N(L+M+2) b. N(L+M+1) c. N(L+M-1) d. N(L+M-2)

16. The first 5 points of the eight-point DFT of a real-valued sequence are {12, 1-j3, j5, 2 -j6, 4}, The remaining three points are:

a. {2 + j6, -j5, 1 + j3} b. {1 + j3, -j5, 2 + j6}
c. {2 - j6, j5, 1 - j3} d. {0, 0, 0}

17. If M and N are the orders of numerator and denominator of rational system function respectively, then how many memory elements are required in direct form-II realization of the IIR filter

a. M+N b. M+N+1 c. min (M, N) d. max (M, N)

18. Which of the following method is not used to convert analog filter into digital filter?

a. Impulse invariance b. Frequency transformation
c. Bilinear transformation d. Matched z-transform

19. If the conversion technique to be effective, then the LHP of s-plane should be mapped into

a. Outside of unit circle b. on and inside of unit circle
c. On Unit circle d. Inside of Unit circle

20. If {x[n]} is the signal to be analyzed, limiting the duration of the sequence to M samples, in the interval $0 \leq n \leq M-1$, is equivalent to multiplying {x[n]} by

a. Rectangular Window b. Hanning Window
c. Hamming Window d. Bartlett Window