



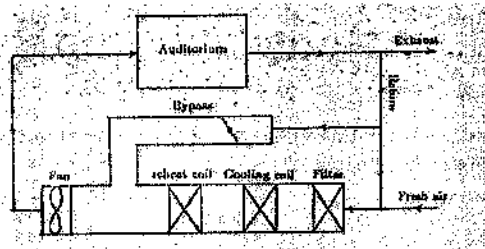
- (a) This exam measures ILOs no.: a.8, a.16, a.19, b.7, b.10, b.14, c1, c6, & c18
- (b) No. of questions: 3 - No. of pages: 2
- (c) This is a close book exam. *Non-programmable calculators, Thermodynamics tables, and Steam Chart* are allowed.
- (d) Clear, systematic answers and solutions are required. In general, marks will not be assigned for answers and solutions that require unreasonable (in the opinion of the instructor) effort to decipher.
- (e) Ask for clarification if any question statement is not clear to you.
- (f) Attempts in all questions.
- (g) The weight of each problem is indicated.
- (h) Assume any missing data.

Answer the following questions:

Question 1

(20 points)

- 1- With the help of neat sketches describe two methods of waste energy recovery in air conditioning systems?
- 2- Sketch the psychrometric chart for the system shown below?



3- A theater is to be air conditioned for the following summer operating conditions:

Inside conditions,	26 °c d.b.t and 50% R.H.
Outside conditions,	38°c d.b.t and 25 °c w.b.t.
Total number of persons,	100
Lighting inside theater	10 kw
Total sensible heat gain from building	430 kw
Total sensible heat gain from persons	0.08 kw per person
Latent heat gain from persons	0.105 kw per person
Fresh air to be allowed	30 m ³ / hour per persons
Conditioned air leaving the coil,	90 % R.H.

Sketch the psychrometric chart and calculate:

- 1- The sensible heat factor,
- 2- The cooling coil mean temperature, and efficiency
- 3- The amount of air to be circulated inside the theater, in m³/ hr.
- 4- The cooling capacity of the plant in ton of refrigeration.

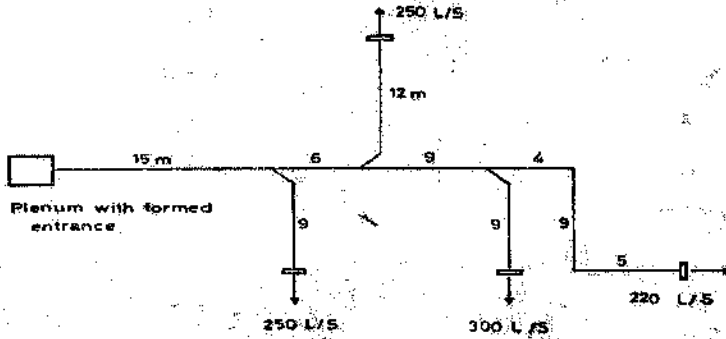
Question 2

(20 points)

1. What are the sources of pressure losses in air ducts? How can they be kept low?
2. Discuss the important air-duct design considerations.



3. Design the duct system shown in the figure using equal friction method. Each outlet has a terminal box that requires a minimum of 12.5 pa total pressure. Other data are shown on the sketch



Question 3

(35 points)

Design a summer air conditioning system for the office building shown below located in Cairo city.

The following information was obtained from preliminary survey:

Indoor condition: 27 °c & 50% R.H.,

Outdoor conditions: 41 °c d.b.t & 22 °c w.b.t

The factory is 5 °c below the outside condition. Number of persons: 18 persons. Equipment's are 35 machines each 4 A at 220 volt. Ventilation 7 L/sec/ person

The overall heat transfer coefficients are as follows; 1.5 w/m²c for east and south walls, 2.5 w/m²c for west , north walls, and ceiling, 6.08 w/m²c for glass windows and door.

Lights: 60 w/ m² . . The number of glass windows is 10 each 1.4 x 6 m. and one door in west of 2.2 x1.8 m.

