

**BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)**

CLASS: MTECH
BRANCH: MECHANICAL

SEMESTER : I
SESSION : SP 23

SUBJECT: ME569 ADVANCED REFRIGERATION AND AIR CONDITIONING

TIME:
3:00 hrs

FULL MARKS: 50

INSTRUCTIONS:

1. The question paper contains 5 questions each of 10 marks and total 50 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
4. Before attempting the question paper, be sure that you have got the correct question paper.

- | | | CO | BL |
|---|-----|----|----|
| Q.1(a) Define the following with the support of neat sketch:
I. Hour Angle
II. Declination
III. Solar Azimuth angle | [5] | 1 | 1 |
| Q.1(b) Calculate the sunrise, sunset, and total sunshine hours at BIT Mesra (23.41° N) on April 25 th | [5] | 1 | 4 |
| Q.2(a) Discuss the effect of external shading, also write the expressions | [5] | 2 | 2 |
| Q.2(b) Calculate the maximum heat transfer rate through a 1.75 m ² area, unshaded, regular double glass facing south-east during the months of May and November without internal shading and with internal shading consisting of Roller shades. Location 32°N. | [5] | 2 | 4 |

SHGF values for Location 32°N

Month	Orientation of the surface					
	N/shade	NE/NW	E/W	SE/SW	S	Horizontal
Jan, Nov	75	90	550	785	775	555
May, July	120	530	685	480	230	865

SC values

Type of glass	Shading Coefficient, SC					
	Thickness mm	No internal shading	Venetian blinds		Roller shades	
			Medium	Light	Dark	Light
Double glass Regular	3	0.90	0.57	0.51	0.60	0.25
Double glass Plate	6	0.83	0.57	0.51	0.60	0.25

- | | | | |
|--|-----|---|---|
| Q.3(a) Argue on decrement factor and Time lag. | [5] | 3 | 5 |
| Q.3(b) A multi-layered wall consists of (from inside to outside) 6mm thick plywood, 125 mm thick common brick, 2.5 mm thick air space, 120 mm thick common brick and 8 mm thick cement plaster. The values of internal and external surface conductance for the wall are 8.3 W/m ² K and 34.4 W/m ² K, respectively. Find the overall heat transfer coefficient of the wall. What is the value of U, if the air space is replaced by 30 mm thick EPS board? Assume the temperature difference across the air space to be 10 K. | [5] | 3 | 4 |
| Q.4(a) Discuss the advantages and disadvantages of All- water System. | [5] | 4 | 2 |
| Q.4(b) With neat sketch, explain the construction and working of single duct multizone all air system. | [5] | 4 | 3 |

PTO

Q.5 Obtain the sizes of various ducts in the system shown in Figure 1 using equal friction method. The ducts are rectangular in cross-section. Also find the total pressure drop in the longest duct. The friction chart is provided in the question paper.

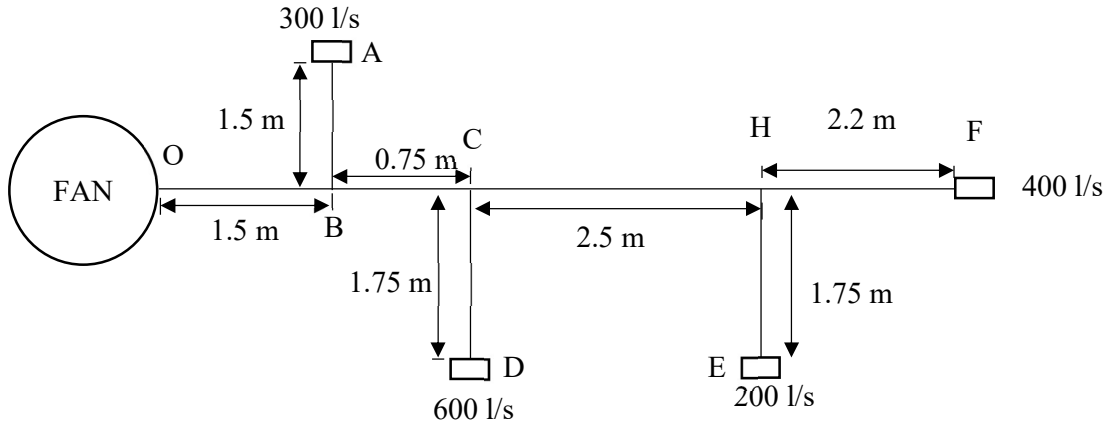


Figure 1. Duct system layout

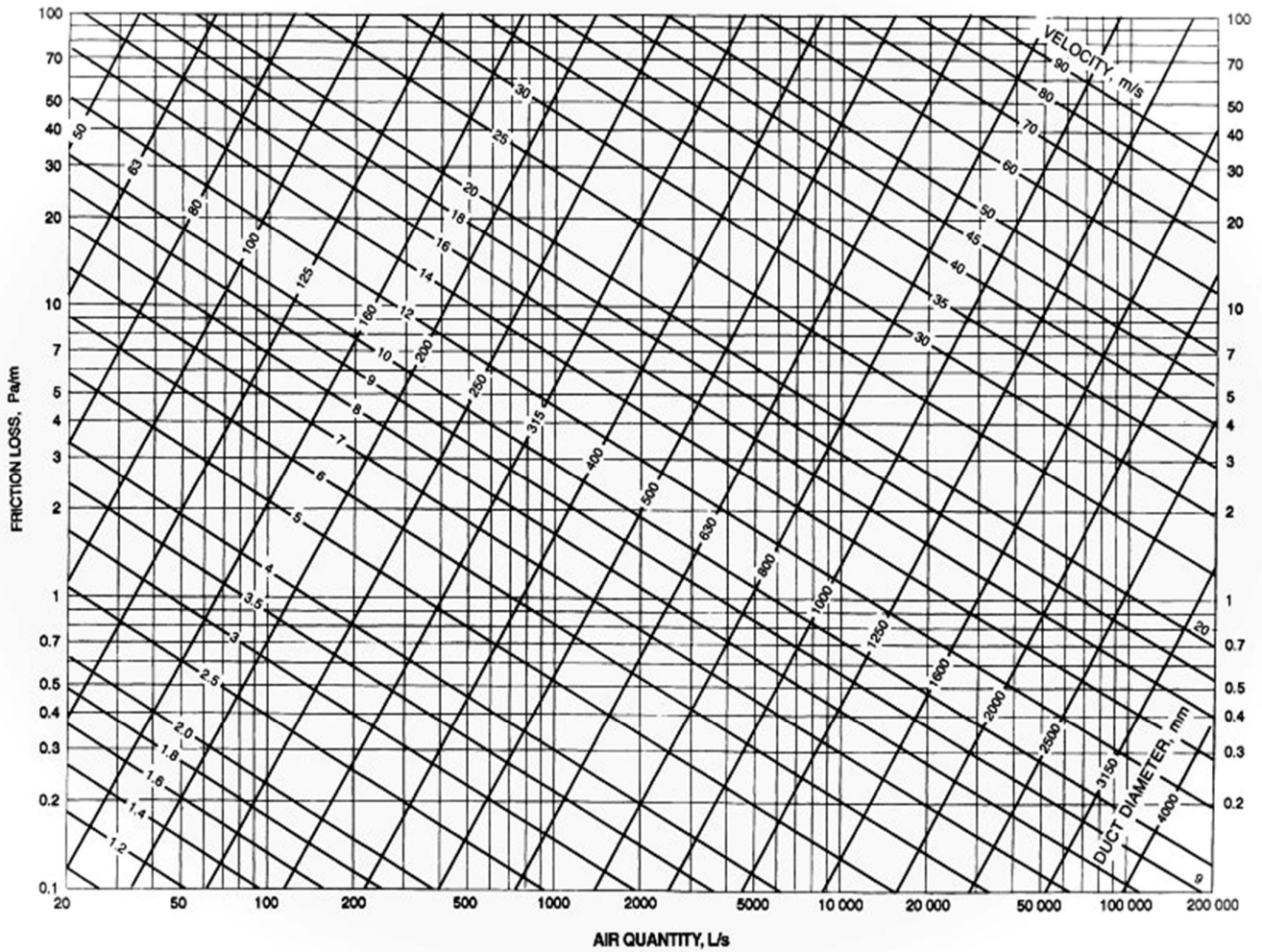


Figure 2. Friction chart