



11 JUN 2009

B.E. (Mech.) Sem. VIII
June - 2009
EP-II - Airconditioning Engineering

Time : 3 Hours]

[Max. Marks : 100

- Instructions :**
- (1) Attempt all questions.
 - (2) Figures to the right indicate full marks.
 - (3) Assume suitable additional data if necessary.
 - (4) Use of calculator, charts and table is permitted.

1. Explain factors governing By-pass factor. 18

A department store has the following data :

Room sensible heat load = 64 kW

Room latent heat load = 16 kW

Room design condition 24 °C DBT & 50% RH

Outside design condition 35 °C DBT & 24 °C WBT

Ventilation air required is 100 m³/min and coil by-pass factor is 0.15.

Plot a psychrometric chart and calculate

- (a) Outdoor air load
 - (b) Grand total heat
 - (c) Effective sensible heat factor
 - (d) Coil ADP
 - (e) Dehumidified air quantity
 - (f) Room sensible heat factor
 - (g) Entering and leaving condition of air at the apparatus
2. (a) What is flywheel effect as applied to load calculation ? How it is useful ? 16
- (b) What do you understand by term SHGF ? How will you estimate the value of SHGF for different orientation, month and time ?

OR

- (b) Calculate ICL and IHG for a 10 m² window having inside venetian blinds as shading device situated in NW wall in Ahmedabad city in the month of 21st June.

3. (a) What is a comfort zone ? What are the physiological-effect of hot and cold extremes ? 16

OR

Explain humidity and its importance for human and industrial air conditioning.
Explain humidification control in Air washer.

- (b) Role of thermostats and humidifiers in Air conditioning system.

OR

What is ventilation ? How it differs from infiltration ?

4. (a) What is the difference between a fan and blower ? Explain construction and working of a Tube Axial Fan. 16
 (b) What do you understand by non-overloading characteristics of a fan ? Which fan takes over load while working in the plant ?

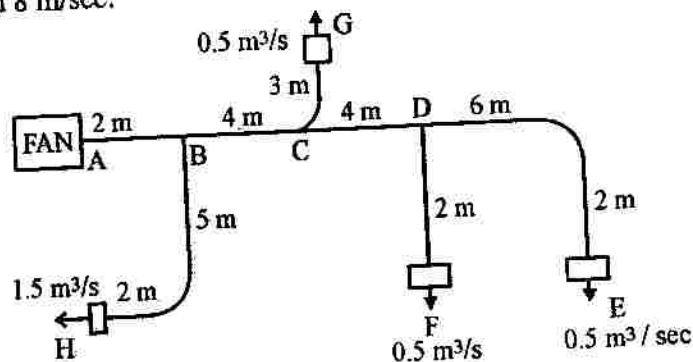
OR

- (b) A fan delivers 9000 lit/sec of standard air at a pressure of 700 Pa. at a fan speed of 450 rpm and a power input of 13 kW. What speed, input power and static pressure are required if the flow rate is increased to 13000 lit/sec. by increasing the rotational speed ?

5. (a) Explain the terms "Aspect Ratio" and "Attic Air". 16
 (b) Derive an expression for equal diameter of circular duct for a rectangular duct, where flow rate in both ducts is same.
 (c) Explain static pressure, velocity pressure and total pressure of air flowing in a duct ? How above pressures are measured by using a pitot tube in your laboratory ?

OR

- (a) What is AHU ? How it differs from FCU ?
 (b) What are the requirements of a good air distribution system ?
 (c) A packaged Air conditioning plant serves four rooms in an apartment. The schematic layout of the duct system together with volume flow rate to each room is shown in Fig. (given below). The lengths of the duct sections are listed in table. Design the duct sizes using the equal friction method using charts and tables. Attach the chart with your answer book. The air velocity in the first section is not to exceed 8 m/sec.

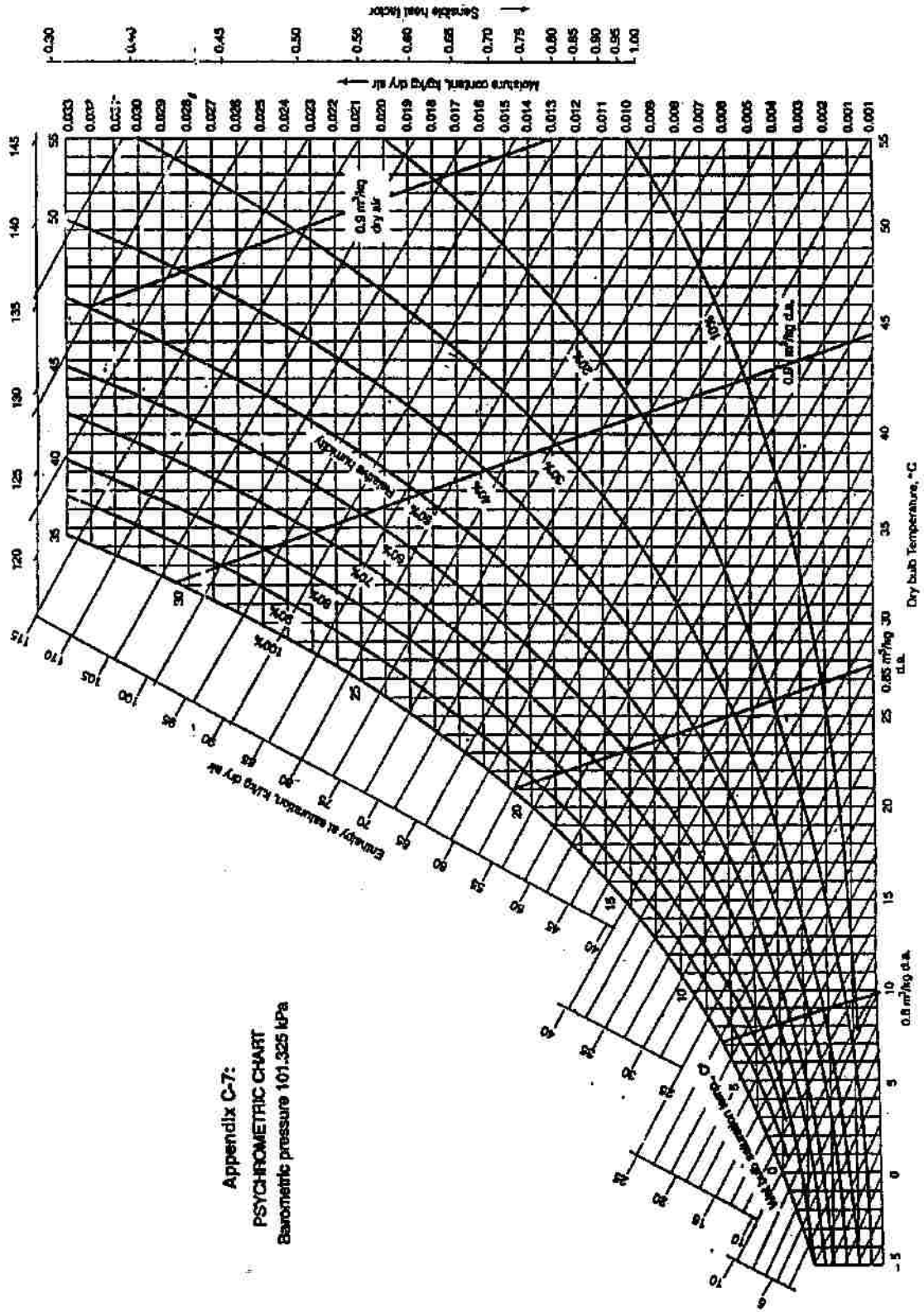


Length of duct sections :

Section	A-B	B-C	C-D	D-E	B-H	C-G	D-F
Length in m.	2	4	4	8	7	3	2

6. Write short note (any three) : 18
 (a) Split Air conditioning unit.
 (b) Face and By-pass damper control.
 (c) Dynamic losses in duct design.
 (d) Construction and working of Anemometer.
 (e) Desert cooler.

Appendix C-7:
 PSYCHROMETRIC CHART
 Barometric pressure 101.325 kPa



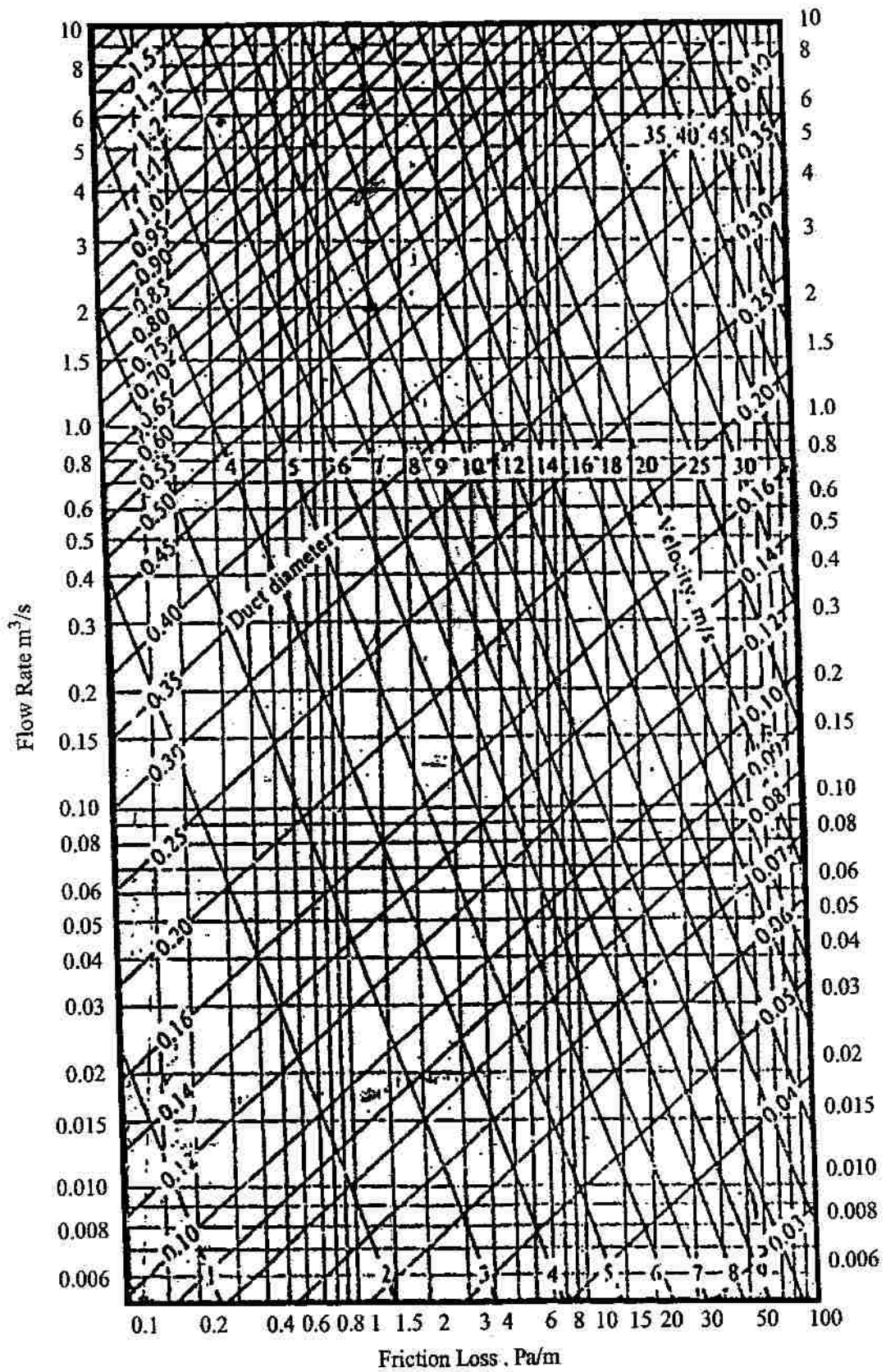


Table 2 Circular Equivalents of Rectangular Duct for Equal Friction and Capacity*

L _{gh} Adj. ^b	Length One Side of Rectangular Duct (a), mm																			
	100	125	150	175	200	225	250	275	300	350	400	450	500	550	600	650	700	750	800	900
100	109																			
125	122	137																		
150	133	150	164																	
175	143	161	177	191																
200	152	172	189	204	219															
225	161	181	200	216	232	246														
250	169	190	210	228	244	259	273													
275	176	199	220	238	256	272	287	301												
300	183	207	229	248	266	283	299	314	328											
350	195	222	245	267	286	303	322	339	354	383										
400	207	235	260	283	305	325	343	361	378	409	437									
450	217	247	274	299	321	343	363	382	400	433	464	492								
500	227	258	287	313	337	360	381	401	420	455	488	518	547							
550	236	269	299	326	352	375	398	419	439	477	511	543	573	601						
600	245	279	319	339	365	390	414	436	457	496	533	567	598	628	656					
650	253	289	321	351	378	404	429	452	474	515	553	587	622	653	683	711				
700	261	298	331	362	391	418	443	467	490	533	573	610	644	677	708	737	765			
750	268	306	341	373	402	430	457	482	506	550	592	630	666	700	732	763	792	820		
800	275	314	350	383	414	442	470	496	520	567	609	649	687	722	755	787	818	847	875	
900	289	330	367	402	435	465	494	522	548	597	643	686	726	763	799	833	866	897	927	954
1000	301	344	384	420	454	486	517	546	574	626	674	719	762	802	840	876	911	944	976	1007
1100	313	358	399	437	473	506	538	569	598	652	703	751	795	838	878	916	953	988	1022	1056
1200	324	370	413	453	490	525	558	590	620	677	731	780	827	872	914	954	992	1030	1066	1103
1300	334	382	426	468	506	543	577	610	642	701	757	808	857	904	948	990	1031	1069	1107	1147
1400	344	394	439	482	522	559	593	627	662	724	781	833	886	934	980	1026	1066	1107	1146	1186
1500	353	404	452	495	536	575	612	648	681	745	805	860	913	963	1011	1057	1100	1143	1183	1224
1600	362	415	463	508	551	591	629	665	700	766	827	885	939	991	1041	1088	1133	1177	1219	1261
1700	371	425	475	521	564	605	644	682	718	785	849	908	964	1018	1069	1119	1164	1209	1253	1295
1800	379	434	485	533	577	619	660	698	735	804	869	930	988	1043	1096	1146	1195	1241	1286	1331
1900	387	444	496	544	590	633	674	713	751	823	889	952	1012	1066	1122	1174	1224	1271	1318	1365
2000	395	453	506	555	602	646	688	728	767	840	908	972	1034	1092	1147	1200	1251	1301	1348	1396
2100	402	461	516	566	614	659	702	743	782	857	927	993	1055	1115	1172	1226	1279	1329	1378	1428
2200	410	470	525	577	625	671	715	757	797	874	945	1013	1076	1137	1195	1251	1305	1356	1406	1456
2300	417	478	534	587	636	683	728	771	812	890	963	1031	1097	1159	1218	1275	1330	1383	1434	1485
2400	424	486	543	597	647	695	740	784	826	905	980	1050	1116	1180	1241	1299	1355	1409	1461	1514
2500	430	494	552	606	658	706	753	797	840	920	996	1068	1136	1200	1262	1322	1379	1434	1487	1541
2600	437	501	560	616	668	717	764	810	853	935	1012	1085	1154	1220	1283	1344	1402	1459	1513	1567
2700	443	509	569	625	678	728	776	822	866	950	1028	1102	1173	1240	1304	1366	1425	1483	1538	1594
2800	450	516	577	634	688	738	787	834	879	964	1043	1119	1190	1259	1324	1387	1447	1506	1562	1619
2900	456	523	585	643	697	749	798	845	891	977	1058	1135	1208	1277	1344	1408	1469	1529	1586	1644

L _{gh} Adj. ^b	Length One Side of Rectangular Duct (a), mm																			
	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	2500	2600	2700	2800	2900
1000	1093																			
1100	1146	1202																		
1200	1196	1256	1312																	
1300	1244	1306	1365	1421																
1400	1289	1354	1416	1475	1530															
1500	1332	1400	1464	1526	1584	1640														
1600	1373	1444	1511	1574	1635	1693	1749													
1700	1413	1486	1555	1621	1684	1745	1803	1858												
1800	1451	1527	1598	1667	1732	1794	1854	1912	1968											
1900	1488	1566	1640	1710	1778	1842	1904	1964	2021	2077										
2000	1523	1604	1680	1753	1822	1889	1952	2014	2073	2131	2186									
2100	1558	1640	1719	1793	1865	1933	1999	2063	2124	2183	2240	2296								
2200	1591	1676	1756	1833	1906	1977	2044	2110	2173	2233	2292	2350	2405							
2300	1623	1710	1793	1871	1947	2019	2088	2155	2220	2283	2343	2402	2459	2514						
2400	1655	1744	1828	1909	1986	2060	2131	2200	2266	2330	2393	2453	2511	2568	2624					
2500	1685	1776	1862	1945	2024	2100	2173	2243	2311	2377	2441	2502	2562	2621	2678	2733				
2600	1715	1808	1896	1980	2061	2139	2213	2285	2355	2422	2487	2551	2612	2672	2730	2787	2842			
2700	1744	1839	1929	2015	2097	2177	2253	2327	2398	2466	2533	2598	2661	2722	2782	2840	2896	2952		
2800	1772	1869	1961	2048	2133	2214	2292	2367	2439	2510	2578	2644	2708	2771	2832	2891	2949	3006	3061	
2900	1800	1898	1992	2081	2167	2250	2329	2406	2480	2552	2621	2689	2755	2819	2881	2941	3001	3058	3115	3170

*Table based on $D_c = 1.10(a+b)^{0.625}/(a+b)^{0.43}$

^bLength adjacent side of rectangular duct (b), mm.

Table No. 2 : % Section Area in branches for maintaining Equal Friction

Capacity m ³ /min %	Duct Area %	Capa. m ³ /min %	Duct Area %	Capa. m ³ /m %	Duct Area %	Capa. m ³ /m %	Duct Area %	Capa. m ³ /m %	Duct Area %	Capa. m ³ /m %	Duct Area %	Capa. m ³ /m %	Duct Area %	Capa. m ³ /m %	Duct Area %	Capa. m ³ /m %	Duct Area %	Capa. m ³ /m %	Duct Area %	
1	2	12	18.5	23	30.5	45	53	56	64	67	73.5	78	83	89	91.5					
2	3.5	13	19.5	24	31.5	46	54	57	65	68	74.5	79	84	90	92					
3	5.5	14	20.5	25	32.5	47	55	58	65.5	69	75.5	80	84.5	91	93					
4	7.0	15	21.5	26	33.5	48	56	59	66.5	70	76.5	81	85.5	92	94					
5	9.0	16	23.0	27	34.5	49	57	60	67.5	71	77.0	82	86	93	94.5					
6	10.5	17	24.0	28	35.5	50	58	61	68	72	78.0	83	87	94	95					
7	11.5	18	25.0	29	36.5	51	59	62	69	73	79	84	87.5	95	96					
8	13.0	19	26.0	30	37.5	52	60	63	70	74	80	85	88.5	96	96.5					
9	14.5	20	27.0	31	39.0	53	61	64	71	75	80.5	86	88.5	97	97.5					
10	16.5	21	28.0	32	40.0	54	62	65	71.5	76	81	87	90	98	98					
11	17.5	22	29.5	33	41.0	55	63	66	72.5	77	82	88	90.5	99	99					
1														100	100					

SOURCE : Hand Book of Air Conditioning System Design-Carrier Corporation 1965