

National Institute of Technology, Hamirpur (H. P.)

Name of End Term Examination: M.Arch. 1st year

Branch : Architecture

Semester : 1st Sem

Course Name : Solar Passive Design

Course Code : AR-613

Time : 2.0 Hours

Maximum Marks : 50

Note:

1. The question paper is given below and is posted on classroom as assignment just before the start of exam.
2. The answers will have to be written in plain A4 sheets preferably or on any other available sheets.
3. On the top of first page of answer sheet write: Name, Roll No. Subject Name, Subject Code, Programme, Semester, Department, Date of exam, Number of pages.
4. At the bottom of each sheet of answer booklet, the candidate is required to put his/her Signature with date.
5. After the exam, scan /take photo using camera and upload the clicked answer sheets on google classroom within 15 minutes after the completion of exam. Alternatively, the candidate may send back the same on email id aniket@nith.ac.in within 15 minutes after the completion of exam.
6. Please keep in mind that after 15 minutes of completion of exam, the candidate may not be able to submit on classroom. Also the email sent afterwards will not be accepted.
7. Delay in submission would lead to rejection of answer booklet.
8. The student need to save pdf of their answer sheet by the name "rollnosubjectcode.pdf" and upload the same on the classroom. It shall be one file and no pdf files for separate pages will be entertained.
9. It is the responsibility of the candidate to ensure adequate internet connectivity and shall keep on their mic and video during the period of exam. Candidate to ensure the same beforehand.
10. Candidates are required to sit in a calm and quiet area so as to avoid background noise.

All questions are mandatory. Assume missing data suitably.

Q1. Discuss the importance of solar passive design for building. Support your answer through various case studies/research work.

(10)

Q2. Calculate various heat gain and flows in a theatre hall of size 10m x 20m x 6m having 200 seats and is fully occupied during a movie time of 3 hours between 3:00 PM to 6:00 PM on 31.10.2020 having Indoor temperature is 22°C and Outdoor temperature is 27°C. Persons are a mix of males and females. 1 projector is used having wattage of 3000W. 100 LED lamps of 15W are used for lighting during interval, start and end of movie and 3 no. 5W exit signs remain lit during the movie time. One side (20m side) wall is exposed having U Value- 0.35 W/m²·K. The hall has no windows. Assume missing data suitably.

(20)

Q3. Discuss briefly various principles of Solar Passive Design. Also explain, how it is different from Sustainable Architecture?

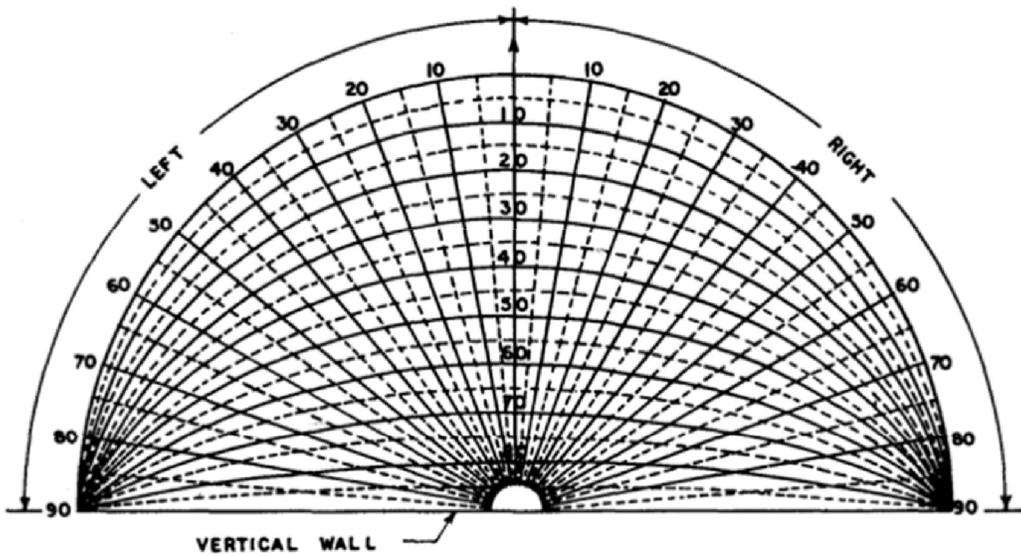
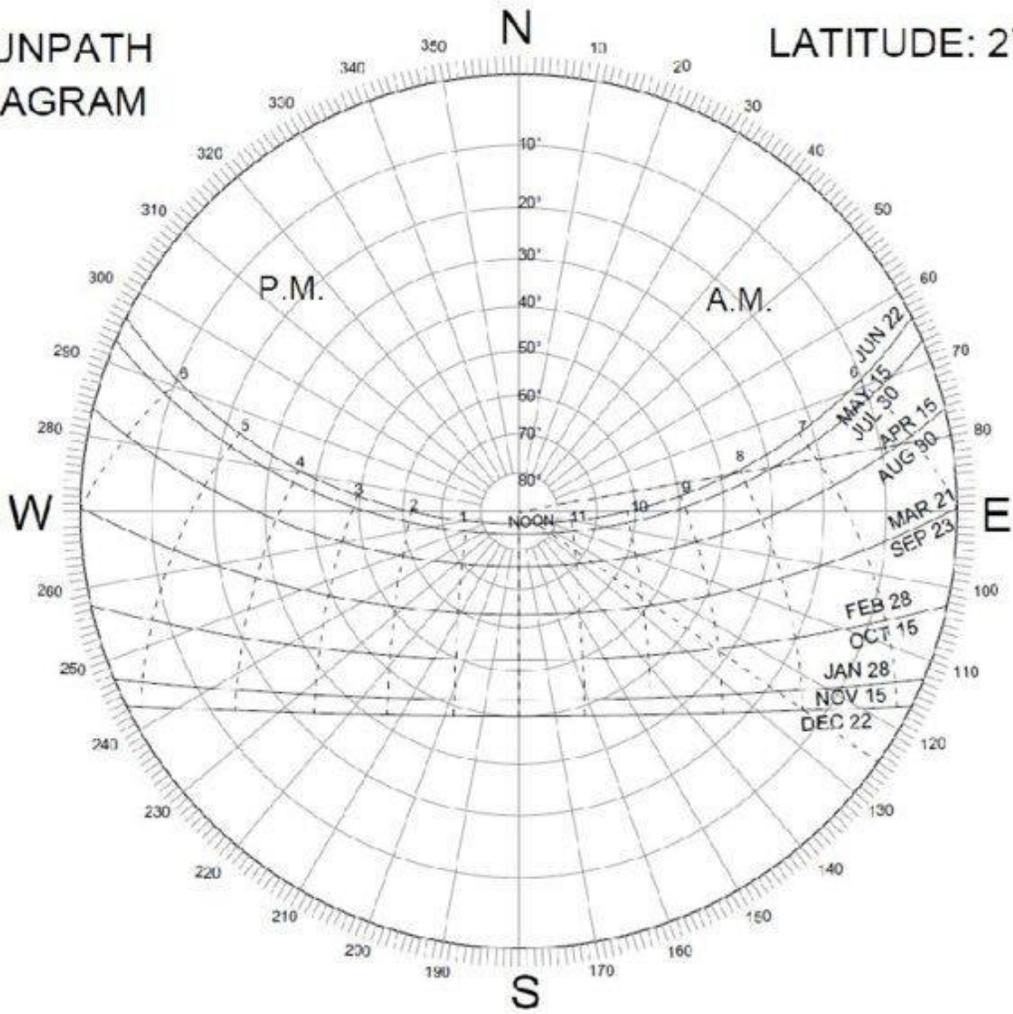
(6+2= 8)

Q4. Design a shading device for a room located at 27°N (near Lucknow) of size 3m x 3 m having windows of size 2.0m (width) x 2.0 m (height) having a sill height of 0.8 m and located at the center of south and north wall. Use sun path diagram and shadow angle protector given.

(12)

Annexure

SUNPATH DIAGRAM LATITUDE: 27°N



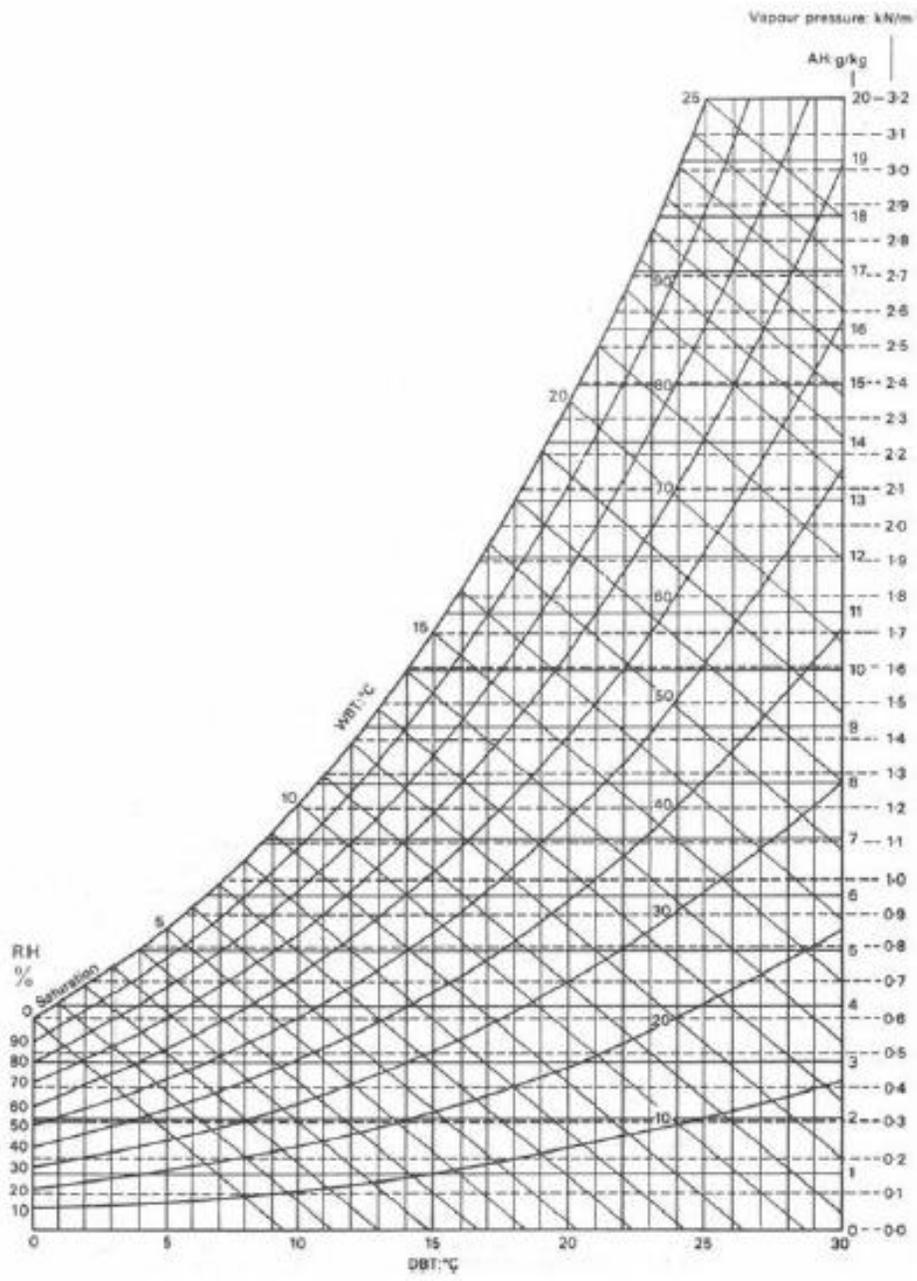


Fig 12 Psychrometric chart

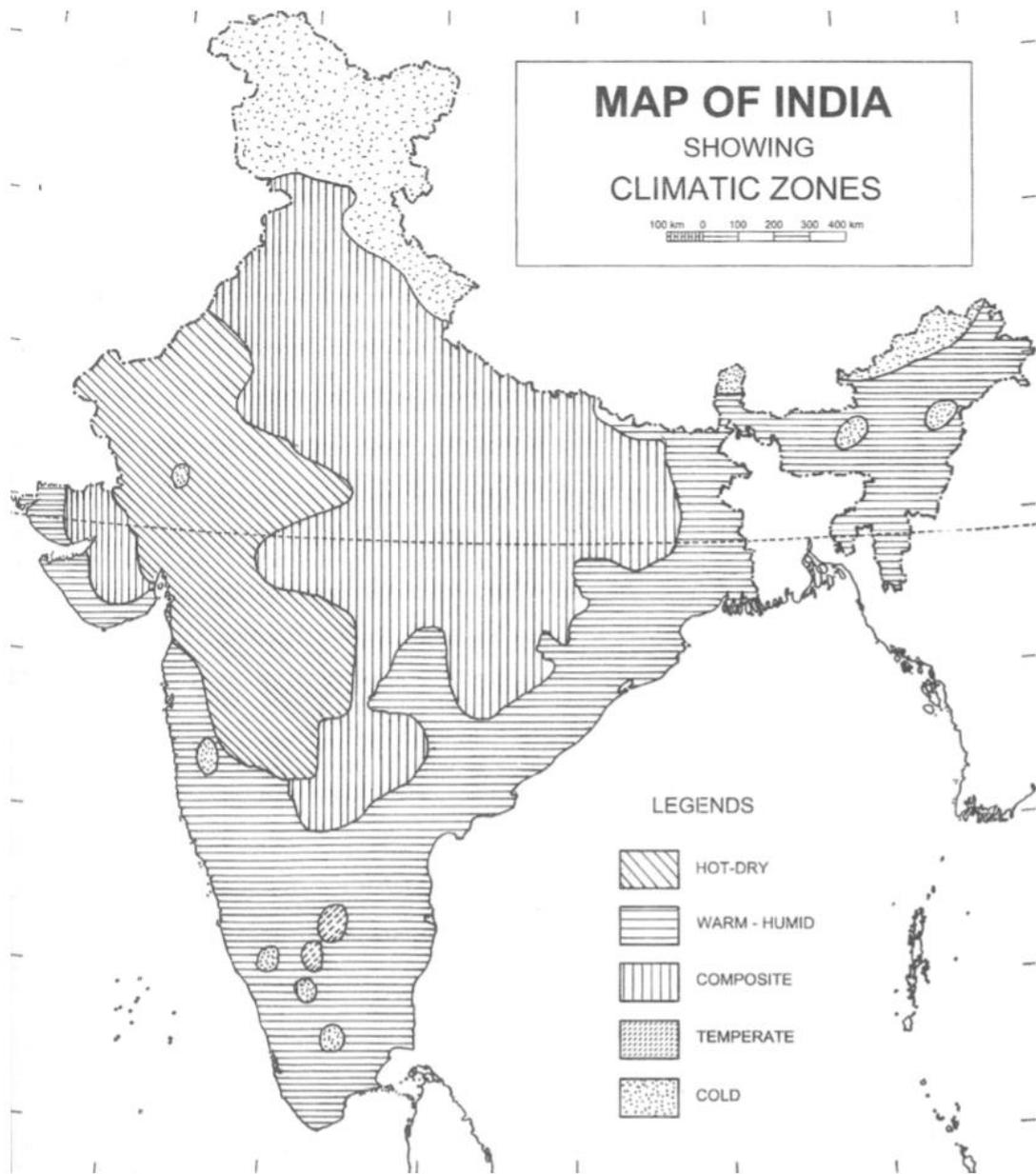


Fig. 2.13b Climatic zones of India [9]

Table 6.3 Typical rates at which heat is given off by human beings in different states of activity.

Degree of activity	Typical building	Total rate of heat emission for adult male / W	Rate of heat emission for mixture of males and females / W			Percentage of sensible heat that is radiant heat for stated air movement / %	
			Total	Sensible	Latent	High	Low
Seated at theatre	Theatre, cinema (matinee)	115	95	65	30	—	—
Seated at theatre, night	Theatre, cinema (night)	115	105	70	35	60	27
Seated, very light work	Offices, hotels, apartments	130	115	70	45	—	—
Moderate office work	Offices, hotels, apartments	140	130	75	55	—	—
Standing, light work; walking	Department store, retail store	160	130	75	55	58	38
Walking; standing	Bank	160	145	75	70	—	—
Sedentary work	Restaurant	145	160	80	80	—	—
Light bench work	Factory	235	220	80	140	—	—
Moderate dancing	Dance hall	265	250	90	160	49	35
Walking; light machine work	Factory	295	295	110	185	—	—
Bowling	Bowling alley	440	425	170	255	—	—
Heavy work	Factory	440	425	170	255	54	19
Heavy machine work; lifting	Factory	470	470	185	285	—	—
Athletics	Gymnasium	585	525	210	315	—	—

Source: ASHRAE Handbook: *Fundamentals* (2001)⁽⁶⁾

Table 6.6 Energy dissipation in lamps⁽¹⁰⁾

Lamp type	Heat output / %		
	Radiant	Conducted/ convected*	Total
Fluorescent	30	70	100
Filament (tungsten)	85	15	100
High pressure mercury/ sodium, metal halide	50	50	100
Low pressure sodium	43	57	100

* The power loss of ballasts should be added to the conducted/convected heat.

Table 6.4 Lighting energy targets

Application	Lamp type	Task illuminance / lux	Average installed power density / W·m ⁻²
Commercial and similar applications (e.g. offices, shops*, schools)	Fluorescent-triphosphor	300	7
		500	11
		750	17
	Compact fluorescent	300	8
		500	14
		750	21
	Metal halide	300	11
		500	18
		750	27
Industrial and manufacturing	Fluorescent-triphosphor	300	6
		500	10
		750	14
		1000	19
	Metal halide	300	7
		500	12
		750	17
		1000	23
	High pressure sodium	300	6
		500	11
		750	16
		1000	21

Table 6.5 Measured energy distribution for fluorescent fittings having four 70 W lamps⁽⁷⁾

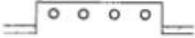
Mounting	Type of fitting		Energy distribution / %	
	Schematic	Description	Upwards	Downwards
Recessed		Open	38	62
		Louvre	45	55
		Prismatic or opal diffuser	53	47
Surface		Open	12	88
		Enclosed prismatic or opal	22	78
		Enclosed prismatic on metal spine	6	94

Table 6.7 Typical heat gains from PCs⁽¹⁴⁾

Nature of value	Value for stated mode / W	
	Continuous	Energy saving
Average	55	20
Conservative	65	25
Highly conservative	75	30

Table 6.8 Typical heat gains from PC monitors⁽¹⁴⁾

Monitor size	Value for stated mode / W	
	Continuous	Energy saving
Small (13–15 inch)	55	0
Medium (16–18 inch)	70	0
Large (19–20 inch)	80	0

Table 4.2 Meaning of the BFRC window energy label rating

Rating	Energy lost per year (kWh/m ² K)
A	0 (no energy lost) or better
B	0 to -10
C	-10 to -20
D	-20 to -30
E	-30 to -50
F	-50 to -70
G	-70 or worse