

Prince of Songkla University

Faculty of Engineering

Mid-Term Examination

Semester 1/2556

2 August 2013

Time 9:00-12:00

215-663 ENERGY MANAGEMENT IN BUILDINGS

Room S201

Directions

- A4 is allowed and can be written on two sides of the A4 paper.
- All types of calculator and dictionary are permitted.
- Attempt all 6 questions.
- The exam paper has 11 pages.

Juntakan Taweekun

Instructor

Question	Marks	
1	20	
2	20	
3	15	
4	25	
5	20	
6	10	
<b>Total</b>	<b>110</b>	

Name ..... ID .....

**Question 1 (20 points)**

An air stream flowing at 0.7 kg/s with dry-bulb temperature of 35°C and relative humidity of 55% is cooled down to 20°C and relative humidity 85%. Determine

1. Cooling load to the air-conditioner (in unit of kW)
2. Sensible Load (in unit of kW)
3. Latent Load (in unit of kW)
4. Condensed water (in unit of kg/h)

Name ..... ID.....

**Question 2 (20 points)**

Calculate sunrise and sunset times on 11 April for a location at latitude  $26^{\circ}$ .

Name ..... ID.....

**Question 3 (15 points)**

Standard local time 15:00 hours on July 28, 2013 in Bangkok, Thailand, calculate the followings:

- 1) Declination angle ( $\delta$ )
- 2) Solar time ( $t_s$ )
- 3) Solar hour angle ( $\omega$ )
- 4) Solar altitude angle ( $\alpha_s$ )
- 5) Solar zenith angle ( $\phi_s$ )

**Given:** The latitude of Bangkok is  $13.7^\circ\text{N}$ .

The standard meridian for the local time zone of Thailand is  $105^\circ\text{E}$ .

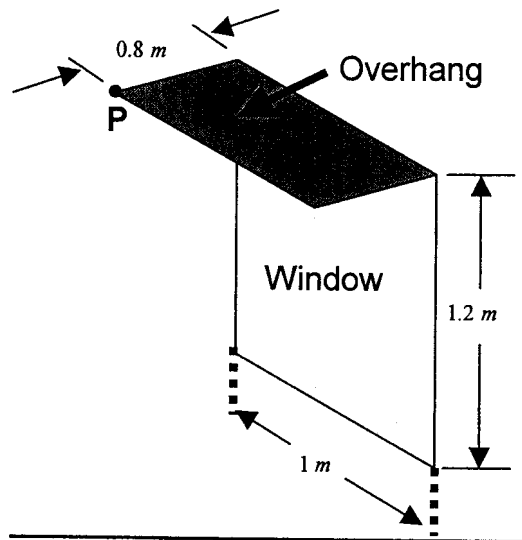
The longitude of Bangkok is  $100.5^\circ\text{E}$ .

Name ..... ID.....

**Question 4 (25 points) [Students may use some obtained results from Question 3]**

A window with height of 1.2 m and width of 1.0 m is on a wall facing southwest. A horizontal shading device (overhang) is installed at the top of the window as shown in Fig.1. The width of the overhang is 0.8 m. In Bangkok at Thailand, local time 15:00 hours on July 28, 2013, calculate the followings:

1. The position of the shade caused by the point P shown in Fig.1.
2. Sketch the shape of the shade due to the overhang.



**Fig.1** A window with an overhang

Name ..... ID.....

**Question 5 (20 points)**

1. Explain all of the factors affect thermal comfort in details.
2. In your opinion, what additional factors should be considered for thermal comfort and why?
3. The prevailing dry-bulb temperature of outdoor air for a given month in a tropical location is 30°C. For a person in sedentary activity and with light clothing in an office and following the recommendations of ASHRAE, can the person achieve thermal comfort if he or she wishes to use natural air for ventilation without mechanical cooling, explain? He or she is allowed to reduce clothing level and use electric fan.

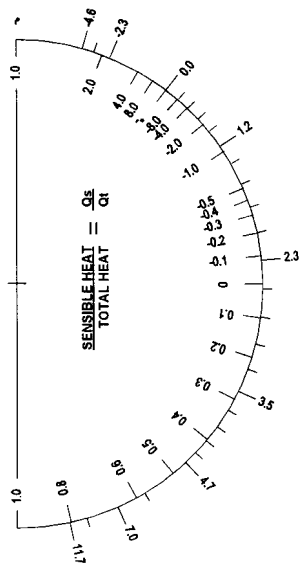
Name ..... ID.....

**Question 6 (10 points)**

For a person weighting 55 kg and possessing a height of 1.6 m, calculate

- a) Body surface area
- b) Fill in the values of  $W/m^2$  and  $W$  (average) for the following table using the calculated body surface area in a) in each activity. In additional, show the calculation of each activity.

Item	Activity	met	$W/m^2$	$W$ (average)
1	Seated and quiet	1.0		
2	Sedentary activity	1.2		
3	Light activity, Standing (Shopping, Laboratory experiment, Light industry)	1.6		
4	High activity (Heavy machine work, garage work)	3.0		



**PSYCHROMETRIC CHART**  
**Normal Temperature**  
**SI Units**  
**SEA LEVEL**  
 BAROMETRIC PRESSURE: 101.325 kPa

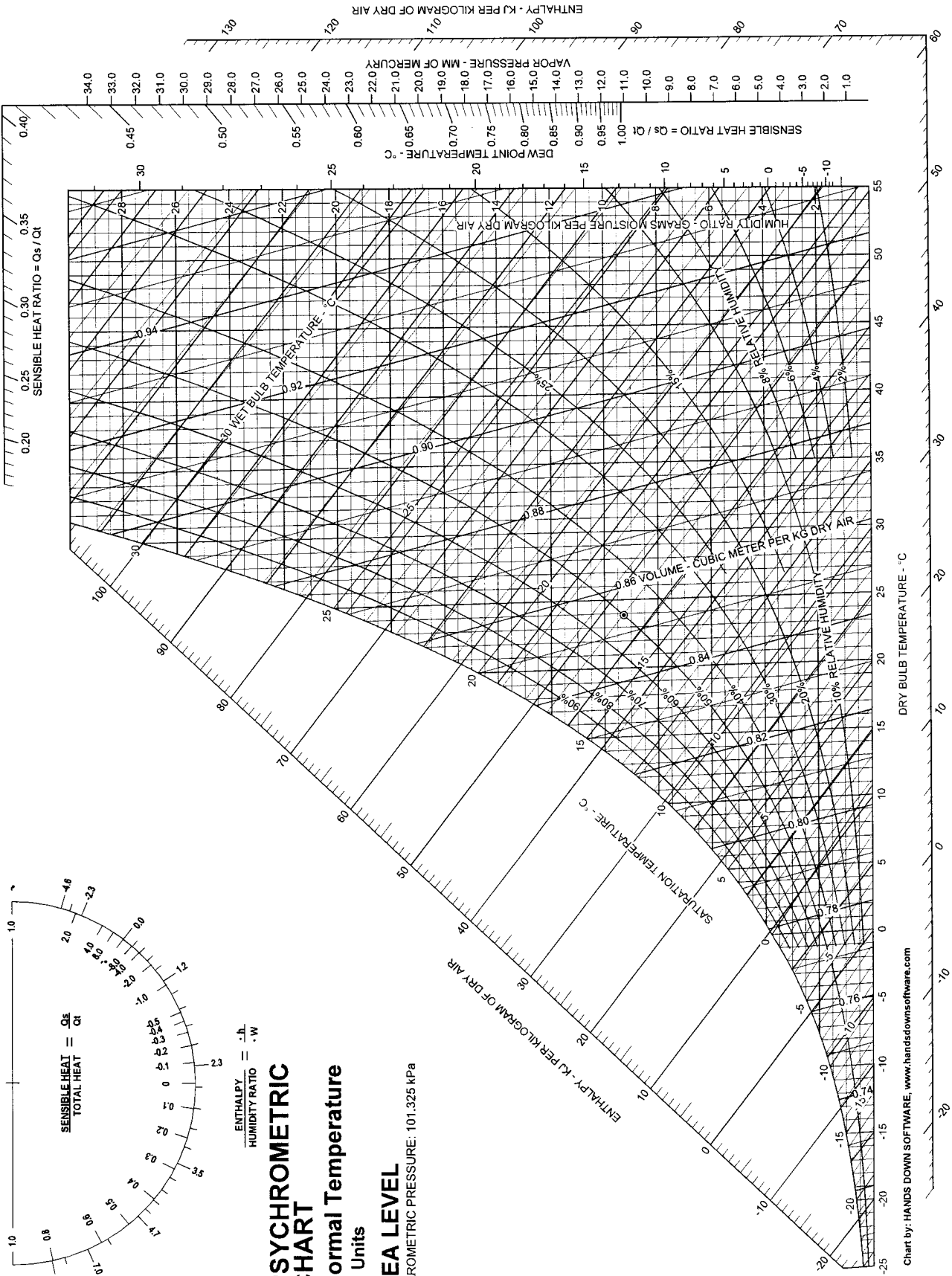


Chart by: HANDS DOWN SOFTWARE, [www.handsdownsoftware.com](http://www.handsdownsoftware.com)