Roll No: ----------

UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, December 2017

Program: M Tech ES & REE **Semester – I**
Subject (Course): Green Buildings **Max. Marks: 100**
Course Code : EPEC-7006 **Duration: 3 Hrs**
No. of page/s: 2

All questions carry equal marks SECTION-A (5*4)

Q1. (CO1) Discuss the important aspects of green building planning and construction. **(4)**

Q2. (CO7) Describe the importance of renewable energy integration for a Green Building **(4)**

Q3. (CO3) Discuss the main parameters of Green Buildings IAQ and write down various materials impacting the air quality within the building with their impacts on human health. **(4)**

Q4. (CO4) Calculate the heat load (TR) across air handling unit (AHU). The measured dry bulb and wet bulb temperatures of air across AHU inlet and outlet are:

Entering air temperature: 24.6 °C DBT, 17.0 °C WBT

Leaving air temperature : 13.5 °C DBT, 13.0 °C WBT

Measured inlet air flow rate : 14800 m^3/h **(4)**

Q5. (CO5) "Green Building materials are not feasible for Indian Building sector" Justify the statement if you agree or disagree with the statement. **(4)**

Attempt any four questions SECTION B (4*10)

Q6. (CO6) Discuss the methodology used for Lighting Audit in a building. Also explain with the help of one example the mandatory clause related to Lighting in ECBC. (**10)**

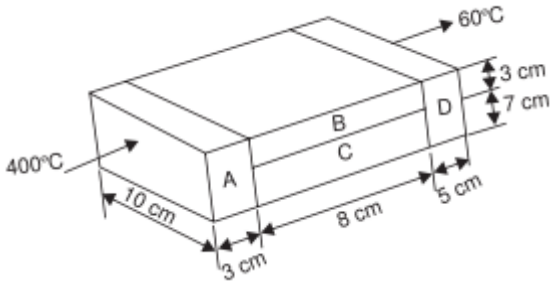
Q7. (CO1, CO4) Discuss in detail various mandatory clause given by ECBC for Building Envelope and HVAC. (**10)**

Q8. (CO5) According to WHO report which chemical has been considered as most hazardous element for the building occupants? Describe the chemical properties of that element stating the ill impact on human health. **(10)**

Q9. (CO6) With the help of neat diagram explain various methods for Rain Water Harvesting and Water Recycle and Reuse in a Green Building**.** **(10)**

Attempt all questions **SECTION C** **(20*2)**

Q10. (CO3)(a) Calculate the heat flow rate through the composite wall of a building as shown in the figure below. Assume one dimension



k_A=150 W/m^{o}C

k_B= 30 W/m^{o}C

k_C=65 W/m^{o}C

k_D=50 W/m^{o}C flow

(10)

(b)(CO2) Discuss various green building rating system practiced in India with their advantages and feasibility with reference to the Indian climatic suitability. **(10)**

Q11. (CO6) Two main areas of an industrial plant have the following lighting systems:

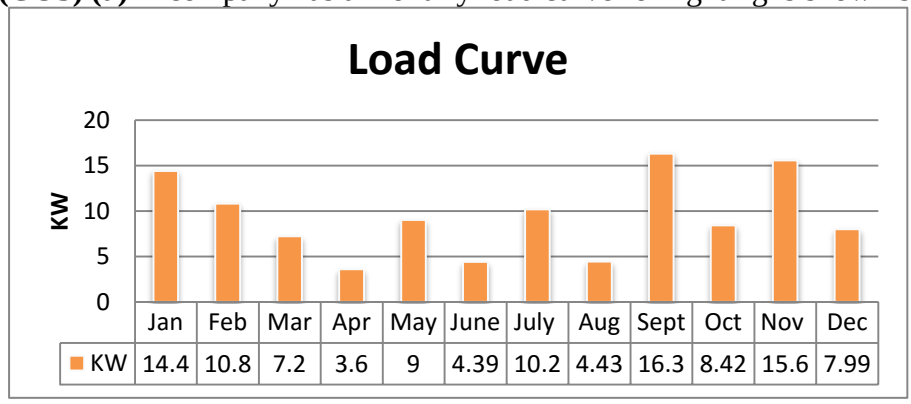
(i) Area A: 50 x 400W High Pressure Sodium (HPSV) single lamp luminaires.

(ii) Area B: 35 x 400W Mercury Vapour (HPMV) single lamp luminaires.

In Area A and Area B, the measured illuminance during daylight hours (12 hours) without artificial light was found to be adequate. In Area B it was noted that 8 of the MV fixtures are redundant. Plant Operating Hours: 24 hours per day, 365 days per year. Electricity Energy costs: Rs 3.00/kWh Calculate the annual potential energy cost savings from switching off unnecessary lights and from disconnecting redundant luminaires. **(20)**

OR

Q12. (CO3) (a) A company has a monthly load curve for lighting is shown below



It is proposed to replace all the CFL by LED of 9W costing Rs. 230. Calculate the payback and draw the new load curve. **(10)**

(b) (CO4) Following is the data collected during the energy audit of a building of chilled water system. Calculate the kW/TR, COP and EER.

Parameter	**Units**	**Measured Data**
Power Drawn by compressor motor	kW	112
Moto Efficiency	%	92
Compressor A Loading	%	61
Compressor B Loading	%	59
Primary Pump Power	kW	11.8
Secondary Pump Power	kW	2.5
Chilled water flow	m^3/Hr	165
Chilled water inlet to evaporator temperature	^oC	8.8
Chilled water inlet to evaporator temperature	^oC	7.2

(10)

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All questions carry equal marks SECTION-A (5*4)

Q1.(CO1,CO5) Discuss the properties to be considered in selection of insulation material.**(4)**

Q2. (CO6) Discuss various methods of lighting controls and write down the steps for Lighting Audit in buildings. **(4)**

Q3. (CO1) "Proper Building design and orientation results into the reduction of EPI of the building" Justify the statement by giving suitable example. **(4)**

Q4. (CO4, CO3) Define the following in the context of green building

(a) Energy Efficiency Ratio
(b) Shading Design
(c) WWR
(d) Solar Heat Gain Coefficient **(4)**

Q5. (CO6) Define color rendering index and calculate annual load factor of the building having an annual consumption 150 lakh kWh, Maximum Demand of 2421 kVA at 0.95 lag. **(4)**

Attempt all questions SECTION B (4*10)

Q6. (CO3) Discuss in detail various practices followed to limit entry of outdoor contaminants in a building. **(10)**

Q7. (CO4) In a commercial building after the energy audit of HVAC system the following observation is made, salt brine flow at the rate of 18 m3/ hr is cooled down from 12°C to 7 °C using chilled water. The chiller unit compressor motor draws 31 kW power and total input power to the allied accessories is 16 kW. The operating efficiency of the motor is 90%. The salt brine density is 1.2 kg/litre and specific heat capacity is 0.97 kCal/kg °C.

a) Calculate the refrigeration load (TR) imposed by the brine cooling?

b) Calculate the COP of refrigeration compressor?

c) Calculate the overall specific power consumption in kW/TR ?. **(10)**

Q8. (CO1) Write detail notes on how good operation and maintenance of building results into reduced economic and environment impact. **(10)**

Q9. (CO6) The dimension of an office hall is 12m*7m. The lamp is located at a height of 3 m from ground level (The working plane is assumed as 0.75 m above the floor). The total electric circuit watt for the office hall is 1600 watts. The average lux level measured in the room is 650 lux. The office works for 8 hours a day for 300 days a year. Calculate the energy saving potential per annum. Target lux data is given below

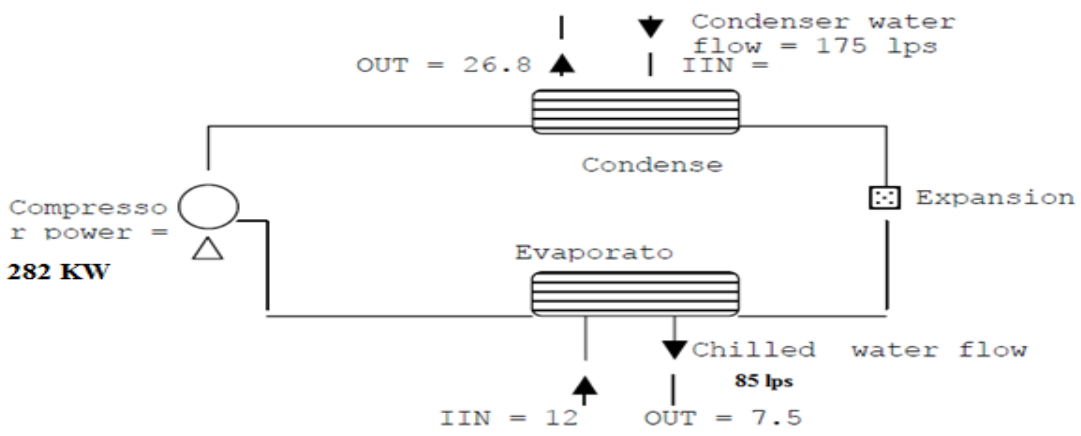
Room Index	Commercial lighting (Offices, Retail stores etc.) & very clean industrial applications, Standard ot Good Colour rendering Ra: 40-85	Industrial Lighting (Manufacturing areas, Workshops, Warehousing etc.) Standard or good colour rendering Ra: 40-85	Industrial Lighting installations where standard or good colour rendering is not essential but some colour discrimination is required Ra: 20-40
5	53(1.89)	49(2.04)	67(1.49)
4	52(1.92)	48(2.08)	66(1.52)
3	50(2)	46(2.17)	65(1.54)
2.5	48(2.08)	44(2.27)	64(1.56)
2	46(2.17)	42(2.38)	61(1.64)
1.5	43(2.33)	39(2.56)	58(1.72
1.25	40(2.5)	36(2.78)	55(1.82)
1	36(2.78)	33(3.03)	52(1.92)
Ra: Colour Rendering Index			

(10)

Attempt both questions **SECTION C** **(20*2)**

Q10. (CO2) Draw a sketch of Green Building showing various measures which should be taken in order to get 5 star rating from GRIHA rating system by justifying each criterion and impact on EPI of the Building. **(20)**

Q11. (CO4) Energy measured parameters for the centrifugal chiller are given below



Evaluate the performance of centrifugal chiller COP and EER and check based on the mandatory criteria given by ECBC shown below this chiller system is accepted for rating system or not?

Equipment Class	Minimum COP	Minimum IPLV	Test Standard
Air Cooled Chiller <530 kW (<150 tons)	2.90	3.16	ARI 550/590-1998
Air Cooled Chiller ≥530 kW (≥150 tons)	3.05	3.32	ARI 550/590-1998
*Centrifugal Water Cooled Chiller < 530 kW (<150 tons)	5.80	6.09	ARI 550/590-1998
*Centrifugal Water Cooled Chiller ≥530 and <1050 kW (≥150 and <300 tons)	5.80	6.17	ARI 550/590-1998
*Centrifugal Water Cooled Chiller ≥ 1050 kW (≥ 300 tons)	6.30	6.61	ARI 550/590-1998
Reciprocating Compressor, Water Cooled Chiller all sizes	4.20	5.05	ARI 550/590-1998
Rotary Screw and Scroll Compressor, Water Cooled Chiller <530 kW (<150 tons)	4.70	5.49	ARI 550/590-1998
Rotary Screw and Scroll Compressor, Water Cooled Chiller ≥530 and <1050 kW (≥150 and <300 tons)	5.40	6.17	ARI 550/590-1998
Rotary Screw and Scroll Compressor, Water Cooled Chiller ≥ 1050 kW (≥ 300 tons)	5.75	6.43	ARI 550/590-1998

(20)

OR

Q12. Explain in detail the following

a. **(CO1)** Environment and Economic impact of Green Buildings

b. **(CO7)** Energy Conservation in Buildings

c. (CO5) Green Materials (VOC Paint, Roof and Attics)

d. **(CO2)** Green Building Rating System. **(20)**