

**BE Electrical Engg. 4<sup>th</sup>Year, 1<sup>st</sup> Semester Examination, 2024**

**ELECTIVE-I (ILLUMINATIONSCIENCE AND LIGHTING DESIGN)**

**Time : Three hours**

**Full Marks : 100**

(50 marks for each part)

**Use separate Answer-script for each part**

**PART – I**

**Q1 is COMPULSORY**

1.A room of 36' length and 28' width is illuminated with suspended direct type retrofit LED luminaire. The reflectances of ceiling surface is 80% , wall surface of the ceiling cavity is 90%, wall surface below the luminaires is 50%,wall from floor to working plane is 10%and floor reflectance is 30%. If the distance of the lamp to ceiling is 2ft. 6 inches, the distance of the lamp to working plane is 7ft. 8 inches,and the distance between the working plane and floor is 2ft. 4inches.

i) Find out theCCR,RCR,FCR, effective ceiling and effective floor cavity reflectances.

ii) Choose the correct luminaire from the given Table and find out the CU value of the luminaire using necessary multiplying factor using the necessary table.

iii)How many luminaires are required to illuminate the room with average 150 lux?(Use 18W LED with 90 lm/W efficacy.)

iv)Show their spacing arrangement.

Given: Lamp lumen depreciation factor=0.8,Lumen dirt depreciation factor=0.75,Room surface dirt depreciation factor=0.85.

14

(Use the given charts and submit the marked charts with your answer scripts)

**Answer any Two from rest**

2.(a) Describe the production of radiation in low Pressure Mercury vapour lamp with necessary transition diagram .

3

OR,

Describe the production of radiation in High Pressure Sodium Vapour lamp with necessary Spectral Power Distribution Diagram.

(b)What is the significance of Room Position Multiplier?

1

Justify the importance of Wall Exitance and Ceiling Cavity Exitance coefficients in lighting Design calculation.

2

[ Turn over

(c) Write short notes on (any six):

6x2=12

(i) Self Absorption Phenomenon

(ii) Ceramic materials used in lamp making

(iii) Glass-metal seal,

(iv) Penning mixture with examples,

(v) Filament making,

(vi) Buffer gases,

(vii) Sodium-resistant glass.

3.(a) How would you determine the Effective Cavity Reflectance for non-horizontal ceilings? Explain with two examples. 6

(b) Discuss the necessity of Non-planar Illuminance in Lighting Design 2

(c) Compare Spherical and Cylindrical Illuminance with suitable diagrams and explain them. 6

(d) Explain the Dynamic V-I characteristic of a low pressure gas discharge lamp with necessary curves. 4

4.(a) Determine the exact illuminance level (200 or 300 or 500 lux) on the table of an office meeting room and justify with necessary Tables. 5

(b) How would you find out Luminaire Efficiency, describe. 4

(c) Explain Parallel plane aspect factor and with necessary diagrams discuss on its use in Illuminance calculation. 9

Table I Per Cent Effective Ceiling or Floor Cavity Reflectances for Various Reflectance Combinations

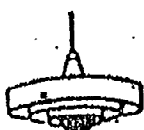
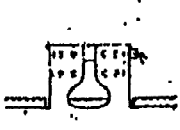
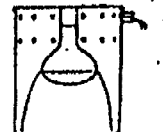
| Per Cent<br>Basal<br>Reflectance | 80   |    |    |    |    |    |    |    |    |    | 70 |    |    |    |    |    |    |    |    |    | 60 |    |    |    |    |    |    |    |    |    | 50 |    |    |    |    |    |    |    |    |    |    |
|----------------------------------|------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
|                                  | 50   | 60 | 50 | 60 | 50 | 60 | 50 | 60 | 50 | 60 | 50 | 60 | 50 | 60 | 50 | 60 | 50 | 60 | 50 | 60 | 50 | 60 | 50 | 60 | 50 | 60 | 50 | 60 | 50 | 60 | 50 | 60 | 50 | 60 | 50 | 60 | 50 | 60 | 50 | 60 |    |
| Cavity Ratio                     | 0.2  | 89 | 88 | 87 | 86 | 85 | 84 | 84 | 82 | 78 | 78 | 77 | 77 | 76 | 76 | 75 | 74 | 72 | 70 | 68 | 66 | 64 | 63 | 63 | 62 | 61 | 58 | 56 | 55 | 54 | 53 | 53 | 52 | 50 | 48 | 46 | 45 | 44 | 44 | 43 | 41 |
|                                  | 0.4  | 89 | 87 | 86 | 84 | 82 | 80 | 79 | 77 | 73 | 73 | 72 | 71 | 70 | 69 | 68 | 66 | 64 | 62 | 60 | 58 | 56 | 55 | 54 | 53 | 51 | 49 | 47 | 45 | 44 | 43 | 42 | 41 | 40 | 38 | 36 | 35 | 34 | 32 | 30 |    |
|                                  | 0.6  | 87 | 86 | 84 | 82 | 80 | 79 | 77 | 75 | 71 | 70 | 69 | 67 | 65 | 63 | 61 | 59 | 57 | 55 | 53 | 51 | 49 | 47 | 45 | 43 | 41 | 39 | 37 | 35 | 34 | 33 | 32 | 30 | 28 | 26 | 25 | 24 | 22 | 20 | 18 | 16 |
|                                  | 0.8  | 87 | 85 | 82 | 80 | 77 | 75 | 72 | 69 | 66 | 64 | 62 | 60 | 58 | 56 | 54 | 52 | 50 | 48 | 46 | 44 | 42 | 40 | 38 | 36 | 34 | 32 | 30 | 28 | 26 | 25 | 24 | 23 | 21 | 19 | 18 | 16 | 15 | 13 | 11 | 9  |
|                                  | 1.0  | 86 | 84 | 80 | 77 | 75 | 72 | 69 | 66 | 64 | 62 | 60 | 58 | 56 | 54 | 52 | 50 | 48 | 46 | 44 | 42 | 40 | 38 | 36 | 34 | 32 | 30 | 28 | 26 | 25 | 24 | 23 | 21 | 19 | 18 | 16 | 15 | 13 | 11 | 9  |    |
|                                  | 1.2  | 85 | 82 | 78 | 75 | 72 | 69 | 66 | 63 | 60 | 57 | 54 | 51 | 48 | 45 | 42 | 39 | 36 | 33 | 30 | 27 | 24 | 21 | 18 | 15 | 12 | 9  | 6  | 3  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                                  | 1.4  | 85 | 80 | 77 | 74 | 71 | 68 | 65 | 62 | 59 | 56 | 53 | 50 | 47 | 44 | 41 | 38 | 35 | 32 | 29 | 26 | 23 | 20 | 17 | 14 | 11 | 8  | 5  | 2  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |    |
|                                  | 1.6  | 84 | 79 | 75 | 72 | 69 | 66 | 63 | 60 | 57 | 54 | 51 | 48 | 45 | 42 | 39 | 36 | 33 | 30 | 27 | 24 | 21 | 18 | 15 | 12 | 9  | 6  | 3  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |    |
|                                  | 1.8  | 83 | 78 | 74 | 71 | 68 | 65 | 62 | 59 | 56 | 53 | 50 | 47 | 44 | 41 | 38 | 35 | 32 | 29 | 26 | 23 | 20 | 17 | 14 | 11 | 8  | 5  | 2  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |    |
|                                  | 2.0  | 83 | 77 | 72 | 67 | 62 | 56 | 53 | 50 | 47 | 44 | 41 | 38 | 35 | 32 | 29 | 26 | 23 | 20 | 17 | 14 | 11 | 8  | 5  | 2  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |    |
|                                  | 2.2  | 82 | 76 | 70 | 65 | 59 | 54 | 50 | 47 | 44 | 41 | 38 | 35 | 32 | 29 | 26 | 23 | 20 | 17 | 14 | 11 | 8  | 5  | 2  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |    |    |
|                                  | 2.4  | 82 | 75 | 69 | 64 | 58 | 53 | 49 | 46 | 43 | 40 | 37 | 34 | 31 | 28 | 25 | 22 | 19 | 16 | 13 | 10 | 7  | 4  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |    |    |
|                                  | 2.6  | 81 | 74 | 67 | 62 | 56 | 51 | 46 | 42 | 38 | 35 | 32 | 29 | 26 | 23 | 20 | 17 | 14 | 11 | 8  | 5  | 2  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |    |    |
|                                  | 2.8  | 81 | 73 | 66 | 60 | 54 | 49 | 44 | 39 | 34 | 30 | 27 | 24 | 21 | 18 | 15 | 12 | 9  | 6  | 3  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |    |    |
|                                  | 3.0  | 80 | 72 | 64 | 58 | 52 | 47 | 42 | 38 | 34 | 30 | 27 | 24 | 21 | 18 | 15 | 12 | 9  | 6  | 3  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |    |    |
|                                  | 3.2  | 79 | 71 | 63 | 56 | 50 | 45 | 40 | 36 | 32 | 28 | 25 | 22 | 19 | 16 | 13 | 10 | 7  | 4  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |    |    |
|                                  | 3.4  | 79 | 70 | 62 | 54 | 48 | 43 | 38 | 34 | 30 | 27 | 24 | 21 | 18 | 15 | 12 | 9  | 6  | 3  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |    |    |
|                                  | 3.6  | 78 | 69 | 61 | 53 | 47 | 42 | 38 | 32 | 28 | 25 | 22 | 19 | 16 | 13 | 10 | 7  | 4  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |    |    |
|                                  | 3.8  | 78 | 69 | 60 | 51 | 45 | 40 | 35 | 31 | 27 | 23 | 20 | 17 | 14 | 11 | 8  | 5  | 2  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |    |    |
|                                  | 4.0  | 77 | 69 | 59 | 51 | 44 | 39 | 33 | 29 | 25 | 22 | 19 | 16 | 13 | 10 | 7  | 4  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |    |    |
|                                  | 4.2  | 77 | 67 | 57 | 50 | 43 | 37 | 32 | 28 | 24 | 21 | 18 | 15 | 12 | 9  | 6  | 3  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |    |    |
|                                  | 4.4  | 76 | 67 | 56 | 49 | 42 | 36 | 31 | 27 | 23 | 20 | 17 | 14 | 11 | 8  | 5  | 2  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |    |    |
|                                  | 4.6  | 76 | 66 | 55 | 47 | 40 | 35 | 30 | 26 | 22 | 19 | 16 | 13 | 10 | 7  | 4  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |    |    |
|                                  | 4.8  | 75 | 65 | 54 | 46 | 39 | 33 | 28 | 24 | 20 | 17 | 14 | 11 | 8  | 5  | 2  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |    |    |
|                                  | 5.0  | 75 | 59 | 53 | 45 | 38 | 33 | 28 | 24 | 20 | 17 | 14 | 11 | 8  | 5  | 2  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |    |    |
|                                  | 6.0  | 73 | 61 | 49 | 41 | 34 | 29 | 24 | 20 | 16 | 11 | 8  | 5  | 2  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |    |    |
|                                  | 7.0  | 70 | 58 | 45 | 38 | 30 | 27 | 21 | 18 | 14 | 10 | 8  | 5  | 2  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |    |    |
|                                  | 8.0  | 68 | 55 | 42 | 35 | 27 | 21 | 15 | 12 | 08 | 06 | 04 | 03 | 02 | 01 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |    |    |
|                                  | 9.0  | 66 | 52 | 38 | 31 | 25 | 21 | 16 | 14 | 11 | 08 | 06 | 04 | 03 | 02 | 01 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |    |    |
|                                  | 10.0 | 65 | 51 | 36 | 29 | 22 | 19 | 15 | 11 | 09 | 04 | 03 | 02 | 01 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |    |    |

\* Values in this table are based on a length to width ratio of 1.0.

† Ceiling, floor or floor of cavity.

[illegible]\* Values in this table are based on a length to width ratio of 1.5.  
† Ceiling, floor or floor of cavity.

† Ceiling, floor or floor of cavity.

| Typical Luminaire | Typical Intensity Distribution and Per Cent Lamp Lumen                              | Foot-candle |     |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |       |     | WDR | RCR |     |  |  |  |
|-------------------|-------------------------------------------------------------------------------------|-------------|-----|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|-------|-----|-----|-----|-----|--|--|--|
|                   |                                                                                     | 50          |     |      |      | 70   |      |      |      | 100  |      |      |      | 150  |      |      |      | 200  |      |       |     |     |     | 300 |  |  |  |
|                   |                                                                                     | 50          | 30  | 10   | 50   | 30   | 10   | 50   | 30   | 10   | 50   | 30   | 10   | 50   | 30   | 10   | 50   | 30   | 10   | 50    | 30  |     |     | 10  |  |  |  |
| RCR               | RCR                                                                                 | RCR         | RCR | RCR  | RCR  | RCR  | RCR  | RCR  | RCR  | RCR  | RCR  | RCR  | RCR  | RCR  | RCR  | RCR  | RCR  | RCR  | RCR  | RCR   | RCR | RCR | RCR |     |  |  |  |
| Typical Luminaire | Typical Intensity Distribution and Per Cent Lamp Lumen                              | RCR         | RCR | RCR  | RCR  | RCR  | RCR  | RCR  | RCR  | RCR  | RCR  | RCR  | RCR  | RCR  | RCR  | RCR  | RCR  | RCR  | RCR  | RCR   | RCR | RCR | RCR |     |  |  |  |
| 1                 |    | 1.5         | 0   | 0.87 | 0.87 | 0.87 | 0.81 | 0.81 | 0.81 | 0.70 | 0.70 | 0.70 | 0.59 | 0.59 | 0.59 | 0.49 | 0.49 | 0.49 | 0.45 | 0.388 | 1   | 1   |     |     |  |  |  |
| 2                 |    | N.A.        | 0   | 0.83 | 0.83 | 0.83 | 0.72 | 0.72 | 0.72 | 0.50 | 0.50 | 0.50 | 0.30 | 0.30 | 0.30 | 0.12 | 0.12 | 0.12 | 0.03 | 0.018 | 1   | 1   |     |     |  |  |  |
| 3                 |  | 1.3         | 0   | 0.99 | 0.99 | 0.99 | 0.87 | 0.87 | 0.87 | 0.83 | 0.83 | 0.83 | 0.88 | 0.88 | 0.88 | 0.85 | 0.85 | 0.85 | 0.83 | 0.823 | 1   | 1   |     |     |  |  |  |
| 4                 |  | 1.3         | 0   | 0.88 | 0.88 | 0.88 | 0.85 | 0.85 | 0.85 | 0.77 | 0.77 | 0.77 | 0.70 | 0.70 | 0.70 | 0.63 | 0.63 | 0.63 | 0.60 | 0.264 | 1   | 1   |     |     |  |  |  |
| 5                 |  | 0.8         | 0   | 1.19 | 1.19 | 1.19 | 1.18 | 1.18 | 1.18 | 1.11 | 1.11 | 1.11 | 1.08 | 1.08 | 1.08 | 1.02 | 1.02 | 1.02 | 1.00 | 0.241 | 1   | 1   |     |     |  |  |  |
| 6                 |  | 0.7         | 0   | 1.01 | 1.01 | 1.01 | 0.99 | 0.99 | 0.99 | 0.94 | 0.94 | 0.94 | 0.93 | 0.93 | 0.93 | 0.87 | 0.87 | 0.87 | 0.85 | 0.115 | 1   | 1   |     |     |  |  |  |

*Table II - Continued*  
Coefficients, Luminaire Spacing Criterion and Maintenance Categories of Typical Luminaires.

| 80                                                                                                 |      |      |      |      |      |      |      |      |      |      |      |      |      |      | 70   |      |      |      |      |      |      |      |      |      |      |      |      |      |      | 50                                                                                                 |      |      |      |      |      |      |      |      |      |      |      |      |      |      | 30   |      |      |      |      |      |      |      |      |      |      |      |      |      |      | 10   |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|----------------------------------------------------------------------------------------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|----------------------------------------------------------------------------------------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| 50                                                                                                 |      |      |      |      | 30   |      |      |      |      | 10   |      |      |      |      | 50   |      |      |      |      | 30   |      |      |      |      | 10   |      |      |      |      | 50                                                                                                 |      |      |      |      | 30   |      |      |      |      | 10   |      |      |      |      | 50   |      |      |      |      | 30   |      |      |      |      | 10   |      |      |      |      | 50   |      |      |      |      | 30   |      |      |      |      | 10   |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| Wall Exitance Coefficients for 20 Per Cent Effective Floor Cavity Reflectance ( $\rho_{fc} = 20$ ) |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      | Ceiling Cavity Exitance Coefficients for 20 Per Cent Floor Cavity Reflectance ( $\rho_{fc} = 20$ ) |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| .328                                                                                               | .187 | .059 | .311 | .178 | .056 | .280 | .161 | .051 | .252 | .145 | .047 | .226 | .131 | .042 | .423 | .423 | .423 | .361 | .361 | .361 | .246 | .246 | .246 | .142 | .142 | .142 | .045 | .045 | .045 | .275                                                                                               | .150 | .046 | .259 | .143 | .044 | .231 | .129 | .040 | .205 | .115 | .036 | .181 | .102 | .032 | .417 | .379 | .347 | .361 | .340 | .321 | .247 | .234 | .222 | .142 | .135 | .129 | .046 | .044 | .042 | .240 | .128 | .038 | .226 | .121 | .036 | .200 | .108 | .033 | .176 | .097 | .030 | .154 | .085 | .026 | .412 | .387 | .332 | .353 | .317 | .287 | .242 | .220 | .202 | .140 | .126 | .119 | .045 | .042 | .039 | .214 | .111 | .033 | .201 | .105 | .031 | .177 | .094 | .028 | .155 | .083 | .025 | .135 | .073 | .022 | .406 | .358 | .321 | .348 | .309 | .279 | .239 | .215 | .196 | .136 | .126 | .116 | .045 | .041 | .038 | .193 | .098 | .028 | .181 | .093 | .027 | .160 | .083 | .024 | .139 | .073 | .022 | .120 | .064 | .019 | .400 | .350 | .314 | .343 | .303 | .273 | .236 | .212 | .193 | .137 | .124 | .114 | .044 | .041 | .038 | .176 | .088 | .025 | .185 | .084 | .022 | .145 | .074 | .022 | .126 | .068 | .019 | .109 | .057 | .017 | .394 | .344 | .309 | .338 | .298 | .269 | .234 | .209 | .190 | .135 | .123 | .113 | .044 | .040 | .037 | .162 | .080 | .023 | .152 | .076 | .022 | .133 | .067 | .019 | .116 | .059 | .017 | .100 | .052 | .015 | .388 | .339 | .305 | .334 | .294 | .266 | .231 | .206 | .187 | .134 | .122 | .112 | .043 | .040 | .037 | .150 | .073 | .021 | .140 | .069 | .020 | .123 | .062 | .018 | .107 | .054 | .016 | .092 | .047 | .014 | .383 | .335 | .302 | .330 | .291 | .264 | .229 | .204 | .187 | .133 | .120 | .111 | .043 | .039 | .037 | .139 | .067 | .019 | .131 | .064 | .018 | .115 | .057 | .016 | .099 | .050 | .014 | .085 | .043 | .013 | .378 | .332 | .300 | .326 | .288 | .262 | .226 | .202 | .186 | .131 | .119 | .111 | .043 | .039 | .037 | .130 | .062 | .017 | .122 | .059 | .016 | .107 | .052 | .015 | .093 | .046 | .013 | .080 | .040 | .011 | .374 | .328 | .298 | .322 | .285 | .260 | .223 | .201 | .185 | .130 | .118 | .110 | .042 | .039 | .037 |      |
| .226                                                                                               | .128 | .041 | .195 | .111 | .035 | .137 | .078 | .025 | .083 | .048 | .015 | .034 | .020 | .006 | .796 | .796 | .796 | .680 | .680 | .680 | .464 | .464 | .464 | .267 | .267 | .267 | .085 | .085 | .085 | .207                                                                                               | .114 | .035 | .179 | .089 | .030 | .126 | .070 | .022 | .077 | .043 | .013 | .031 | .018 | .006 | .784 | .755 | .731 | .671 | .650 | .632 | .463 | .450 | .441 | .265 | .262 | .258 | .085 | .085 | .084 | .191 | .102 | .030 | .165 | .084 | .027 | .116 | .063 | .019 | .071 | .039 | .012 | .029 | .016 | .006 | .776 | .743 | .715 | .667 | .641 | .620 | .455 | .445 | .435 | .265 | .260 | .256 | .085 | .084 | .084 | .177 | .092 | .027 | .153 | .080 | .024 | .108 | .057 | .017 | .066 | .035 | .011 | .027 | .014 | .004 | .773 | .734 | .703 | .664 | .634 | .611 | .456 | .442 | .430 | .264 | .259 | .255 | .085 | .084 | .084 | .164 | .084 | .024 | .142 | .073 | .021 | .100 | .052 | .015 | .061 | .032 | .010 | .025 | .013 | .004 | .768 | .728 | .696 | .660 | .629 | .605 | .455 | .439 | .427 | .263 | .258 | .253 | .085 | .084 | .084 | .153 | .077 | .022 | .133 | .067 | .019 | .094 | .048 | .014 | .057 | .030 | .009 | .023 | .012 | .004 | .764 | .721 | .690 | .656 | .624 | .601 | .453 | .437 | .425 | .263 | .257 | .253 | .085 | .084 | .083 | .143 | .071 | .020 | .124 | .062 | .018 | .088 | .044 | .013 | .054 | .027 | .008 | .022 | .011 | .003 | .759 | .716 | .686 | .653 | .621 | .598 | .451 | .435 | .423 | .262 | .256 | .252 | .085 | .084 | .083 | .134 | .066 | .018 | .116 | .057 | .018 | .082 | .041 | .012 | .050 | .026 | .007 | .020 | .010 | .003 | .755 | .712 | .683 | .650 | .618 | .595 | .450 | .434 | .422 | .262 | .256 | .252 | .085 | .084 | .083 | .126 | .061 | .017 | .109 | .053 | .015 | .077 | .038 | .011 | .047 | .024 | .007 | .019 | .010 | .003 | .751 | .708 | .680 | .647 | .615 | .593 | .448 | .432 | .421 | .261 | .255 | .251 | .085 | .084 | .083 | .119 | .057 | .016 | .103 | .050 | .014 | .073 | .036 | .010 | .045 | .022 | .006 | .018 | .009 | .003 | .747 | .706 | .678 | .644 | .613 | .592 | .447 | .431 | .421 | .261 | .255 | .251 | .084 | .084 | .083 |      |
| .159                                                                                               | .159 | .159 | .138 | .138 | .138 | .093 | .093 | .093 | .053 | .053 | .053 | .017 | .017 | .017 | .150 | .150 | .151 | .128 | .112 | .097 | .088 | .077 | .067 | .050 | .045 | .039 | .016 | .014 | .013 | .240                                                                                               | .131 | .040 | .235 | .129 | .040 | .225 | .125 | .039 | .216 | .121 | .038 | .208 | .117 | .037 | .143 | .110 | .062 | .123 | .085 | .071 | .064 | .066 | .050 | .046 | .038 | .029 | .016 | .012 | .008 | .225 | .120 | .036 | .220 | .118 | .035 | .212 | .115 | .035 | .204 | .112 | .034 | .196 | .109 | .034 | .143 | .137 | .035 | .062 | .118 | .062 | .054 | .061 | .057 | .036 | .047 | .033 | .022 | .015 | .011 | .007 | .208 | .109 | .032 | .205 | .107 | .032 | .197 | .105 | .031 | .190 | .102 | .031 | .184 | .100 | .030 | .131 | .134 | .048 | .113 | .073 | .042 | .077 | .051 | .030 | .045 | .030 | .018 | .014 | .010 | .006 | .194 | .099 | .029 | .191 | .098 | .029 | .184 | .096 | .028 | .177 | .094 | .028 | .171 | .092 | .026 | .125 | .076 | .039 | .108 | .065 | .034 | .074 | .046 | .024 | .043 | .027 | .014 | .014 | .008 | .005 | .181 | .091 | .028 | .177 | .090 | .026 | .171 | .088 | .026 | .166 | .086 | .025 | .160 | .084 | .025 | .118 | .069 | .032 | .103 | .060 | .028 | .074 | .042 | .020 | .041 | .025 | .012 | .013 | .008 | .004 | .166 | .083 | .024 | .165 | .082 | .023 | .160 | .081 | .023 | .155 | .079 | .023 | .150 | .078 | .023 | .114 | .063 | .027 | .098 | .055 | .024 | .069 | .038 | .017 | .039 | .023 | .010 | .017 | .007 | .003 | .157 | .077 | .022 | .155 | .076 | .022 | .150 | .075 | .021 | .145 | .074 | .021 | .141 | .072 | .021 | .109 | .058 | .024 | .093 | .050 | .021 | .065 | .035 | .015 | .038 | .021 | .009 | .012 | .007 | .003 | .147 | .071 | .020 | .145 | .071 | .020 | .141 | .070 | .020 | .136 | .068 | .020 | .133 | .067 | .019 | .103 | .054 | .021 | .089 | .047 | .018 | .062 | .033 | .013 | .035 | .019 | .008 | .012 | .006 | .003 | .138 | .066 | .018 | .136 | .066 | .018 | .132 | .065 | .018 | .129 | .064 | .018 | .125 | .063 | .018 | .098 | .051 | .018 | .085 | .044 | .016 | .059 | .031 | .011 | .034 | .018 | .007 | .011 | .006 | .002 |
| .243                                                                                               | .138 | .044 | .232 | .132 | .042 | .211 | .121 | .039 | .192 | .111 | .036 | .175 | .101 | .033 | .290 | .290 | .290 | .248 | .248 | .248 | .169 | .169 | .169 | .097 | .097 | .097 | .031 | .031 | .031 | .216                                                                                               | .118 | .036 | .206 | .114 | .035 | .187 | .104 | .032 | .170 | .095 | .030 | .154 | .087 | .027 | .276 | .248 | .221 | .236 | .212 | .191 | .162 | .147 | .133 | .095 | .085 | .078 | .030 | .028 | .025 | .196 | .104 | .031 | .187 | .100 | .030 | .170 | .092 | .028 | .154 | .085 | .026 | .140 | .077 | .024 | .263 | .233 | .204 | .231 | .201 | .177 | .156 | .139 | .124 | .092 | .081 | .073 | .028 | .026 | .024 | .180 | .093 | .027 | .171 | .090 | .027 | .156 | .083 | .025 | .142 | .076 | .023 | .128 | .070 | .021 | .263 | .223 | .192 | .226 | .192 | .167 | .155 | .134 | .117 | .090 | .079 | .068 | .029 | .026 | .023 | .166 | .084 | .024 | .158 | .081 | .024 | .144 | .075 | .022 | .131 | .069 | .021 | .118 | .064 | .019 | .257 | .215 | .183 | .221 | .186 | .160 | .152 | .130 | .113 | .088 | .076 | .067 | .028 | .025 | .022 | .154 | .077 | .022 | .147 | .074 | .021 | .134 | .069 | .020 | .122 | .064 | .019 | .111 | .058 | .017 | .252 | .208 | .177 | .216 | .180 | .154 | .140 | .126 | .109 | .087 | .074 | .065 | .026 | .024 | .021 | .143 | .071 | .020 | .137 | .068 | .019 | .125 | .063 | .018 | .114 | .059 | .017 | .104 | .054 | .016 | .246 | .203 | .173 | .212 | .176 | .151 | .146 | .123 | .107 | .085 | .073 | .063 | .027 | .024 | .021 | .134 | .066 | .018 | .129 | .063 | .018 | .118 | .059 | .017 | .108 | .055 | .016 | .098 | .050 | .015 | .242 | .199 | .169 | .208 | .172 | .148 | .144 | .121 | .105 | .084 | .071 | .062 | .027 | .023 | .021 | .126 | .061 | .017 | .121 | .059 | .017 | .111 | .056 | .016 | .102 | .051 | .015 | .093 | .047 | .014 | .237 | .195 | .166 | .204 | .169 | .145 | .142 | .119 | .103 | .083 | .070 | .061 | .027 | .023 | .020 | .119 | .057 | .016 | .114 | .055 | .015 | .105 | .051 | .014 | .096 | .048 | .014 | .088 | .044 | .013 | .233 | .192 | .164 | .201 | .167 | .143 | .139 | .117 | .102 | .081 | .069 | .061 | .026 | .023 | .020 |      |
| .189                                                                                               | .189 | .189 | .163 | .163 | .163 | .111 | .111 | .111 | .064 | .064 | .064 | .020 | .020 | .020 | .174 | .157 | .141 | .149 | .135 | .122 | .102 | .093 | .084 | .059 | .054 | .049 | .019 | .017 | .016 | .202                                                                                               | .107 | .032 | .197 | .105 | .032 | .187 | .101 | .031 | .178 | .098 | .030 | .170 | .094 | .029 | .151 | .114 | .084 | .130 | .098 | .073 | .089 | .068 | .051 | .051 | .040 | .030 | .017 | .013 | .010 | .191 | .099 | .029 | .188 | .098 | .029 | .178 | .094 | .028 | .170 | .091 | .028 | .163 | .089 | .027 | .142 | .100 | .067 | .122 | .066 | .058 | .084 | .060 | .041 | .049 | .035 | .024 | .016 | .011 | .008 | .180 | .092 | .027 | .176 | .091 | .026 | .169 | .088 | .026 | .162 | .086 | .025 | .156 | .083 | .025 | .116 | .077 | .047 | .080 | .053 | .033 | .046 | .031 | .020 | .015 |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |

Table III: Multiplying Factors for Other than 20 Per Cent Effective Floor Cavity Reflectance

| % Effective Ceiling Cavity Reflectance, $\rho_{ce}$                     | 60    |       |       |       | 70    |       |       |       | 50    |       |       |       | 30    |       |       |       | 10    |       |       |       |
|-------------------------------------------------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|                                                                         | 70    | 50    | 30    | 10    | 70    | 50    | 30    | 10    | 70    | 50    | 30    | 10    | 70    | 50    | 30    | 10    | 70    | 50    | 30    | 10    |
| For 30 Per Cent Effective Floor Cavity Reflectance (20 Per Cent = 1.00) |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| Room Cavity Ratio                                                       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 1                                                                       | 1.092 | 1.082 | 1.075 | 1.068 | 1.077 | 1.070 | 1.064 | 1.058 | 1.049 | 1.044 | 1.040 | 1.037 | 1.028 | 1.026 | 1.023 | 1.017 | 1.012 | 1.010 | 1.008 | 1.006 |
| 2                                                                       | 1.079 | 1.068 | 1.065 | 1.047 | 1.068 | 1.057 | 1.048 | 1.039 | 1.041 | 1.033 | 1.027 | 1.020 | 1.028 | 1.021 | 1.017 | 1.012 | 1.014 | 1.009 | 1.005 | 1.003 |
| 3                                                                       | 1.070 | 1.054 | 1.042 | 1.033 | 1.061 | 1.048 | 1.037 | 1.028 | 1.034 | 1.027 | 1.021 | 1.015 | 1.022 | 1.015 | 1.010 | 1.014 | 1.009 | 1.004 | 1.001 | 1.000 |
| 4                                                                       | 1.062 | 1.045 | 1.033 | 1.024 | 1.055 | 1.040 | 1.029 | 1.021 | 1.030 | 1.022 | 1.015 | 1.012 | 1.020 | 1.013 | 1.008 | 1.014 | 1.009 | 1.004 | 1.001 | 1.000 |
| 5                                                                       | 1.058 | 1.038 | 1.026 | 1.018 | 1.050 | 1.034 | 1.024 | 1.015 | 1.027 | 1.018 | 1.011 | 1.009 | 1.019 | 1.012 | 1.008 | 1.014 | 1.009 | 1.004 | 1.001 | 1.000 |
| 6                                                                       | 1.052 | 1.033 | 1.021 | 1.014 | 1.047 | 1.030 | 1.020 | 1.012 | 1.024 | 1.015 | 1.008 | 1.007 | 1.018 | 1.010 | 1.005 | 1.014 | 1.008 | 1.003 | 1.000 | 1.000 |
| 7                                                                       | 1.047 | 1.029 | 1.018 | 1.011 | 1.043 | 1.026 | 1.017 | 1.009 | 1.022 | 1.013 | 1.006 | 1.005 | 1.016 | 1.009 | 1.004 | 1.013 | 1.007 | 1.002 | 1.000 | 1.000 |
| 8                                                                       | 1.044 | 1.028 | 1.015 | 1.009 | 1.040 | 1.024 | 1.015 | 1.007 | 1.020 | 1.012 | 1.005 | 1.004 | 1.015 | 1.009 | 1.004 | 1.013 | 1.007 | 1.002 | 1.000 | 1.000 |
| 9                                                                       | 1.040 | 1.024 | 1.014 | 1.007 | 1.037 | 1.022 | 1.014 | 1.006 | 1.019 | 1.011 | 1.004 | 1.003 | 1.015 | 1.009 | 1.003 | 1.013 | 1.007 | 1.002 | 1.000 | 1.000 |
| 10                                                                      | 1.037 | 1.022 | 1.012 | 1.006 | 1.034 | 1.020 | 1.012 | 1.005 | 1.017 | 1.010 | 1.003 | 1.002 | 1.015 | 1.009 | 1.003 | 1.013 | 1.007 | 1.002 | 1.000 | 1.000 |
| For 10 Per Cent Effective Floor Cavity Reflectance (20 Per Cent = 1.00) |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| Room Cavity Ratio                                                       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 1                                                                       | 1.923 | 1.929 | 1.935 | 1.940 | 1.953 | 1.959 | 1.963 | 1.968 | 1.956 | 1.960 | 1.963 | 1.967 | 1.973 | 1.976 | 1.979 | 1.989 | 1.991 | 1.993 | 1.995 | 1.996 |
| 2                                                                       | 1.931 | 1.942 | 1.950 | 1.958 | 1.940 | 1.949 | 1.957 | 1.963 | 1.962 | 1.968 | 1.974 | 1.975 | 1.978 | 1.980 | 1.983 | 1.988 | 1.988 | 1.992 | 1.996 | 1.996 |
| 3                                                                       | 1.939 | 1.951 | 1.961 | 1.969 | 1.945 | 1.957 | 1.966 | 1.973 | 1.967 | 1.975 | 1.980 | 1.981 | 1.982 | 1.986 | 1.991 | 1.997 | 1.997 | 1.997 | 1.997 | 1.997 |
| 4                                                                       | 1.944 | 1.958 | 1.969 | 1.978 | 1.950 | 1.963 | 1.973 | 1.980 | 1.972 | 1.980 | 1.985 | 1.986 | 1.987 | 1.990 | 1.995 | 1.997 | 1.997 | 1.997 | 1.997 | 1.997 |
| 5                                                                       | 1.949 | 1.964 | 1.976 | 1.983 | 1.954 | 1.968 | 1.978 | 1.985 | 1.977 | 1.985 | 1.990 | 1.991 | 1.992 | 1.995 | 1.999 | 1.999 | 1.999 | 1.999 | 1.999 | 1.999 |
| 6                                                                       | 1.953 | 1.969 | 1.980 | 1.986 | 1.958 | 1.972 | 1.982 | 1.989 | 1.981 | 1.989 | 1.994 | 1.995 | 1.996 | 1.999 | 1.999 | 1.999 | 1.999 | 1.999 | 1.999 | 1.999 |
| 7                                                                       | 1.957 | 1.973 | 1.983 | 1.991 | 1.961 | 1.975 | 1.985 | 1.991 | 1.983 | 1.991 | 1.996 | 1.997 | 1.998 | 1.999 | 1.999 | 1.999 | 1.999 | 1.999 | 1.999 | 1.999 |
| 8                                                                       | 1.960 | 1.978 | 1.988 | 1.993 | 1.963 | 1.977 | 1.987 | 1.993 | 1.985 | 1.993 | 1.998 | 1.999 | 1.999 | 1.999 | 1.999 | 1.999 | 1.999 | 1.999 | 1.999 | 1.999 |
| 9                                                                       | 1.963 | 1.978 | 1.987 | 1.994 | 1.965 | 1.979 | 1.989 | 1.994 | 1.987 | 1.995 | 1.999 | 1.999 | 1.999 | 1.999 | 1.999 | 1.999 | 1.999 | 1.999 | 1.999 | 1.999 |
| 10                                                                      | 1.965 | 1.980 | 1.989 | 1.995 | 1.967 | 1.981 | 1.990 | 1.995 | 1.989 | 1.997 | 1.999 | 1.999 | 1.999 | 1.999 | 1.999 | 1.999 | 1.999 | 1.999 | 1.999 | 1.999 |
| For 0 Per Cent Effective Floor Cavity Reflectance (20 Per Cent = 1.00)  |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| Room Cavity Ratio                                                       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 1                                                                       | 1.859 | 1.870 | 1.879 | 1.886 | 1.873 | 1.884 | 1.893 | 1.901 | 1.896 | 1.902 | 1.908 | 1.913 | 1.916 | 1.920 | 1.923 | 1.928 | 1.933 | 1.937 | 1.941 | 1.944 |
| 2                                                                       | 1.871 | 1.887 | 1.903 | 1.919 | 1.896 | 1.902 | 1.916 | 1.928 | 1.925 | 1.933 | 1.938 | 1.943 | 1.947 | 1.950 | 1.954 | 1.958 | 1.963 | 1.967 | 1.971 | 1.974 |
| 3                                                                       | 1.882 | 1.904 | 1.915 | 1.942 | 1.896 | 1.918 | 1.934 | 1.947 | 1.945 | 1.956 | 1.961 | 1.966 | 1.970 | 1.973 | 1.976 | 1.980 | 1.985 | 1.989 | 1.993 | 1.996 |
| 4                                                                       | 1.893 | 1.919 | 1.941 | 1.958 | 1.908 | 1.930 | 1.948 | 1.961 | 1.959 | 1.970 | 1.975 | 1.980 | 1.983 | 1.986 | 1.989 | 1.992 | 1.995 | 1.998 | 2.001 | 2.004 |
| 5                                                                       | 1.903 | 1.931 | 1.953 | 1.969 | 1.914 | 1.938 | 1.958 | 1.970 | 1.969 | 1.979 | 1.984 | 1.989 | 1.992 | 1.995 | 1.998 | 2.001 | 2.004 | 2.007 | 2.010 | 2.013 |
| 6                                                                       | 1.911 | 1.940 | 1.961 | 1.976 | 1.920 | 1.945 | 1.965 | 1.977 | 1.976 | 1.986 | 1.991 | 1.995 | 1.998 | 2.001 | 2.004 | 2.007 | 2.010 | 2.013 | 2.016 | 2.019 |
| 7                                                                       | 1.917 | 1.947 | 1.967 | 1.981 | 1.924 | 1.950 | 1.970 | 1.982 | 1.981 | 1.991 | 1.996 | 1.999 | 2.002 | 2.005 | 2.008 | 2.011 | 2.014 | 2.017 | 2.020 | 2.023 |
| 8                                                                       | 1.922 | 1.953 | 1.973 | 1.988 | 1.929 | 1.955 | 1.975 | 1.988 | 1.987 | 1.997 | 2.002 | 2.005 | 2.008 | 2.011 | 2.014 | 2.017 | 2.020 | 2.023 | 2.026 | 2.029 |
| 9                                                                       | 1.928 | 1.958 | 1.978 | 1.993 | 1.933 | 1.959 | 1.979 | 1.992 | 1.991 | 2.001 | 2.006 | 2.009 | 2.012 | 2.015 | 2.018 | 2.021 | 2.024 | 2.027 | 2.030 | 2.033 |
| 10                                                                      | 1.933 | 1.962 | 1.982 | 1.997 | 1.937 | 1.963 | 1.983 | 1.996 | 1.995 | 2.005 | 2.010 | 2.013 | 2.016 | 2.019 | 2.022 | 2.025 | 2.028 | 2.031 | 2.034 | 2.037 |

**B.E. ELECTRICAL ENGINEERING 4<sup>TH</sup> YEAR 1<sup>ST</sup> SEMESTER EXAM 2024**  
**SUBJECT: ILLUMINATION SCIENCE AND LIGHTING DESIGN**

Time: 3 hours

Use Separate Answer script for each part

Full Marks:100

**Part-II****ANSWER ANY THREE QUESTIONS****Q. NO. (5) carries 18 marks**

Q.1. (A) Define visual acuity and contrast sensitivity. Illustrate, with suitable diagrams, how these two parameters depend on background luminance and explain how 'region of seeing' and 'region of non-seeing' are identified in the diagrams. (CO 1)

(B) Discuss the color matching experiment to determine red, green and blue component of a test color and hence the genesis of R-G-B chromaticity model by a suitable diagram. (CO 2)

(C) Develop a computational procedure to obtain chromaticity of a test object illuminated by a CIE standard illuminant. (CO 2 & CO 4)

5+6+5=16

Q.2. (A) What are the major functions of a luminaire? Compare between IP55 and IP65 for an outdoor luminaire. (CO 1 & CO 4)

(B) Draw typical light distribution plots for a roadlight luminaire and hence recognize the 'throw' and 'spread' angle from the corresponding plot. (CO 3 & CO 5)

(C) Explain the light distribution pattern of the following indoor luminaire types-  
 i) semi-direct and ii) diffue. (CO 3 & CO 5)

4+6+4=16

Q.3. (A) Discuss additive color theory and subtractive color theory with suitable diagram. (CO 2)

(B) What do you understand by SDCM (standard deviation of color matching)? Illustrate SDCM with respect to a test chromaticity. How SDCM is estimated for white LED source? (CO 2)

6+10=16

Q.4. (A) Compare the spectral power distribution of a warm white LED and a cool white LED lamp and hence mention their selection criteria to design an indoor lighting system. (CO 5)

(B) Compare between CCT(correlated color temperature) and CRI(color rendering index) of a warm white LED lamp and a cool white LED lamp. (CO 5)

(C) Explain the procedure of determination of CCT from chromaticity of a test lamp using McCamy model. (CO 3)

6+4+6=16

Q.5. (A) Develop the mathematical expression of Grassman's colour mixing law. (CO 4)

(B) Apply the Grassman's colour mixing law to compute the chromaticity of the resultant radiation using the following tabulated data. (CO 2)

| Parameter      | MH (250W) | HPSV (250W) |
|----------------|-----------|-------------|
| CCT(K)         | 4500      | 2100        |
| x              | 0.362     | 0.512       |
| y              | 0.371     | 0.420       |
| Lumen per watt | 90        | 110         |
| Quantity       | 2         | 5           |

8+10=18