EX/EE/ T /414F/2019

B.E. ELECTRICAL ENGG. 4th YEAR, 1st SEMESTER EXAM 2019

ADVANCED ILLUMINATION ENGG.

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)Explain the method of selection of the illuminance value of a particular place from the ranges of values given in IS 3646.Explain with necessary Tables and one practical example. 4

(b) A room of 34′ length and 20′ width is illuminated with suspended direct type retrofit LED luminaires. The reflectances of ceiling surface is 80% , wall surface of the ceiling cavity is 70%, wall surface below the luminaires is 50%,wall from floor to working plane is 30% and floor reflectance is 10%. If the distance of the lamp to ceiling is 1ft. 10 inches, the distance of the lamp to working plane is 7ft. 6 inches,and the distance between the working plane and floor is 2ft. 6 inches,

i) Find out the 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.

iii)How many luminaires are required to illuminate the room with average 150 lux?(Use 20W LED with 100 lm/W efficacy.)

iv)Show their spacing arrangement.

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

(Usethegivencharts) 14

Answer any Two from rest

2.Write short notes on (any four) 4×4=16

(a)Buffer gases and their uses,

(b) Ceramic materials used in lamp making,

(c) Penning mixture with example,

(d)Glass Metal Seal with example,

(e)Names of different Glasses and their specialities and applications.

[Turn over

3.(a) Find out the effective cavity reflectance of a triangular shaped ceiling.Assume the dimensions and reflectances as you wish.

(b) What is meant by ''Coefficient of Utilisation'' of a luminaire? Describe it.

(c)Discuss the necessity of Non-planar Illuminance in Lighting Design. Compare Spherical and Cylindrical Illuminance with suitable diagrams and explain them .

(d) Discuss the production of radiation in Low and High Pressure Sodium Vapour lamp with necessary Spectral Power Distribution Diagrams. 4+4+4+4=16

4.(a)Describe the process of Filament making.

(b)When multiple coloured walls are being used, how would you calculate the weighted average reflectance?

(c)What is the significance of Room Position Multiplier? Justify the importance of Wall Exitance and Ceiling Cavity Exitance coefficients in lighting design calculation.

(d) In a room with Coffered ceiling, each coffer cavity of 2′x2′x1′ dimension is separated by 1foot band. All ceiling surfaces have reflectances of 80%.Using the given Tables, find out weightedaverageceilingreflectance.

(e)ExplainResonance radiation of Hg with diagram. 3+2+4+4+3=16

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

(b)A 36W fluorescent lamp and a magnetic choke are connected in series across a 230 V r.m.s, 50 Hz supply.

i) Draw its circuit diagram with glow starter and one power factor improving capacitor.

ii) Explain its operation.

iii) Find out the inductance of the ballast when the following r.m.s. measurements were obtained :Vlamp = 104 V, I = 413 mA, Plamp = 36 W, Pballast = 10 W.

iv) Draw necessary vector diagrams.

v)What value of capacitor will be used to obtain unity power factor? 12

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

Per Cent Base† Reflectance	90										80										70										60										50									
Per Cent Wall Reflectance	90	80	70	60	50	40	30	20	10	0	90	80	70	60	50	40	30	20	10	0	90	80	70	60	50	40	30	20	10	0	90	80	70	60	50	40	30	20	10	0	90	80	70	60	50	40	30	20	10	0
Cavity Ratio																																																		
0.2	89	88	88	87	86	85	85	84	84	82	79	78	78	77	77	76	76	75	74	72	70	69	68	68	67	67	66	66	65	64	60	59	59	59	58	57	56	56	55	53	50	50	49	49	48	48	47	46	46	44
0.4	88	87	86	85	84	83	81	80	79	76	79	77	76	75	74	73	72	71	70	68	69	68	67	66	65	64	63	62	61	58	60	59	59	58	57	55	54	53	52	50	50	49	48	48	47	46	45	45	44	42
0.6	87	86	84	82	80	79	77	76	74	73	78	76	75	73	71	70	68	66	65	63	69	67	65	64	63	61	59	58	57	54	60	58	57	56	55	53	51	51	50	46	50	48	47	46	45	44	43	42	41	38
0.8	87	85	82	80	77	75	73	71	69	67	78	75	73	71	69	67	65	63	61	57	68	66	64	62	60	58	56	55	53	50	59	57	56	55	54	51	48	47	46	43	50	48	47	45	44	42	40	39	38	36
1.0	86	83	80	77	75	72	69	66	64	62	77	74	72	69	67	65	62	60	57	55	68	65	62	60	58	56	53	52	50	47	59	57	55	53	51	48	45	44	43	41	50	48	46	44	43	41	38	37	36	34
1.2	85	82	78	75	72	69	66	63	60	57	78	73	70	67	64	61	58	55	53	51	67	64	61	59	57	54	50	48	46	44	59	56	54	51	49	46	44	42	40	38	50	47	45	43	41	39	36	35	34	29
1.4	85	80	77	73	69	65	62	59	57	52	78	72	68	65	62	59	55	53	50	48	67	63	60	58	55	51	47	45	43	41	59	56	53	49	47	44	41	39	38	36	50	47	45	42	40	38	35	34	32	27
1.6	84	79	75	71	67	63	59	56	53	50	75	71	67	63	60	57	53	50	47	44	67	62	59	56	53	47	45	43	41	38	59	55	52	48	45	42	39	37	35	33	50	47	44	41	39	36	33	32	30	26
1.8	83	78	73	69	64	60	56	53	50	48	75	70	66	62	58	54	50	47	44	41	66	61	58	54	51	46	42	40	38	35	58	55	51	47	44	40	37	35	33	31	50	46	43	40	38	35	31	30	28	25
2.0	83	77	72	67	62	58	53	50	47	43	74	69	64	60	56	52	48	45	41	38	66	60	56	52	49	45	40	38	36	33	58	54	50	46	43	39	35	33	31	29	50	46	43	40	37	34	30	28	26	24
2.2	82	76	70	65	59	54	50	47	44	40	74	68	63	58	54	49	45	42	38	35	66	60	55	51	48	43	38	35	34	32	58	53	49	45	42	37	34	31	29	28	50	46	42	38	36	33	29	27	24	22
2.4	82	75	69	64	58	53	48	45	41	37	73	67	61	56	52	47	43	40	36	33	65	60	54	50	46	41	37	35	32	30	58	53	48	44	41	36	32	30	27	26	50	46	42	37	35	31	27	25	23	21
2.6	81	74	67	62	56	51	46	42	38	35	73	66	60	55	50	45	41	38	34	31	65	59	54	49	45	40	35	33	30	28	58	53	48	43	39	35	31	28	26	24	50	46	41	37	34	30	26	23	21	20
2.8	81	73	66	60	54	49	44	40	36	34	73	65	59	53	48	43	39	36	32	29	65	59	53	48	43	38	33	30	28	26	58	53	47	43	38	34	29	27	24	22	50	46	41	36	33	29	25	22	20	19
3.0	80	72	64	58	52	47	42	38	34	30	72	65	58	52	47	42	37	34	30	27	64	58	52	47	42	37	32	29	27	24	57	52	46	42	37	32	28	25	23	20	50	45	40	36	32	28	24	21	19	17
3.2	79	71	63	56	50	45	40	36	32	28	72	65	57	51	45	40	36	33	28	25	64	58	51	46	40	36	31	28	25	23	57	51	45	41	36	31	27	23	22	18	50	44	39	35	31	27	23	20	18	16
3.4	79	70	62	54	48	43	38	34	30	27	71	64	56	49	44	39	34	32	27	24	64	57	50	45	39	35	29	27	24	22	57	51	45	40	35	30	26	23	20	17	50	44	39	35	30	26	22	19	17	15
3.6	78	69	61	53	47	42	36	32	28	25	71	63	54	48	43	38	32	30	25	23	63	56	49	44	38	33	28	25	22	20	57	50	44	39	34	29	25	22	19	16	50	44	39	34	29	25	21	18	16	14
3.8	78	69	60	51	45	40	35	31	27	23	70	62	53	47	41	36	31	28	24	22	63	56	49	43	37	32	27	24	21	19	57	50	43	38	33	29	24	21	19	15	50	44	38	34	29	25	21	17	15	13
4.0	77	69	58	51	44	39	33	29	25	22	70	61	53	46	40	35	30	28	22	20	63	55	48	42	36	31	26	23	20	17	57	49	42	37	32	28	23	20	18	14	50	44	38	33	28	24	20	17	15	12
4.2	77	62	57	50	43	37	32	28	24	21	69	60	52	45	39	34	29	25	21	18	62	55	47	41	35	30	25	22	19	16	56	49	42	37	32	27	22	19	17	14	50	43	37	32	28	24	20	17	14	12
4.4	76	61	56	49	42	36	31	27	23	20	69	60	51	44	38	33	28	24	20	17	62	54	48	40	34	29	24	21	18	15	56	49	42	36	31	27	22	19	16	13	50	43	37	32	27	23	19	16	13	11
4.6	76	60	55	47	40	35	30	26	22	19	69	59	50	43	37	32	27	23	19	15	62	53	45	39	33	28	24	21	17	14	56	49	41	35	30	26	21	18	16	13	50	43	36	31	26	22	18	15	13	10
4.8	75	59	54	46	39	34	28	25	21	18	68	58	49	42	36	31	26	22	18	14	62	53	45	38	32	27	23	20	16	13	56	48	41	34	29	25	21	18	15	12	50	43	36	31	26	22	18	15	12	09
5.0	75	59	53	45	38	33	28	24	20	18	68	58	48	41	35	30	25	21	18	14	61	52	44	36	31	26	22	19	16	12	56	48	40	34	28	24	20	17	14	11	50	42	35	30	25	21	17	14	12	09
6.0	73	61	49	41	34	29	24	20	18	11	68	55	44	36	31	27	22	19	15	10	60	51	41	35	28	24	19	16	13	09	55	45	37	31	25	21	17	14	11	07	50	42	34	29	23	19	15	13	10	06
7.0	70	58	45	38	30	27	21	18	14	08	64	53	41	35	29	24	19	16	12	07	58	48	38	32	26	22	17	14	11	06	54	43	35	30	24	20	15	12	09	05	49	41	32	27	21	18	14	11	08	05
8.0	68	55	42	35	27	23	18	15	12	06	62	50	38	32	25	21	17	14	11	05	57	46	35	29	23	19	15	13	10	05	53	42	33	28	22	18	14	11	08	04	49	40	30	25	19	16	12	10	07	03
9.0	66	52	38	31	25	21	16	14	11	05	61	49	36	30	23	19	15	13	10	04	56	45	33	27	21	18	14	12	09	04	52	40	31	26	20	16	12	10	07	03	48	39	29	24	18	15	11	09	07	03
10.0	65	51	36	29	22	19	15	11	09	04	59	48	33	27	21	18	14	11	08	03	55	43	31	25	19	16	12	10	08	03	51	39	29	24	18	15	11	08	07	02	47	37	27	22	17	14	10	08	06	02

* Values in this table are based on a length to width ratio of 1.8.

† Ceiling, floor or floor of cavity.

Table I - Continued*

Per Cent Beset† Reflectance	40										30										20										10										0									
Per Cent Wall Reflectance	90	80	70	60	50	40	30	20	10	0	90	80	70	60	50	40	30	20	10	0	90	80	70	60	50	40	30	20	10	0	90	80	70	60	50	40	30	20	10	0	90	80	70	60	50	40	30	20	10	0
Cavity Ratio																																																	
0.2	40	40	39	39	39	38	38	37	36	36	31	31	30	30	29	29	29	28	28	27	21	20	20	20	20	20	19	19	19	17	11	11	11	10	10	10	10	09	09	09	02	02	02	01	01	01	00	00	00	0
0.4	41	40	39	38	38	37	36	35	34	34	31	31	30	30	29	28	28	27	26	26	22	21	20	20	20	19	19	18	18	16	12	11	11	11	11	10	10	09	09	08	04	03	03	02	02	02	01	01	00	0
0.6	41	40	39	38	37	36	34	33	32	31	32	31	30	29	28	27	26	26	25	23	23	21	21	20	19	19	18	18	17	15	13	13	12	11	11	10	10	09	09	08	05	05	04	03	03	02	02	01	01	0
0.8	41	40	38	37	36	35	33	32	31	29	32	31	30	29	28	28	25	25	23	22	24	22	21	20	19	19	18	17	16	14	15	14	13	12	11	10	10	09	08	07	07	06	05	04	04	03	02	02	01	0
1.0	42	40	38	37	35	33	32	31	28	27	33	32	30	28	27	25	24	23	22	20	25	23	22	20	19	18	17	16	15	13	16	14	13	12	12	11	10	09	08	07	08	07	06	05	04	03	02	02	01	0
1.2	42	40	38	36	34	32	30	28	27	25	33	32	30	28	27	25	23	22	21	19	26	23	22	20	19	17	17	16	14	12	17	16	14	13	12	11	10	09	07	06	10	08	07	06	05	04	03	02	01	0
1.4	42	39	37	35	33	31	29	27	25	23	34	32	30	28	26	24	22	21	19	18	26	24	22	20	18	17	16	15	13	12	18	16	14	13	12	11	10	09	07	06	11	09	08	07	06	05	03	02	01	0
1.6	42	39	37	35	32	30	27	25	23	22	34	33	29	27	25	23	22	20	18	17	26	24	22	20	18	17	16	15	13	11	19	17	15	14	12	11	09	08	07	06	12	10	09	07	06	05	03	02	01	0
1.8	42	39	36	34	31	29	26	24	22	21	35	33	29	27	25	23	21	19	17	16	27	25	23	20	18	17	15	14	12	10	19	17	15	14	13	11	09	08	06	05	13	11	09	08	07	05	04	03	01	0
2.0	42	39	36	34	31	28	25	23	21	19	35	33	29	26	24	22	20	18	16	14	26	25	23	20	18	16	15	13	11	09	20	18	16	14	13	11	09	08	06	05	14	12	10	09	07	05	04	03	01	0
2.2	42	39	36	33	30	27	24	22	19	18	36	32	28	26	24	22	19	17	15	13	26	25	23	20	18	16	14	12	10	08	21	19	16	14	13	11	09	07	06	05	15	13	11	09	07	05	04	03	01	0
2.4	43	39	35	33	29	27	24	21	18	17	36	32	29	26	24	22	19	16	14	12	26	26	23	20	18	16	14	12	10	08	22	19	17	15	13	11	09	07	06	05	16	13	11	09	08	06	04	03	01	0
2.6	43	38	35	32	29	26	23	20	17	15	36	32	29	25	23	21	18	16	14	12	29	26	23	20	18	16	14	11	09	08	23	20	17	15	13	11	09	07	06	04	17	14	12	10	08	06	05	03	02	0
2.8	43	39	35	32	28	25	22	19	16	14	37	33	28	25	23	21	17	15	13	11	30	27	23	20	18	16	13	11	09	07	23	20	18	16	13	11	09	07	05	03	17	15	13	10	08	07	05	03	02	0
3.0	43	39	35	31	27	24	21	18	16	13	37	33	29	25	22	20	17	15	12	10	30	27	23	20	17	15	13	11	09	07	24	21	18	16	13	11	09	07	05	03	18	16	13	11	09	07	05	03	02	0
3.2	43	39	35	31	27	23	20	17	15	13	37	33	29	25	22	19	16	14	12	10	31	27	23	20	17	15	12	11	09	08	25	21	18	16	13	11	09	07	05	03	19	16	14	11	09	07	05	03	02	0
3.4	43	39	34	30	26	23	20	17	14	12	37	33	29	25	22	19	16	14	11	09	31	27	23	20	17	15	12	10	08	06	26	22	18	16	13	11	09	07	05	03	20	17	14	12	09	07	05	03	02	0
3.6	44	39	34	30	26	22	19	16	14	11	38	33	29	24	21	18	15	13	10	09	32	27	23	20	17	15	12	10	08	05	26	22	19	16	13	11	09	06	04	03	20	17	15	12	10	08	05	04	02	0
3.8	44	38	33	29	25	22	18	16	13	10	38	33	28	24	21	18	15	13	10	08	32	28	23	20	17	15	12	10	07	05	27	23	19	17	14	11	09	06	04	02	21	18	15	12	10	08	05	04	02	0
4.0	44	38	33	29	25	21	18	15	12	10	38	33	28	24	21	18	14	12	09	07	33	28	23	20	17	14	11	09	07	05	27	23	20	17	14	11	09	06	04	02	22	18	15	13	10	08	05	04	02	0
4.2	44	38	33	29	24	21	17	15	12	10	38	33	28	24	20	17	14	12	09	07	33	28	23	20	17	14	11	09	07	04	28	24	20	17	14	11	09	06	04	02	22	19	16	13	10	08	06	04	02	0
4.4	44	38	33	28	24	20	17	14	11	09	38	33	28	24	20	17	14	11	08	06	34	28	24	20	17	14	11	09	07	04	28	24	20	17	14	11	08	06	04	02	23	19	16	13	10	08	06	04	02	0
4.6	44	38	32	28	23	19	16	14	11	08	38	33	28	24	20	17	13	10	08	05	34	29	24	20	17	14	11	09	07	04	29	25	20	17	14	11	08	06	04	02	23	20	17	13	11	08	06	04	02	0
4.8	44	38	32	27	22	19	16	13	10	08	38	33	28	24	20	17	13	10	08	05	35	29	24	20	17	13	10	08	06	04	29	25	20	17	14	11	08	06	04	02	24	20	17	14	11	08	06	04	02	0
5.0	45	38	31	27	22	19	15	13	10	07	38	33	28	24	19	16	13	10	08	05	35	29	24	20	16	13	10	08	06	04	30	25	20	17	14	11	08	06	04	02	25	21	17	14	11	08	06	04	02	0
6.0	44	37	30	25	20	17	13	11	08	05	38	33	27	23	18	15	11	09	06	04	36	30	24	20	16	13	10	08	05	02	31	26	21	18	14	11	08	06	03	01	27	23	18	15	12	09	06	04	02	0
7.0	44	36	29	24	19	16	12	10	07	04	40	33	26	22	17	14	10	08	05	03	35	30	24	20	15	12	09	07	04	02	32	27	21	17	13	11	08	06	03	01	28	24	19	15	12	09	06	04	02	0
8.0	44	35	28	23	18	15	11	09	06	03	40	33	26	21	16	13	09	07	04	02	37	30	23	19	15	12	08	06	03	01	33	27	21	17	13	10	07	05	03	01	30	25	20	15	12	09	06	04	02	0
9.0	44	35	26	21	16	13	10	08	05	02	40	33	25	20	15	12	09	07	04	02	37	28	23	19	14	11	08	06	03	01	34	28	21	17	13	10	07	05	02	01	31	25	20	16	12	09	06	04	02	0
10.0	43	34	25	20	15	12	08	07	05	02	40	32	24	18	14	11	08	06	03	01	37	26	22	18	13	10	07	05	03	01	34	26	21	17	12	10	07	05	02	01	31	25	20	15	12	08	06	04	02	0

* Values in this table are based on a length to width ratio of 1.6.

† Ceiling, floor or floor of cavity.

TABLE II
Coefficients of Utilization

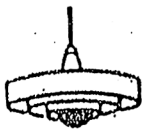
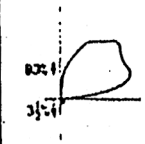
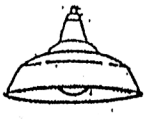
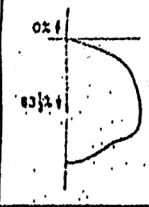
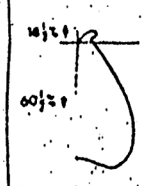
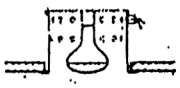
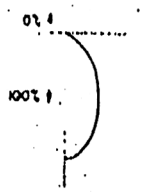
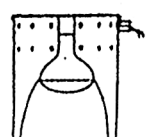
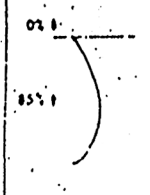
Typical Luminaire	Typical Intensity Distribution and Per Cent Lamp Lumens	ρ_{cc} →	80			70			50			30			10			0	WDRC	ρ_{cc} →
		ρ_w →	50	30	10	50	30	10	50	30	10	50	30	10	50	30	10	0		ρ_w →
	Maint. Cat. / SC	RCR ↓	Coefficients of Utilization for 20 Per Cent Effective Floor Cavity Reflectance (ρ_{fc} = 20)																	RCR ↓
1  Pendant diffusing sphere with incandescent lamp	V 1.5 	0	.87	.87	.87	.81	.81	.81	.70	.70	.70	.59	.59	.59	.49	.49	.49	.45		
		1	.71	.66	.62	.65	.61	.58	.55	.52	.49	.46	.44	.42	.38	.36	.34	.30	.388	1
		2	.60	.53	.48	.55	.50	.45	.47	.42	.38	.39	.36	.32	.31	.29	.26	.23	.279	2
		3	.52	.44	.38	.48	.41	.36	.40	.35	.31	.33	.29	.26	.27	.24	.21	.18	.227	3
		4	.45	.37	.32	.42	.35	.29	.35	.30	.25	.29	.25	.21	.23	.20	.17	.14	.192	4
		5	.40	.32	.27	.37	.30	.25	.31	.25	.21	.26	.21	.18	.21	.17	.14	.12	.166	5
		6	.35	.28	.23	.33	.26	.21	.28	.22	.18	.23	.19	.15	.19	.15	.12	.10	.146	6
		7	.32	.25	.19	.29	.23	.18	.25	.20	.16	.21	.18	.13	.17	.13	.11	.09	.130	7
		8	.29	.22	.17	.27	.20	.16	.23	.17	.14	.19	.15	.12	.15	.12	.09	.07	.117	8
		9	.26	.19	.15	.24	.18	.14	.21	.16	.12	.17	.13	.10	.14	.11	.08	.07	.107	9
		10	.24	.17	.13	.22	.16	.12	.19	.14	.11	.16	.12	.09	.13	.10	.08	.06	.098	10
2  Concentric ring unit with incandescent silvered-bowl lamp	II N.A. 	0	.83	.83	.83	.72	.72	.72	.50	.50	.50	.30	.30	.30	.12	.12	.12	.03		
		1	.72	.69	.66	.62	.60	.57	.43	.42	.40	.26	.25	.25	.10	.10	.10	.03	.018	1
		2	.63	.58	.54	.54	.50	.47	.38	.35	.33	.23	.22	.20	.09	.09	.08	.02	.015	2
		3	.55	.49	.45	.47	.43	.39	.33	.30	.28	.20	.19	.17	.08	.07	.07	.02	.013	3
		4	.48	.42	.37	.42	.37	.33	.29	.26	.23	.18	.16	.15	.07	.06	.06	.02	.012	4
		5	.43	.36	.32	.37	.32	.28	.26	.23	.20	.16	.14	.12	.06	.06	.05	.01	.011	5
		6	.38	.32	.27	.33	.28	.24	.23	.20	.17	.14	.12	.11	.06	.05	.04	.01	.010	6
		7	.34	.28	.23	.30	.24	.21	.21	.17	.15	.13	.11	.09	.05	.04	.04	.01	.009	7
		8	.31	.25	.20	.27	.21	.18	.19	.15	.13	.12	.10	.08	.05	.04	.03	.01	.008	8
		9	.28	.22	.18	.24	.19	.16	.17	.14	.11	.10	.09	.07	.04	.03	.03	.01	.006	9
		10	.25	.20	.16	.22	.17	.14	.16	.12	.10	.10	.08	.06	.04	.03	.03	.01	.007	10
3  Porcelain-enameled ventilated standard dome with incandescent lamp	IV 1.3 	0	.99	.99	.99	.97	.97	.97	.93	.93	.93	.89	.89	.89	.85	.85	.85	.83		
		1	.87	.84	.81	.85	.82	.79	.82	.79	.77	.79	.76	.74	.76	.74	.72	.71	.323	1
		2	.76	.70	.65	.74	.69	.65	.71	.67	.63	.69	.65	.62	.66	.63	.60	.59	.311	2
		3	.66	.59	.54	.65	.59	.53	.62	.57	.53	.60	.56	.52	.58	.54	.51	.49	.288	3
		4	.58	.51	.45	.57	.50	.45	.55	.49	.44	.53	.48	.44	.51	.47	.43	.41	.264	4
		5	.52	.44	.39	.51	.44	.38	.49	.43	.39	.47	.42	.37	.46	.41	.37	.35	.241	5
		6	.46	.39	.33	.46	.38	.33	.44	.38	.33	.42	.37	.32	.41	.36	.32	.31	.221	6
		7	.42	.34	.29	.41	.34	.29	.40	.33	.29	.39	.33	.29	.38	.32	.28	.27	.203	7
		8	.38	.31	.26	.37	.31	.26	.36	.30	.26	.35	.30	.26	.34	.29	.25	.24	.187	8
		9	.35	.28	.23	.34	.28	.23	.33	.27	.23	.32	.27	.23	.32	.28	.23	.21	.173	9
		10	.32	.25	.21	.32	.25	.21	.31	.25	.21	.30	.24	.21	.29	.24	.20	.19	.161	10
4  Prismatic square surface drum	V 1.3 	0	.89	.89	.89	.85	.85	.85	.77	.77	.77	.70	.70	.70	.63	.63	.63	.60		
		1	.77	.74	.71	.74	.71	.68	.67	.65	.63	.61	.59	.57	.55	.54	.53	.50	.264	1
		2	.68	.63	.59	.65	.61	.57	.59	.56	.53	.54	.51	.49	.49	.47	.45	.42	.224	2
		3	.61	.55	.50	.58	.53	.48	.53	.49	.45	.49	.45	.42	.44	.42	.39	.37	.197	3
		4	.54	.48	.43	.52	.46	.42	.48	.43	.39	.44	.40	.37	.40	.37	.34	.32	.176	4
		5	.49	.42	.38	.47	.41	.37	.43	.38	.35	.40	.36	.33	.37	.33	.31	.29	.159	5
		6	.44	.38	.33	.43	.37	.32	.39	.34	.31	.36	.32	.29	.34	.30	.27	.26	.145	6
		7	.40	.34	.30	.39	.33	.29	.36	.31	.27	.33	.29	.26	.31	.27	.25	.23	.133	7
		8	.37	.31	.27	.36	.30	.26	.33	.28	.25	.31	.27	.24	.29	.25	.22	.21	.124	8
		9	.34	.28	.24	.33	.27	.24	.31	.26	.22	.29	.24	.21	.27	.23	.20	.19	.115	9
		10	.32	.26	.22	.30	.25	.21	.28	.24	.21	.27	.23	.20	.25	.21	.19	.17	.108	10
5  R-40 flood without shielding	IV 0.8 	0	1.19	1.19	1.19	1.16	1.16	1.16	1.11	1.11	1.11	1.06	1.06	1.06	1.02	1.02	1.02	1.00		
		1	1.06	1.05	1.03	1.06	1.03	1.01	1.02	1.00	.98	.98	.97	.95	.95	.93	.92	.90	.241	1
		2	.99	.94	.89	.97	.92	.86	.93	.90	.86	.90	.87	.84	.88	.85	.83	.81	.238	2
		3	.90	.84	.79	.88	.83	.78	.86	.81	.77	.83	.79	.76	.81	.77	.74	.73	.227	3
		4	.82	.75	.70	.81	.75	.70	.79	.73	.69	.77	.72	.68	.75	.71	.67	.66	.215	4
		5	.78	.68	.63	.75	.68	.63	.73	.67	.62	.71	.66	.62	.69	.65	.61	.59	.202	5
		6	.70	.62	.57	.69	.62	.57	.67	.61	.57	.66	.60	.56	.64	.60	.56	.54	.191	6
		7	.65	.57	.52	.64	.57	.52	.62	.56	.52	.61	.56	.52	.60	.55	.51	.50	.180	7
		8	.60	.53	.48	.59	.53	.48	.58	.52	.48	.57	.52	.47	.56	.51	.47	.46	.169	8
		9	.56	.49	.44	.55	.49	.44	.54	.48	.44	.53	.48	.44	.52	.47	.44	.42	.160	9
		10	.52	.46	.41	.52	.45	.41	.51	.45	.41	.50	.45	.41	.49	.44	.41	.39	.152	10
6  R-40 flood with specular anodized reflector, short, 45° cutoff	IV 0.7 	0	1.01	1.01	1.01	.99	.99	.99	.94	.94	.94	.90	.90	.90	.87	.87	.87	.85		
		1	.86	.83	.81	.83	.81	.80	.89	.88	.87	.86	.85	.84	.83	.82	.82	.80	.115	1
		2	.80	.86	.83	.87	.84	.82	.85	.82	.80	.82	.80	.79	.80	.78	.77	.76	.115	2
		3	.83	.80	.77	.82	.79	.76	.80	.77	.75	.78	.76	.74	.76	.74	.72	.71	.113	3
		4	.79	.74	.71	.78	.74	.71	.76	.73	.70	.74	.71	.69	.73	.70	.68	.67	.110	4
		5	.74	.70	.67	.74	.69	.66	.72	.68	.66	.71	.68	.65	.69	.67	.65	.63	.107	5
		6	.70	.66	.62	.70	.65	.62	.68	.65	.62	.67	.64	.61	.66	.63	.61	.60	.104	6
		7	.67	.62	.59	.66	.62	.59	.65	.61	.58	.64	.61	.58	.63	.60	.58	.57	.100	7
		8	.63	.59	.56	.63	.58	.55	.62	.58	.55	.61	.58	.55	.60	.57	.55	.54	.097	8
		9	.60	.56	.53	.60	.56	.53	.59	.55	.52	.58	.55	.52	.58	.54	.52	.51	.094	9
		10	.57	.53	.50	.57	.53	.50	.56	.52	.50	.56	.52	.50	.55	.52	.49	.48	.091	10

Table II - continued

Coefficients, Luminaire Spacing Criterion and Maintenance Categories of Typical Luminaires.

Wall Exitance Coefficients for 20 Per Cent Effective Floor Cavity Reflectance (ρ_{fc} = 20)													Ceiling Cavity Exitance Coefficients for 20 Per Cent Floor Cavity Reflectance (ρ_{fc} = 20)												
80			70			50			30			10	80			70			50			30			10
50	30	10	50	30	10	50	30	10	50	30	10	50	50	30	10	50	30	10	50	30	10	50	30	10	50	30	10
.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	.422	.396	.373	.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	.417	.379	.347	.357	.327	.300	.245	.226	.209	.141	.131	.123	.045	.043	.040
.214	.111	.033	.201	.105	.031	.177	.094	.028	.155	.083	.025	.135	.073	.022	.412	.367	.332	.353	.317	.287	.242	.220	.202	.140	.128	.119	.045	.042	.039
.193	.098	.028	.181	.093	.027	.160	.083	.024	.139	.073	.022	.120	.064	.019	.406	.358	.321	.348	.309	.279	.239	.215	.196	.138	.126	.116	.045	.041	.038
.176	.088	.025	.165	.084	.024	.145	.074	.022	.126	.066	.019	.109	.057	.017	.400	.350	.314	.343	.303	.273	.236	.212	.193	.137	.124	.114	.044	.041	.038
.162	.080	.023	.152	.076	.022	.133	.067	.019	.116	.059	.017	.100	.052	.015	.394	.344	.309	.338	.298	.269	.234	.209	.190	.135	.123	.113	.044	.040	.037
.150	.073	.021	.140	.069	.020	.123	.062	.018	.107	.054	.016	.092	.047	.014	.388	.339	.305	.334	.294	.266	.231	.206	.188	.134	.122	.112	.043	.040	.037
.139	.067	.019	.131	.064	.018	.115	.057	.016	.099	.050	.014	.085	.043	.013	.383	.335	.302	.330	.291	.264	.228	.204	.187	.133	.120	.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	.119	.110	.042	.039	.037
													.796	.796	.796	.680	.680	.680	.464	.464	.464	.267	.267	.267	.085	.085	.085
.226	.128	.041	.195	.111	.035	.137	.078	.025	.083	.048	.015	.034	.020	.006	.790	.772	.756	.676	.663	.651	.462	.456	.450	.266	.264	.262	.085	.085	.085
.207	.114	.035	.179	.099	.030	.126	.070	.022	.077	.043	.013	.031	.018	.006	.784	.755	.731	.671	.650	.632	.460	.450	.441	.265	.262	.258	.085	.085	.084
.191	.102	.030	.165	.088	.027	.116	.063	.019	.071	.039	.012	.029	.016	.005	.778	.743	.715	.667	.641	.620	.458	.445	.435	.265	.260	.256	.085	.084	.084
.177	.092	.027	.153	.080	.024	.106	.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	.726	.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	.016	.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	.709	.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	.136	.136	.136	.093	.093	.093	.053	.053	.053	.017	.017	.017
.248	.141	.045	.242	.138	.044	.231	.133	.042	.221	.128	.041	.212	.123	.040	.150	.130	.113	.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	.082	.123	.095	.071	.084	.066	.050	.048	.038	.029	.016	.012	.009
.225	.120	.036	.220	.118	.036	.212	.115	.035	.204	.112	.034	.196	.109	.034	.137	.095	.062	.118	.082	.054	.081	.057	.036	.047	.033	.022	.015	.011	.007
.209	.109	.032	.205	.107	.032	.197	.105	.031	.190	.102	.031	.184	.100	.030	.131	.084	.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	.028	.125	.076	.039	.108	.065	.034	.074	.046	.024	.043	.027	.014	.014	.009	.005
.181	.091	.026	.177	.090	.026	.171	.088	.026	.166	.086	.025	.160	.084	.025	.119	.069	.032	.103	.060	.028	.071	.042	.020	.041	.025	.012	.013	.008	.004
.168	.083	.024	.165	.082	.023	.160	.081	.023	.155	.079	.023	.150	.078	.023	.114	.063	.027	.098	.055	.024	.068	.038	.017	.039	.023	.010	.013	.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	.036	.019	.008	.012	.006	.003
.138	.066	.018	.136	.066	.018	.132	.065	.018	.129	.064	.018	.125	.063	.018	.099	.051	.018	.085	.044	.016	.059	.031	.011	.034	.018	.007	.011	.006	.002
													.290	.290	.290	.248	.248	.248	.169	.169	.169	.097	.097	.097	.031	.031	.031
.243	.138	.044	.232	.132	.042	.211	.121	.039	.192	.111	.036	.175	.101	.033	.283	.264	.247	.242	.227	.213	.166	.156	.147	.095	.090	.085	.031	.029	.028
.216	.118	.036	.206	.114	.035	.187	.104	.032	.170	.095	.030	.154	.087	.027	.276	.240	.221	.236	.212	.191	.162	.147	.133	.093	.085	.078	.030	.028	.025
.196	.104	.031	.187	.100	.030	.170	.092	.028	.154	.085	.026	.140	.077	.024	.269	.233	.204	.231	.201	.177	.158	.139	.124	.092	.081	.073	.029	.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	.069	.029	.026	.023
.166	.084	.024	.158	.081	.024	.144	.075	.022	.131	.069	.021	.119	.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	.149	.126	.109	.087	.074	.065	.028	.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	.055	.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
													.190	.190	.190	.163	.163	.163	.111	.111	.111	.064	.064	.064	.020	.020	.020
.220	.125	.040	.213	.122	.039	.200	.115	.037	.189	.109	.035	.178	.103	.033	.174	.157	.141	.149	.135	.122	.102	.093	.084	.059	.054	.049	.019	.017	.016
.212	.116	.036	.206	.114	.035	.195	.109	.034	.185	.104	.033	.176	.099	.031	.161	.132	.107	.138	.114	.093	.095	.079	.065	.055	.046	.038	.018	.015	.012
.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	.186	.098	.029	.178	.094	.028	.170	.091	.028	.163	.089	.027	.142	.100	.067	.122	.086	.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	.135	.088	.055	.116	.077	.047	.080	.053	.033	.046	.031	.020	.015	.010	.007
.171	.086	.024	.167	.084	.024	.161	.082	.024	.155	.080	.024	.149	.078	.023	.128	.080	.045	.110	.069	.039	.076	.048	.028	.044	.028	.017	.014	.009	.005
.162	.080	.023	.158	.079	.022	.153	.077	.022	.147	.075	.022	.142	.074	.022	.121	.072	.038	.104	.063	.033	.072	.044	.024	.042	.026	.014	.014	.008	.005
.153	.075	.021	.150	.074	.021	.145	.073	.021	.140	.071	.021	.136	.070	.020	.115	.066	.033	.099	.058	.029	.069	.040	.020	.040	.024	.012	.013	.008	.004
.145	.070	.020	.143	.070	.020	.138	.068	.019	.134	.067	.019	.130	.066	.019	.110	.061	.029	.095	.053	.025	.066	.037	.018	.038	.022	.011	.012	.007	.003
.138	.066	.018	.136	.066	.018	.132	.065	.018	.128	.064	.018	.124	.062	.018	.105	.057	.025	.091	.050	.022	.063	.035	.016	.037	.021	.009	.012	.007	.003
													.162	.162	.162	.138	.138	.138	.094	.094	.094	.054	.054	.054	.017	.017	.017
.139	.079	.025	.133	.076	.024	.123	.070	.022	.113	.065	.021	.104	.060	.019	.144	.133	.124	.123	.115	.106	.084	.079	.074	.049	.046	.043	.016	.015	.014
.132	.072	.022	.127	.070	.022	.119	.066	.020	.110	.062	.019	.103	.058	.018	.131	.112	.097	.112	.097	.084	.077	.067	.059	.044	.039	.034	.014	.013	.011
.126	.067	.020	.122	.065	.020	.114	.062	.019	.107	.059	.018	.101	.056	.017	.120	.096	.078	.102	.083	.067	.070	.058	.047	.041	.034	.028	.013	.011	.009
.119	.062	.018	.116	.061	.018	.110	.058	.017	.104	.056	.017	.098	.053	.016	.110	.084	.063	.095	.072	.055	.065	.050	.039	.038	.029	.023	.012	.010	.008
.114	.058	.017	.111	.057	.017	.105	.055	.016	.100	.053	.016	.095	.051	.015	.103	.074	.052	.088	.064	.045	.061	.044	.032	.035	.026	.019	.011	.009	.006
.109	.055	.016	.106	.054	.015	.101	.052	.015	.097	.050	.015	.093	.049	.014	.096	.066	.044	.083	.057	.038	.057	.040	.027	.033	.023	.016	.011	.008	.005
.104	.052	.015	.102	.051	.014	.098	.049	.014	.094	.048	.014	.090	.047	.014	.091	.059	.037	.078	.051	.032	.054	.036	.023	.031	.021	.014	.010	.007	.004
.100	.049	.014	.098	.048	.014	.094	.047	.013	.090	.046	.013	.087	.045	.013	.086	.054	.032	.074	.047	.028	.051	.033	.020	.030	.019	.012	.010	.006	.004
.096	.046	.013	.094	.046	.013	.091	.045	.013	.087	.044	.013	.084	.043	.012	.081	.049	.027	.070	.043	.024	.049	.030	.017	.028	.018	.010	.009	.006	.003
.092	.044	.012	.091	.044	.012	.088	.043	.012	.085	.042	.012	.082	.041	.012	.077	.045	.024	.067	.039	.021	.046	.028	.015	.027	.016	.009	.009	.005	.003

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

% Effective Ceiling Cavity Reflectance, ρ_{cc}	80				70				50			30			10		
% Wall Reflectance, ρ_w	70	50	30	10	70	50	30	10	50	30	10	50	30	10	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	1.059	1.049	1.044	1.040	1.028	1.026	1.023	1.012	1.010	1.008
2	1.079	1.066	1.055	1.047	1.068	1.057	1.048	1.039	1.041	1.033	1.027	1.028	1.021	1.017	1.013	1.010	1.006
3	1.070	1.054	1.042	1.033	1.061	1.048	1.037	1.028	1.034	1.027	1.020	1.024	1.017	1.012	1.014	1.009	1.005
4	1.062	1.045	1.033	1.024	1.055	1.040	1.029	1.021	1.030	1.022	1.015	1.022	1.015	1.010	1.014	1.009	1.004
5	1.056	1.038	1.026	1.018	1.050	1.034	1.024	1.015	1.027	1.018	1.012	1.020	1.013	1.008	1.014	1.009	1.004
6	1.052	1.033	1.021	1.014	1.047	1.030	1.020	1.012	1.024	1.015	1.009	1.019	1.012	1.008	1.014	1.008	1.003
7	1.047	1.029	1.018	1.011	1.043	1.026	1.017	1.009	1.022	1.013	1.007	1.018	1.010	1.005	1.014	1.008	1.003
8	1.044	1.026	1.015	1.009	1.040	1.024	1.015	1.007	1.020	1.012	1.006	1.017	1.009	1.004	1.013	1.007	1.003
9	1.040	1.024	1.014	1.007	1.037	1.022	1.014	1.006	1.019	1.011	1.005	1.016	1.009	1.004	1.013	1.007	1.002
10	1.037	1.022	1.012	1.006	1.034	1.020	1.012	1.005	1.017	1.010	1.004	1.015	1.009	1.003	1.013	1.007	1.002
For 10 Per Cent Effective Floor Cavity Reflectance (20 Per Cent = 1.00)																	
Room Cavity Ratio																	
1	.923	.929	.935	.940	.933	.939	.943	.948	.956	.960	.963	.973	.976	.979	.989	.991	.993
2	.931	.942	.950	.956	.940	.949	.957	.963	.962	.968	.974	.976	.980	.985	.988	.991	.995
3	.939	.951	.961	.969	.945	.957	.966	.973	.967	.975	.981	.978	.983	.988	.988	.992	.996
4	.944	.958	.969	.978	.950	.963	.973	.980	.972	.980	.986	.980	.986	.991	.987	.992	.996
5	.949	.964	.976	.983	.954	.968	.978	.985	.975	.983	.989	.981	.988	.993	.987	.992	.997
6	.953	.969	.980	.986	.958	.972	.982	.989	.977	.985	.992	.982	.989	.995	.987	.993	.997
7	.957	.973	.983	.991	.961	.975	.985	.991	.979	.987	.994	.983	.990	.996	.987	.993	.998
8	.960	.976	.986	.993	.963	.977	.987	.993	.981	.988	.995	.984	.991	.997	.987	.994	.998
9	.963	.978	.987	.994	.965	.979	.989	.994	.983	.990	.996	.985	.992	.998	.988	.994	.999
10	.965	.980	.989	.995	.967	.981	.990	.995	.984	.991	.997	.986	.993	.998	.988	.994	.999
For 0 Per Cent Effective Floor Cavity Reflectance (20 Per Cent = 1.00)																	
Room Cavity Ratio																	
1	.859	.870	.879	.886	.873	.884	.893	.901	.916	.923	.929	.948	.954	.960	.979	.983	.987
2	.871	.887	.903	.919	.886	.902	.916	.928	.926	.938	.949	.954	.963	.971	.978	.983	.991
3	.882	.904	.915	.942	.896	.918	.934	.947	.936	.950	.964	.958	.969	.979	.978	.984	.993
4	.883	.919	.941	.958	.908	.930	.948	.961	.945	.961	.974	.961	.974	.984	.975	.985	.994
5	.903	.931	.953	.969	.914	.938	.958	.970	.951	.967	.980	.964	.977	.988	.975	.985	.995
6	.911	.940	.961	.976	.920	.945	.965	.977	.955	.972	.985	.966	.979	.991	.975	.986	.996
7	.917	.947	.967	.981	.924	.950	.970	.982	.959	.975	.988	.968	.981	.993	.975	.987	.997
8	.922	.953	.971	.985	.929	.955	.975	.986	.963	.978	.991	.970	.983	.995	.976	.988	.998
9	.928	.958	.975	.988	.933	.959	.980	.989	.966	.980	.993	.971	.985	.996	.976	.988	.998
10	.933	.962	.979	.991	.937	.963	.983	.992	.969	.982	.995	.973	.987	.997	.977	.989	.999

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Ref.No. EE/T/415.6/2019

B.E.E. 4th Year; 1st Semester Examination 2019
Elective-I (Advanced Illumination Engineering)

Time: 3 hours Use Separate Answer script for each part Full Marks:100

Part-II
ANSWER Q. No. (1) AND ANY TWO QUESTIONS

Q.1. (A) Explain stimulated emission with suitable diagram. Why population inversion is one of the prerequisites for laser generation?
(B) Draw the energy level diagrams of 3-energy level and 4-energy level schemes of laser generation and compare between them in terms of pumping energy efficiency.
(C) How both of the physical processes, viz. electroluminescence and photoluminescence are exploited in white light generation from WLED?
(D) Derive the mathematical expression of radiative efficiency of injection luminescence related to LED emission.
(E) Draw ray diagram of a circular-parabolic reflector unit and an elliptical-parabolic reflector unit for a point source. Explain the ray diagrams.
(F) Draw a typical V-H intensity distribution plot for an asymmetric floodlight luminaire and hence show graphically the process of determination of the inner beam angles.
(G) What is the advantage of taking $\bar{y}_\lambda$ identical with V_λ in CIE 1931 chromaticity system?
(H) Why CIE standard illuminants are essential for the determination of colour rendering index of a test lamp?
(I) What is the difference between specific colour rendering index and general colour rendering index?

3+3+2+2+2+2+2+2+2=20

Q.2. Derive the relation among stimulated absorption. stimulated emission and spontaneous emission for a system of atoms under thermal equilibrium. Hence show that population inversion can't be achieved under thermal equilibrium condition for a two energy level system. 15

Q.3.(A) Explain radiative recombination and non-radiative recombination processes of injection luminescence.
(B) Define thermal resistance related to light emitting diode and mention its physical significance. Estimate the junction temperature of a typical LED from the following data:
(i) temperature (^{0}C): solder point = 90; ambient = 30;
(ii) thermal resistance: 9 ^{0}C/W;
(iii) forward voltage and current : 3.5V; 350mA;
(iv) emitted optical power: 354 mW.
(C) Discuss about the Gonio-spectroradiometric measurement of a test LED module.

4+4+7=15

Q.4.(A) Write down the binary search algorithm to determine CCT of a test lamp from its SPD data.
(B) Explain why CIE General CRI models fails in case of phosphor coated white LED lamps.
(C) Derive the expression of Grassman's colour mixing law. 7+3+5=15

Q.5. Write down short notes on any two from the followings 7.5 x 2 =15
(i) Photometric specification of roadlight luminaire;
(ii) Design procedure of non-conic reflector contour;
(iii) Procedure to generate Planckian locus on CIE 1931 Chromaticity diagram