

**NOTE**

- 1. Question No 1 is Compulsory**
- 2. Solve any Three Questions out of the remaining**
3. Assume suitable data if required and specify the same

**Q No 1.** Answer the following questions

- a. State the various steps followed in Tendering Procedure. [5]
- b. Discuss the selection and sizing of UPS. [5]
- c. State the various steps in the implementation of energy monitoring and targeting. [5]
- d. State the various features of Energy Conservation ACT 2001. [5]

**Q No 2A.** Discuss the designing of electrical earthing system. [10]

**Q No 2B.** Find the KVA rating of the transformer required which is feeding following three phase loads. Specify the various specifications required for transformer and its criteria's for the selection. For which load power factor correction is required and why? Calculate the compensating KVAR required. [10]

Load No	Rating KW	LF	DF	Efficiency	Power Factor
1	100	0.8	0.7	0.7	0.95
2	350	0.75	0.6	0.8	0.9
3	200	0.75	0.6	0.9	0.85
4	400	0.8	0.5	0.9	0.7

**Q No 3A** Discuss how electricity bill is useful for energy consumption optimization. [10]

**Q No 3B** A reading room measuring (43m (L) + 18m (B) + 5m (H) requires an average illumination of 400 lux. State the various assumptions in design of lighting system for this room. Calculate the number of lamps required. Draw the lighting layout. [10]

**Q No 4A.** A 50 KW heater, rated for 415V, 3 $\phi$ , 50Hz is connected to PCC by a cable of length 100m. Two other cables are running in a cable tray. Ambient temperature is 40°C. Fault level is 20 KA. Grouping factor is 0.7. Calculate and specify the cable required for the same. [10]

**Q No 4B** Discuss the various electrical load management techniques. [10]

**Q No 5A.** Discuss the energy performance assessment of motors. [10]

**Q No 5B** What are the different types of energy audits? Discuss any one in detail. [10]

**Q No 6A.** Discuss the energy saving potentials of energy efficient transformer and smart lighting system. [10]

**Q No 6B.** Discuss the implementation of Building Management System [10]

**Data Required for Illumination Design Problem**

K	R <sub>c</sub> = 0.7			R <sub>c</sub> = 0.5			R <sub>c</sub> = 0.3		
	R <sub>w</sub> = 0.5	R <sub>w</sub> = 0.3	R <sub>w</sub> = 0.1	R <sub>w</sub> = 0.5	R <sub>w</sub> = 0.3	R <sub>w</sub> = 0.1	R <sub>w</sub> = 0.5	R <sub>w</sub> = 0.3	R <sub>w</sub> = 0.1
0	0	0	0	0	0	0	0	0	0
0.6	0.43	0.39	0.36	0.42	0.38	0.36	0.41	0.38	0.36
0.8	0.45	0.41	0.38	0.44	0.40	0.38	0.43	0.40	0.38
1.00	0.51	0.47	0.44	0.55	0.47	0.44	0.49	0.46	0.40
1.25	0.55	0.51	0.49	0.53	0.50	0.48	0.52	0.50	0.48
1.50	0.57	0.54	0.52	0.56	0.53	0.51	0.54	0.52	0.50
2.00	0.61	0.58	0.56	0.59	0.57	0.55	0.57	0.56	0.54
2.50	0.63	0.61	0.59	0.61	0.59	0.57	0.59	0.58	0.56
3.00	0.65	0.63	0.61	0.63	0.61	0.59	0.61	0.59	0.58
4.00	0.67	0.65	0.63	0.64	0.63	0.62	0.62	0.61	0.59
5.00	0.68	0.67	0.65	0.65	0.64	0.63	0.63	0.62	0.61

Lamp Data			
Sr. No.	Type of Lamp	Wattage	Lumen output
1.	Fluorescent (T8/T5)	18 (Halo phosphate)	1015
		36 (Halo phosphate)	2450
		18 (82/84/86)	1300
		36 (82/84/86)	3250
		28 (T5)	2800
2.	CFL	9	600
		11	760
		13	920
		18	1200

**Data Required for Cable Design Problem**

TABLE 14:  
IEE-Table 9D2  
Current-carrying capacities and associated voltage drops for twin and multicore p.v.c. -insulated cables, non-armoured (copper conductors)

Conductor operating temperature : 70°C

Conductor Cross sectional area	Installation methods A to C of Fig. 1 ('Enclosed')				Installation methods E to H of Fig. 1 ('Clipped direct')				Installation method K of Fig. 1 ('Dedined conditions')			
	One twin cable With or without protective conductor single-phase a.c. or d.c.		One three-core cable with or without protective conductor or one four-core cable, three phase		One Twin cable With or without protective conductor single-phase a.c. or d.c.		One three-core cable with or without protective conductor or one four-core cable, three phase		One Twin cable With or without protective conductor single-phase a.c. or d.c.		One three-core cable with or without protective conductor or one four-core cable, three phase	
	Current carrying capacity	Volt drop per ampere per metre	Current carrying capacity	Volt drop per ampere per metre	Current carrying capacity	Volt drop per ampere per metre	Current carrying capacity	Volt drop per ampere per metre	Current carrying capacity	Volt drop per ampere per metre	Current carrying capacity	Volt drop per ampere per metre
	2	3	4	5	6	7	8	9	10	11	12	13
mm <sup>2</sup>	A	mV	A	mV	A	mV	A	mV	A	mV	A	mV
1.0	14	42	12	37	16	42	13	37	..	..	..	..
1.5	18	28	16	24	20	28	17	24	..	..	..	..
2.5	24	17	21	15	28	17	24	15	..	..	..	..
4	32	11	29	9.2	36	11	32	9.2	..	..	..	..
6	40	7.1	36	6.2	46	7.1	40	6.2	..	..	..	..
10	53	4.2	49	3.7	64	4.2	54	3.7	..	..	..	..
16	70	2.7	62	2.3	85	2.7	71	2.3	..	..	..	..
25	79	1.8	70	1.6	108	1.8	90	1.6	114	1.8	95	1.6
35	94	1.3	86	1.1	132	1.3	115	1.1	139	1.3	122	1.1
50	..	..	..	..	163	0.92	140	0.81	172	0.92	146	0.81
70	..	..	..	..	207	0.65	176	0.57	218	0.65	186	0.57
95	..	..	..	..	251	0.48	215	0.42	265	0.48	227	0.42
120	..	..	..	..	290	0.40	251	0.34	306	0.40	265	0.34
150	..	..	..	..	330	0.32	287	0.29	348	0.32	302	0.29
185	..	..	..	..	360	0.29	330	0.24	400	0.29	348	0.24
240	..	..	..	..	450	0.25	392	0.20	474	0.25	413	0.20
300	..	..	..	..	520	0.23	459	0.18	548	0.23	474	0.18
400	..	..	..	..	600	0.22	520	0.17	632	0.22	548	0.17

CORRECTION FACTORS

FOR AMBIENT TEMPERATURE	25°C	35°C	40°C	45°C	50°C	55°C	60°C	65°C
Ambient temperature	25°C	35°C	40°C	45°C	50°C	55°C	60°C	65°C
Correction factor	1.06	0.94	0.87	0.79	0.71	0.61	0.50	0.35

**TABLE 15**  
**IEE-Table 9D3**  
**Current-carrying capacities and associated voltage drops for twin and multicore armoured p.v.c. -insulated cables (copper conductors).**

Conductor operating temperature : 70°C

Conductor cross sectional area 1	Installation method E, F and G of Table 11 (Clipped direct)				Installation method K of Table 11 (Defined conditions)			
	One twin cable single phase a.c. or d.c.		One three- or four-core cable three-phase		One twin cable single phase a.c. or d.c.		One three- or four-core cable three-phase	
	Current carrying capacity 2	Volt drop per ampere per metre 3	Current carrying capacity 4	Volt drop per ampere per metre 5	Current carrying capacity 6	Volt drop per ampere per metre 7	Current carrying capacity 8	Volt drop per ampere per metre 9
mm <sup>2</sup>	A	mV	A	mV	A	mV	A	mV
1.5	20	29	18	25	.	.	.	.
2.5	29	18	24	16	.	.	.	.
4	37	12	31	9.6	.	.	42	6.3
6	48	7.4	41	6.3	50	7.3	.	.
10	66	4.3	56	3.8	69	4.3	50	3.8
16	86	2.7	73	2.3	90	2.7	77	2.3
25	115	1.8	97	1.6	121	1.8	102	1.6
35	142	1.3	119	1.1	149	1.3	125	1.1
50	168	0.92	147	0.81	180	0.92	155	0.81
70	209	a.c. 0.65 d.c. 0.64	180	0.57	220	a.c. 0.65 d.c. 0.64	180	0.57
95	257	0.48 0.46	219	0.42	270	0.48 0.46	230	0.42
120	295	0.40 0.36	257	0.34	310	0.40 0.36	270	0.34
150	337	0.32 0.25	295	0.29	355	0.32 0.25	310	0.29
185	390	0.29 0.23	333	0.24	410	0.29 0.23	350	0.24
240	461	0.25 0.18	399	0.20	485	0.25 0.18	420	0.20
300	523	0.23 0.14	461	0.18	550	0.23 0.14	475	0.18
400	589	0.22 0.11	523	0.17	620	0.22 0.11	550	0.17

**CORRECTION FACTORS**

FOR AMBIENT TEMPERATURE  
 Ambient temperature  
 Correction factor

25°C	35°C	40°C	45°C	50°C	55°C	60°C	65°C
1.08	0.94	0.87	0.78	0.71	0.61	0.50	0.35

**TABLE 20**  
**IEE-Table 9K1**  
**Current-carrying capacities and associated voltage drops for single-core p.v.c. -insulated cables, non-armoured, with sheath (Aluminium conductors)**

Conductor operating temperature : 70°C

Gross sectional area of conductor 1	Installation methods A to C of Table 11 (Enclosed)				Installation methods E to H of Table 11 (Clipped direct)				Installation method J of Table 11 (Defined conditions)							
	2 Cables, single-phase a.c. or d.c.		3 or 4 cables three-phase a.c.		2 Cables, single-phase a.c. or d.c.		3 or 4 cables three-phase a.c.		Flat or vertical (2 cables, single-phase a.c. or d.c. or 3 or 4 cables three-phase)			Tinsel (3 cables three-phase)				
	Current carrying capacity	Volt drop per ampere per metre	Current carrying capacity	Volt drop per ampere per metre	Current carrying capacity	Volt drop per ampere per metre	Current carrying capacity	Volt drop per ampere per metre	Current carrying capacity	Volt drop per ampere per metre	Current carrying capacity	Volt drop per ampere per metre	Current carrying capacity	Volt drop per ampere per metre		
mm <sup>2</sup>	A	mV	A	mV	A	mV	A	mV	A	mV	A	mV	A	mV		
16	4.5	4.5	52	3.9	72	4.5	4.5	65	3.9	.	.	.	.	.		
25	78	2.8	2.8	67	2.5	94	2.8	2.8	85	2.5	.	.	.	.		
35	98	2.1	2.0	83	1.8	115	2.1	2.0	105	1.8	.	.	.	.		
50	120	1.6	1.5	100	1.4	143	1.5	1.5	123	1.3	155	1.5	1.5	1.34	140	1.3
70	150	1.2	1.0	125	1.0	181	1.1	1.0	156	0.93	190	1.1	1.0	0.85	170	0.80
95	175	0.93	0.75	150	0.80	223	0.77	0.75	191	0.69	235	0.80	0.75	0.72	205	0.67
120	205	0.80	0.60	175	0.70	261	0.62	0.60	223	0.56	275	0.85	0.60	0.60	235	0.64
150	235	0.73	0.49	200	0.64	298	0.51	0.49	259	0.48	320	0.95	0.40	0.51	270	0.45
185	.	.	.	.	.	345	0.42	0.39	290	0.40	378	0.44	0.39	0.45	350	0.37
240	.	.	.	.	.	411	0.34	0.29	361	0.34	446	0.43	0.29	0.43	370	0.30
300	.	.	.	.	.	476	0.29	0.23	418	0.30	510	0.38	0.23	0.39	435	0.25
380	.	.	.	.	.	554	0.24	0.19	465	0.28	589	0.35	0.19	0.37	490	0.22
480	.	.	.	.	.	643	0.23	0.15	541	0.26	677	0.32	0.15	0.34	570	0.20
600	.	.	.	.	.	737	0.21	0.12	616	0.24	776	0.30	0.12	0.33	648	0.18

**CORRECTION FACTORS**

FOR AMBIENT TEMPERATURE  
 Ambient temperature  
 Correction factor

25°C	35°C	40°C	45°C	50°C	55°C	60°C	65°C
1.06	0.94	0.87	0.78	0.71	0.61	0.50	0.35

**TABLE 21**  
**IEE-Table 9K2**  
 Current-carrying capacities and associated voltage drops for twin and multicore armoured p.v.c. -insulated cables, non-armoured (Aluminium conductors)  
 Conductor operating temperature : 70°C

Conductor cross sectional area	Installation method E, to H † of Table 11 (Clipped direct)				Installation method K of Table 11 (Defined conditions)			
	One twin cable single phase a.c. or d.c.		One three - or - four core cable, three-phase		One twin cable, single phase a.c. or d.c.		One three - or - four core cable, three-phase	
	Current carrying capacity 2	Volt drop per ampere per metre 3	Current carrying capacity 4	Volt drop per ampere per metre 5	Current carrying capacity 6	Volt drop per ampere per metre 7	Current carrying capacity 8	Volt drop per ampere per metre 9
mm <sup>2</sup>	A	mV	A	mV	A	mV	A	mV
16	62	4.5	53	3.9	65	4.5	55	3.9
25	82	2.9	70	2.5	86	2.9	74	2.5
35	102	2.1	86	1.8	107	2.1	91	1.8
50	120	1.5	106	1.3	125	1.5	110	1.5
70	150	1.1	133	0.93	158	1.1	139	0.93
95	185	0.79	163	0.68	195	0.79	172	0.68
120	.	.	190	0.54	.	.	200	0.54
150	.	.	217	0.46	.	.	227	0.46
185	.	.	247	0.37	.	.	260	0.37
240	.	.	296	0.29	.	.	311	0.29
300	.	.	340	0.25	.	.	358	0.25

**CORRECTION FACTORS**

FOR AMBIENT TEMPERATURE  
 Ambient temperature  
 Correction factor

25°C	35°C	40°C	45°C	50°C	55°C	60°C	65°C
1.06	0.94	0.87	0.79	0.71	0.61	0.50	0.36

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