

Duration: 3hour

Max. Marks: 80

Note:- 1. Question No1 is compulsory.

2. Solve any three questions out of remaining

3. Assume data if necessary and justify the same.

Q1. Solve the following Questions (20 marks)

- i Explain Maximum Demand Controller
- ii What are the various elements of Energy Monitoring and Targeting
- iii Explain the term Coordination and Discrimination.
- iv Explain Benchmarking and what are its types?

Q2 (20 Marks)

An office room measuring 20m (L) + 15m (B) + 5m (H) requires an average illumination of 400 lux.

- A a. State the design consideration for above lighting system
- b. Calculate the number of lamps required
- c. Draw the lighting layout

B What are the benefits of Power factor improvement? Also explain selection and location of capacitors for same.

Q3 (20 Marks)

Discuss the role of following energy efficient technologies and corresponding saving potential

(i) Energy Efficient Motor (ii) Energy Efficient Transformer

From the data given below,

- (i) Calculate the kVA rating of transformer required for the loads
- (ii) Draw a single line diagram showing various metering instruments, protections and load connections

Load No.	kW Rating	LF	DF	Efficiency	Power Factor
1	800	0.8	0.8	0.75	0.7
2	600	0.85	0.6	0.8	0.85
3	300	0.7	0.7	0.9	0.95
4	400	0.6	0.5	0.8	0.75

Q4 (20 Marks)

A Explain Ten step Methodology for Detailed Energy Audit

B Explain step by step approach towards electrical load management.

Q5 (20 Marks)

A Discuss in detail procedure involved in the selection of cable conductor size and other specifications, for a cable used for connection of a motor to a control panel through a short length.

B Discuss the energy performance assessment of lighting system

Q6 Write a short note on (any four) (20 Marks)

- i Advantages of lead acid batteries.
- ii UPS
- iii Building Management System (BMS)
- iv Single line diagram
- v Variable Speed Drives

Data for Illumination Design problems

K	$R_C = 0.7$			$R_C = 0.5$			$R_C = 0.3$		
	$R_W = 0.5$	$R_W = 0.3$	$R_W = 0.1$	$R_W = 0.5$	$R_W = 0.3$	$R_W = 0.1$	$R_W = 0.5$	$R_W = 0.3$	$R_W = 0.1$
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

TABLE-36

Correction factors for groups of more than three single-core cables or more than one multicore cables or more than one multicore cables

Multicore cables: (Factors to be applied to the values for one cable)	Number of cables								
	2	3	4	5	6	7	8	9	10
	0.80	0.70	0.65	0.60	0.57	0.52	0.48	0.45	0.43

- NOTES: 1. These factors are applicable to groups of cables all of one size equally loaded, including groups bunched in more than one plane
2. Where, spacing between adjacent cables exceeds twice their overall diameter, no reduction factor need be applied

TURN OVER

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 (Defined 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
1	2	3	4	5	6	7	8	9	10	11	12	13
mm ²	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	6.5	46	7.1	40	6.5	.	.	.	.
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	98	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	148	0.81
70	.	.	.	.	207	0.65	175	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	.	.	.	.	380	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	450	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
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	0.79	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	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	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
1	2	3	4	5	6	7	8	9
mm ²	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	.	.	.	.
6	48	7.4	41	6.3	50	7.3	42	6.3
10	66	4.3	56	3.8	69	4.3	58	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	0.79	0.71	0.61	0.50	0.35

[TURN OVER

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

Cross sectional area of conductor	Installation methods A to C of Table 14 ('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)					
	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	1 ph	d.c.	3 ph	Volt drop per ampere per metre
1	2	a.c. 3	d.c. 4	5	6	7	a.c. 8	d.c. 9	10	11	12	13	14	15	16	17
mm ²	A	mV	mV	A	mV	A	mV	mV	A	mV	A	mV	mV	mV	A	mV
16	60	4.5	4.5	52	3.9	72	4.5	4.5	65	3.9	.	.	.	.	.	.
25	78	2.9	2.8	67	2.5	94	2.8	2.8	85	2.5	.	.	.	.	.	.
35	96	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	180	1.1	1.0	0.85	170	0.90
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	225	0.56	275	0.65	0.60	0.60	235	0.54
150	235	0.73	0.49	200	0.64	298	0.51	0.49	259	0.48	320	0.55	0.49	0.51	270	0.45
185	.	.	.	.	.	345	0.42	0.39	290	0.40	378	0.48	0.39	0.45	310	0.37
240	.	.	.	.	.	411	0.34	0.29	361	0.34	448	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	0.26	0.19	465	0.28	584	0.35	0.19	0.37	490	0.22
480	.	.	.	.	.	643	0.23	0.35	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

FOR AMBIENT TEMPERATURE
 Ambient temperature
 Correction factor

CORRECTION FACTORS

25°C	35°C	40°C	45°C	50°C	55°C	60°C	65°C
1.08	0.94	0.87	0.79	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	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
1	2	3	4	5	6	7	8	9
mm ²	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	1.3
70	150	1.1	133	0.93	158	1.1	139	0.99
95	185	0.79	163	0.68	195	0.79	172	0.68
120	.	.	190	0.54	.	.	200	0.54
150	.	.	217	0.45	.	.	227	0.46
185	.	.	247	0.37	.	.	260	0.37
240	.	.	296	0.29	.	.	311	0.29
300	.	.	340	0.25	.	.	358	0.25

FOR AMBIENT TEMPERATURE
 Ambient temperature
 Correction factor

CORRECTION FACTORS

25°C	35°C	40°C	45°C	50°C	55°C	60°C	65°C
1.08	0.94	0.87	0.79	0.71	0.61	0.50	0.35