(3 Hours) **(Total Marks: 80)**

N.B.

1. **Question No.1 is Compulsory**.
2. Answer any three out of remaining five questions
3. Assume any suitable data wherever required but justified the same
4. Illustrate answer with sketches wherever required

Q 1 a. State whether true or false and justify the same (Any five)

1) Soft starter provide significant energy savings in case of variable torque load **(02)**
2) In a distribution system air circuit is generally used as main circuit breaker **(02)**
3) Electronic ballast will improve energy efficiency **(02)**
4) Energy efficient motor is more compact in size compared to standard motor of same rating **(02)**
5) Derating factors does not play vital role in cable sizing and selection **(02)**
6) In a distribution network, Dyn11 grouped transformer is generally used **(02)**

Q 1 b. Name and explain the function of following protective devices **(05)**

i) No.51 ii) No.52 iii) No.27 iv) No.32 v) No.55

Q 1 c. What can you say about energy monitoring and Targeting. List out the elements of monitoring and targeting **(05)**

Q 2 a) From the data given below, **(10)**

i. Draw the SLD showing the location of loads metering devices and various protective devices and their ratings.
ii. Calculate the kVA rating of transformer required for the loads.
iii. Specify the ratings of HT and LT (main) circuit breaker

Type of load	Load in kW	Efficiency	Power Factor	Load Factor	Diversity Factor
Plant I	800	0.9	0.8	0.8	0.7
Plant II	600	0.8	0.85	0.75	0.8
Heaters	350	0.8	0.7	0.85	0.85
Other load	300	0.75	0.75	0.9	0.8

b) Discuss various energy efficient technologies used to improve performance of motor. **(10)**

Q 3 a) A MCC supplies power to 5 motors each of 15HP, 50Hz, 440V, 0.85p.f lag operating at 87%, 1440rpm, delta connected I.M. Distance between MCC and motor installation is 40m. Ambient temp is 40°C. Fault level at distribution point is 20kA. Assume type F installation. Size the copper cable for supplying power from MCC to motor and specify the same. Make suitable assumptions if necessary with justifications. **(10)**

Sr. No	Type of Cable	Value of k (Cu)
a)	PVC cable ≤ 300mm^2	115
b)	PVC cable > 300mm^2	103
c)	XLPE cable	114

b) What are the factors are to be considered while selection and installation of DG set? Explain in detail. **(10)**

Q 4 a) What way you would design illumination system for a reading room with dimensions (20L*15B*3.5H) in meter. Develop the lighting layout and justify the various assumptions. **(10)**

b) How would you classify types of installation of capacitor bank in detail? **(10)**

Q 5 a) Define Energy Audit? Explain need of energy audit? Explain in detail the steps taken to perform detailed audit **(10)**

b) How would you categorize different means to achieve the energy efficiency in motor? Explain in detail. **(10)**

Q 6 Write a short note on **(any four)** **(20)**

- **i)** Variable Speed Drives
- **ii)** UPS
- **iii)** CUSUM Technique
- **iv)** Energy Management System
- **v)** Elementary Diagram

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**
			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
mm²	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	-	-	-	- FLAT
2.5	24	17	21	15	28	17	24	15	-	-	-	- CABLES
4	32	11	29	9.2	36	11	32	9.2	-	-	-	- ONLY
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	98	1.3	86	1.1	134	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 0.64	176	0.57	218	0.65 0.64	186	0.57
95	-	-	-	-	251	0.48 0.46	215	0.42	265	0.48 0.46	227	0.42
120	-	-	-	-	290	0.40 0.36	251	0.34	306	0.40 0.36	265	0.34
150	-	-	-	-	330	0.32 0.25	287	0.29	348	0.32 0.25	302	0.29
185	-	-	-	-	380	0.29 0.23	330	0.24	400	0.29 0.23	348	0.24
240	-	-	-	-	450	0.25 0.18	392	0.20	474	0.25 0.18	413	0.20
300	-	-	-	-	520	0.23 0.14	450	0.18	548	0.23 0.14	474	0.18
400	-	-	-	-	600	0.22 0.11	520	0.17	632	0.22 0.11	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								
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	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	Vol tdrop per ampere per metre	Current carrying capacity	Volt drop per ampere per metre
1	2	3	4	5	6	7	8	9
mm²	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
	a.c	d.c.			a.c.	d.c.		
70	209 0.65	0.64	180	0.57	220 0.65	0.64	190	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	25°C	35°C	40°C	45°C	50°C	55°C	60°C	65°C
Ambient temperature								
Correction factor	1.06	0.94	0.87	0.79	0.71	0.61	0.50	0.35

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

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