2018

ELECTRICAL ENGINEERING-II

Time Allowed : 3 Hours

Full Marks : 200

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored

Answers may be written either in English or in Bengali but all the answers must be in one and the same language

Answer any **five** (5) out of eight

1.(a) What are the parameters generally considered in indoor lighting design? What do you mean by Light Loss Factor for lighting design? What is the significance of three values of service illuminance level as mentioned in IS 3646, 1992, Part-II ? What do you mean by term service illuminance? **14**

(b) Design a general Lighting Scheme with two different options with different types of lighting system (mentioned below) for an auditorium. The tentative dimension of the auditorium is 28 m X 12 m X 4 m . The target maintained average illuminance level is 300 Lux . The overall Light Loss Factor to be considered as 0.7. Consider the room is to be used for 300 days per year with 10 hours per day. Compute the energy consumption for both the options and clearly mention which one is the best option from energy saving point of view. Also calculate LPD (light power density) for both. **16**

Option-1

Lighting System type –Luminaire with 2 X 36 W T12 Fluorescent lamp & Electro Magnetic Ballast

Luminous flux per Lamp = 3100 Lumen

Coefficient of Utilization Value = 0.75

Cost per Luminaire(including Ballast) = Rs 2000/-

Cost per Lamp = Rs. 50/-

Power consumption per luminaire (including Ballast) = 80 W

Option-2

Lighting System type –Luminaire with 2 X 20 W LED tube based lighting system

Luminous flux per Lamp = 3350 Lumen

Coefficient of Utilization Value = 0.85

Cost per Luminaire(including Driver) = Rs 6000/-

Power consumption per luminaire (including Ballast) = 42 W

(c) Prove that in case of flat perfect diffuser Luminous Flux $\Phi = \Pi I_n$ where I_n = Intensity along normal direction. **10**

2.(a)What are the differences between integral cycle control and integral control for a heating process ? **6**

(b)Discuss the starting process of a salt bath furnace. **6**

(c)In a single phase 220V resistance oven the wire temperature is controlled by series parallel combinations of two nichrome coils, each of 8.5 m length and 0.312 cm conductor dia. Determine the different option of oven temperature. Maximum temperature of the wire is 1175°C. Take, K=0.57, e=0.95, p=1.09 $\mu\Omega$-m **12**

(d) Justify the following (4X4 =**16**)

(i) Thermal plants are not suitable for supplying fluctuating loads

(ii) Sulphur and oxygen are an undesirable element in coal.

(iii) Balanced draught must be used in thermal power plants.

(iv) Pumped storage plants are economic as peak load plant

3. (a) Explain the principle of delta modulation with neat diagrams. How is adaptive delta modulation different from delta modulation? **14**
b)Explain the Armstrong method of FM generation **6**
c)Mention the drawbacks of installation of higher capacity power plant. Specify the apprehended problems of distributed generation while uploading in the grid **10**
d)Explain the limitations of renewable energy resources. Write the principal of operation of solar engine.**10**

4. (a) An air blast circuit breaker has to open a transformer in the following operating conditions:

i) Transformer supplying a full load of 200A at 0.8 lagging power factor.
ii) Transformer supplying no load i.e. with the secondary terminals open.
Which of these two operations may appear to be more critical? Explain your answer. **8**

(b) A 50Hz, 20 kV generating system with negligible resistance has reactance of 5 ohm is connected to the bus bar through a circuit breaker. The distributed capacitance to neutral is 0.01μF. Calculate i) the maximum voltage across the contacts of then circuit breaker when it breaks a short circuit current at current zero, ii) the frequency of the transient oscillation and iii) the average rate of rise of restriking voltage upto the first peak of oscillation. **10**

(c) Why autoreclosing feature is preferable for circuit breakers under certain operating conditions? Why oil circuit breaker is not suitable for auto-reclosing operation? Name two types of circuit breakers suitable for auto reclosing. Also state why they are suitable for this purpose. **(5+3+2+2=12)**

(d) "In a power system, active power - voltage magnitude (P- V) and reactive power – angle (Q-δ) are weakly coupled" – justify this statement. **10**

5. (a) Discuss operating principle of an non-directional IDMTL type overcurrent relay? Draw characteristics of attraction type overcurrent relay and IDMTL type overcurrent relay. Which one would perform better for feeder protection? Justify your answer. **(5+4+3=12)**

(b) An IDMTL relay with PSM =18, is carrying a fault current of 135 A in CT secondary. The rated current CT secondary current is 5A. Calculate plug setting of the relay. This relay is acting as a backup relay with DTM of 0.2 sec where the actual time of operation of the primary relay is 0.52 sec. Also calculate TMS of the relay. **8**

PSM	2	6	10	12	18	20
Time	10	3.8	3	2.8	2.4	2.2

(c) Discuss how differential relay is employed for stator winding inter-phase fault protection of an alternator. Why biasing is required for differential relay? **8**

(d) A load of 240 MW is to be shared by the three generators, rated at 75, 125 and 100 MW at a power plant. Determine the optimum distribution of the load and incremental production cost. Assume operating cost of the three generators to be respectively **12**

$$C1 = 100 + 0.200\ P1 + 0.001\ P12$$

$$C2 = 150 + 0.160\ P2 + 0.002\ P22$$

$$C3 = 200 + 0.100\ P1 + 0.001\ P32$$

6. (a) Derive an expression for voltage regulation for a transformer. **10**

(b)Two single phase transformers work in parallel on a load of 750 A at 0.8 p.f. lagging.

Determine the secondary voltage and the output and power-factor of each transformer. Test data are:

Open-circuit: 11,000/3,300 V for each transformer.

Short-circuit: with h.v. winding short circuited.

Transformer A-secondary input 200 V. 400 A, 15 kW

Transformer B-secondary input 100 V. 400 A, 20 kW **20**

(c)Two identical single phase transformer have tapping at 50% and 86.7% . Describe with proper diagrams how they can be connected in Scott connection producing two phase output from three phase input. **10**

7.(a) Using the per phase equivalent circuit of a three phase induction motor discuss how you can determine the parameters of this circuit. Show the schematic circuit diagram. **15**

(b)Describe the phenomenon of cogging and crawling. What measures can eliminate these effects? **10**

(c)The standstill impedances of the two cages of a double-cage induction motor are (3.2+j1.2) ohm and (0.5+j6.5) ohm respectively. If the full-load slip is 5%, then find the ratio of starting torque to full-load torque. Neglect magnetizing current and stator impedance.**15**

8.(a) A three phase fully controlled full wave rectifier is connected to a 380 V peak, 50 Hz three phase supply. The load is resistive with a value of 10 ohm. If it is required to get 400 V DC output voltage, calculate (a) firing angle, and (b) r.m.s output voltage. **15**

(b)Sketch the circuit and explain the operation of a step-down DC-DC Chopper (or buck converter) feeding a resistive load using relevant waveforms. Derive the expression for its output average voltage in terms of its input voltage. Also briefly explain the need for a low-pass LC filter at its output. **15**

(c)What is commutation overlap? Sketch with necessary sketches for a three phase half wave rectifier. **10**