

**APJ ABDULKALAM TECHNOLOGICAL UNIVERSITY  
MODEL QUESTION PAPER**

**Subject: EE 405 Electrical System Design**

**Maximum marks: 100**

**Exam Duration: 3Hours**

**(Approved Data Handbook is permitted inside examination hall)**

**Part A**

**(Answer ALL questions. 8x5=40 marks)**

- 1 How is National Electrical Code 2011 different from CEA regulations?
2. List the design guidelines for estimating the connected load of a domestic building as per NEC 2011.
3. Distinguish between 3 core, 3.5 core and 4 core cables? How are they coded?
4. The source impedance of a 11 kV transformer substation is  $0.2+j1.5$  ohm per phase. Determine, i) Initial symmetrical short circuit current and ii) peak short circuit current if a balanced three phase fault occurs on the 11kV side of the transformer.
- 5 List the different types of lamps suitable for street lighting and explain with reference to their relative advantages.
6. What are the special requirements for the transformers used in high rise buildings ?
- 7 Distinguish between Grid tied and Stand alone Solar Photovoltaic systems.
- 8 List out the design steps for Domestic Solar PV systems.

**Part B**

**(Answer any two questions) (2x10=20 marks)**

- 9 A rest house has four bed rooms with attached toilets, dining hall, kitchen, living room and verandah. Prepare the room wise list of electrical for the rest house. Make provision for air-conditioning of the bed rooms. Design the electrical system for the rest house using NEC guidelines and find a) Number of light circuits, b) Number of power circuits, c) Connected load, d) Maximum demand, e) Size of the distribution board with specifications and f) type of power supply required. Draw the schematic diagram showing the ratings of MCBs and sub circuits. (10)

- 10 A two bedroom domestic building has following loads.

Sl.No.	Room Type	Light load	6 A sockets	Fan load	16 A sockets
1	Bedrooms-2 Nos.	18W LED, and 5W LED lamps each.	1 no. in each room	1 no. each - 1200mm	1 each
2	Drawing cum dining	28 W LED, 1 no and 15W LED 2nos	2 nos.	2nos- 1200mm	1 no.
3	Kitchen	18 W LED, 2 nos.	2 nos.	Exhaust fan 1 no.225mm	2 nos.
4	Toilet-2Nos.	9 W LED, 1 no.		Exhaust fan 1 no.225mm	1 .each
5	Verandah	9W LED 1No			

Determine using NEC guidelines, a) the total connected load, b) the type of supply, c) the maximum demand and d) the number of sub circuits required for the installation. Give specifications of main switch, distribution board and draw the schematic diagram. (10)

- 11 a) What are the main objectives of the Electricity Act 2003? (5)  
b) Distinguish between MCB, MCCB and ELCB. (5)

**Part C**  
**(Answer any two questions) (2x10=20 marks)**

- 12 An industry consists of the following loads:
- a. 7.5kW, 3 phase cage induction motor – 1 No.
  - b. 10kW, 3 phase cage induction motor – 2 Nos.
  - c. 22.2kW, 3 phase cage induction motor – 1 No.
  - d. Power sockets – 15Nos.
  - e. Lighting loads - 40 Nos of 2 x 28 W LED retrofit lamps
  - f. Exhaust fans 300mm, 1420rpm -4 Nos.
- Design the electrical system for the industry, if the industry is located in a village, and also determine:

- (a) Type of industry,
- (b) Transformer capacity required and type of substation
- (c) Draw the single line schematic diagram showing the details of cable sizes, starters and switch gears. Use a switch board with MCCB/SFU incomer and MCCB/SFU outgoing and MCB type distribution boards. (10)

- 13 A factory has the following connected load

Machine shop:	50kW
Air conditioner load	150kW
Furnace Load	60kW
Welding transformer	50kW
Light and fans	10kW

Design an indoor substation and draw the schematic diagram showing the details of switchgear and cable sizes. Assume a diversity factor of 1.2. (10)

- 14 A cement factory is supplied from a Utility substation 5km away from the factory through an over head line. The cement factory has two numbers of 630kVA, 11kV/ 433V, 3 phase transformers with a percentage reactance of 6% operating in parallel. If the 3 phase fault level on the 11 kV side of the substation is 500 MVA, determine the number of earthing stations required using plate electrodes for the transformer station. The O/H line conductor (AAC-Grasshopper) has a cross section of 84.1 mm<sup>2</sup> and a spacing of 900 mm. Assume a soil resistivity of 65 Ωm. (10)

**Part D**  
**(Answer any two questions) (2x10=20 marks)**

**15** It is required to provide area lighting for an airport parking lot with an illumination level of 10 lux. The area is 225m long and 90m wide. The mounting height of the lamp has to be restricted to 10m. Assuming two lamps per pole, determine rating and spacing of the lamps for providing the required level of illumination. The luminaries available are:

- a. HPSV lamps with CU=0.65 and LLF=0.7 (Sodium vapour)
- b. PSMH lamps with CU=0.60 and LLF=0.85(Metal Halide)

Which alternative is more energy conservative? (10)

**16** Design a road way lighting scheme and determine the spacing between the poles and the wattage of the lamps using the following data. Which alternative you will choose, from the point of energy conservation?

- Width of the road way = 12 m
- Illumination required = 15lux
- Mounting height of poles = 9 m
- Arm length = 2m

The lamps are placed on one side of the road. Assume any missing data. (10)

Details	HPSV	LPSV
CU	<b>0.65</b>	<b>0.5</b>
LLF	<b>0.7</b>	<b>0.9</b>

**17** An office room of size 9X15m is to be illuminated by 2x28W LED luminaire. The lamps are being mounted at a height of 3m from the work plane. The average illumination required is 240 lux. Calculate the number of lamps required to be fitted, assuming a CU of 0.75 and a LLF of 0.8. Assume the ceiling height of room as 5m. Show the arrangement of lamps. The lumen output of 2x28W LED may be taken as 6000lumens. (10)