Question (1)

Define each of the following terms in words and formula:
LDC, LF, DF, PDF, GDF, CF, FOR, COPT, LOLE, EDNS, EENS, EIR, CAT.

Question (2)

Explain the following terms:

a) The importance of power system planning specially in developing counties.
b) Basic factors of power system planning process.
c) Several costs of power system.
d) Family (Types) of I / O curves and their shapes and units
e) Reliability indices used in power system planning and their units.

Question (3)

Select and underline the true word between the brackets in the following statements

a) Base load needs (high, moderate, low) operating cost units.
b) Peak load units are the (highest, moderate, least) operating cost.
c) Diversity factor (less than, equal, higher than) one.
d) Demand factor for cold-stores is very (low, moderate, high).
e) Base load (decreases, increases, does not affect) the load factor.
f) Large diversity factor means (high, moderate, low) peak load.
g) Unit efficiency varies (linearly, nonlinearly) with the load.
h) LOLE increases (linearly, nonlinearly) with load increase.
i) Series connection for components (improves, worsens) system reliability.
j) Parallel connection for components (improves, worsens) system reliability.

Question (4)

Two consumers groups are connected to a PP of 170 MW rated capacity The daily load for each customer is given in the following table:

hours	Group # 1 (MW)	Group # 2 (MW)
0-7	22	15
7-9	25	20
9-12	40	35
12-18	50	45
18-23	70	60
23-24	40	35

It is required to:

a) Draw the load curve for each consumer and determine the energy consumed by each one (the area under each curve).

b) Draw the combined load curve for the two consumers and determine the total energy consumed by the two consumers (the area under this combined curve), and then shows that it is equal to the summation of the two energies in (a).

c) Calculate the UF of the system.

d) Determine the GDF of the system.

Question (5)

A steel factory is expected to have 200 MW annual peak load and a load factor of *0.80.* Therefore, a PP is to be built to supply this load and having the following characteristics:

Installed Capacity	230 (MW)
Capital cost unit	1500 (SR/kW)
FCR	14(%)
I/O curve	$80+5L+0.006L^2$ (MBTU/h)
Fuel cost	3 (SR/MBTU)
O&M/year	30 (MSR)

It is required to find out:

a. The cost of producing a unit of energy, (i.e. H/kWh)
b. The load at which maximum efficiency (η_{max}) occurs.
c. The increase in input required to increase the plant output from 80 MW to 100 MW.
d. The CF, UF, LF for this system.

Question (6)

The annual LDC for a small town is considered to be a straight line between maximum load (L_{max} = 150 MW) and the minimum load (L_{min} = 50 MW). This load is supplied by a PP which contains 4 units with 50 MW each. If each unit has an FOR 0.15, evaluate the **LOLE** and the **εDNS** for the system.

Question (7)

The annual peak load for an industrial zone is 160 MW, and the annual LDC can be represented as:

$$\mathbf{L\,(t) = (1 - 0.6t)\,L_{max} \qquad 0 \le t \le 1}$$

The following generating units are planed to meet this load

2x50 MW (FOR = 0.05)
1x100 MW (FOR = 0.10)

Evaluate the **LOLE, the εDNS** and the **εENS** for the system.

Question (8)

A PP has the following data:

Capacity (MW)	FOR	Loading Priority
100	0.06	1
60	0.02	2

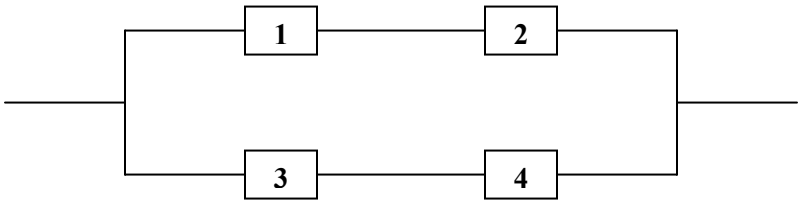
The LDC is to be considered as a straight line connecting a max. load of 180 MW and a min. load of 100 MW. If the total operating time is 150 hours, evaluate the following:

(a) The Expected Energy Served (**εES**) by each unit in the system.
(b) The Energy Index of Reliability (**EIR**) of the system.

Question (9)

The system shown below has the following data:

$$\lambda_1 = 2\times10^{-5} \quad \text{f/h}$$
$$\lambda_2 = 3\times10^{-5} \quad \text{f/h}$$
$$\lambda_3 = 5\times10^{-5} \quad \text{f/h}$$
$$\lambda_4 = 8\times10^{-5} \quad \text{f/h}$$

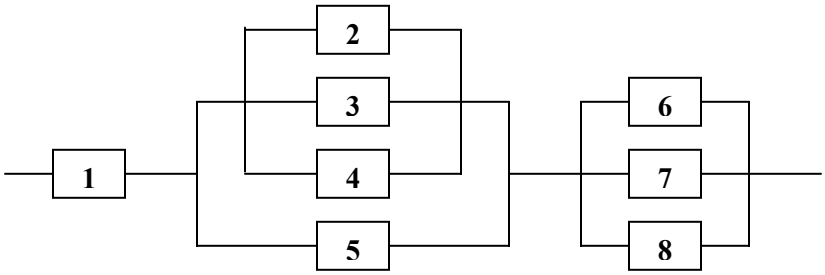


For the above system, it is required to calculate the reliability for a 1000 hours operation.

Question (10)

For the system shown below, all components are identical and each has a reliability of R. For components 2,3,4 only one component may fail for system successful operation. For components 6,7,8 at least two components must work for system successful operation. It is required to:

a) Find out an expression for the overall system reliability.
b) Calculate system reliability if Q = 0.1



Question (11)

A system consists of 4 transistors each with $\lambda = 1\times10^{-6}$ f/h, 2 diodes each with $\lambda = 1.5\times10^{-6}$ f/h, 4 capacitors each with $\lambda = 2.5\times10^{-6}$ f/h, 6 resistors each with $\lambda = 5\times10^{-6}$ f/h and 3 switches each with $\lambda = 4\times10^{-6}$ f/h. **[f / h *means failure/hour*]**

Evaluate the followings:

a) The reliability of the system if all components must work for system success for 10,000 hours.
b) The reliability of the system if another similar circuit is connected in parallel and only one circuit of the two circuits is required to work for system success.

Question (12)

Evaluate the reliability of the system shown below if all components are identical with a reliability of 0.95