IV YEAR B.E. EXAMINATION
(ELECTRICAL ENGINEERING)
ENERGY MANAGEMENT & AUTOMATION
(EEE-434)

Maximum Marks: 60  Duration: 02 Hours

Answer all questions. Assume suitable data if missing. Notations used have their usual meaning.

1(a) What are the three phases of energy audit? Explain any one. [6]
1(b) Write short note on Energy management system. [6]
2(a) Discuss the components of RTU. [6]
2(b) What is MODBUS protocol? Also explain the message frame involved. [6]
3(a) Draw the Architecture of SCADA based electrical transmission, also mention the related EMS functions. [6]
3(b) Write a note on SCADA security. [6]

OR

3'(a) Discuss the application functions of Generation SCADA. [6]
3'(b) Write short note on DAC. [6]
4(a) Mention the three areas where distribution automation can be implemented. Explain any one. [6]
4(b) What is geographical information system? How can it be helpful in electrical distribution system? [6]

OR

4'(a) What are the three fundamental components of any automated distribution system, explain each. [8]
4'(b) Define the following terms: [4]
   (a) Merging units
   (b) Outage Management system

5(a) Explain the objectives of demand side management. [8]
5(b) What is the effect of DSM on environment? [4]
Maximum Marks: 60                  Credits: 04                  Duration: Two Hours

Answer all the questions.
Assume suitable data if missing.
Notations used have their usual meaning.

Q.No.                      Questions                                      M.M. 60

1.(a) What are “Peak Load” and “Base Load” stations? Describe the characteristics of any one of them.  [6]
1.(b) A feeder supplies three distribution transformers which feed the following connected loads:

<table>
<thead>
<tr>
<th>Transformer</th>
<th>Loads</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transformer-1</td>
<td>Motor loads 30 kW, demand factor 0.6, Commercial load 10 kW, demand factor 0.5</td>
</tr>
<tr>
<td>Transformer-2</td>
<td>Residential loads 50 kW, demand factor 0.4</td>
</tr>
<tr>
<td>Transformer-3</td>
<td>Residential loads 40 kW, demand factor 0.5</td>
</tr>
</tbody>
</table>

The diversity factor for the loads on the three transformers may be taken as 1.8, 2.5 and 3. The diversity factor between transformers may be taken as 1.1. Find (a) peak load on each transformer and (b) peak load on feeder.

OR

1'.(a) Explain the term “depreciation”. Discuss any two methods of calculating depreciation of an electric power plant.  [8]
1'.(b) A central station supplies energy to two substations. Four feeders take off from each of the substation. The maximum demands are as under:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Central Station</td>
<td>10 MW</td>
</tr>
<tr>
<td>Sub-station-A</td>
<td>6 MW</td>
</tr>
<tr>
<td>Sub-station-B</td>
<td>8 MW</td>
</tr>
<tr>
<td>Feeders on sub-station-A</td>
<td>1.5, 2, 5, 3 MW</td>
</tr>
<tr>
<td>Feeders on sub-station-B</td>
<td>2, 4, 5, 1 MW</td>
</tr>
</tbody>
</table>
Calculate the diversity factors between: (a) Sub-stations (b) Feeders of sub-station A and (c) Feeders of sub-station B.

2.(a) Define the term “tariff”. What objectives should a utility keep in mind while deciding the tariff for consumers?  
2.(b) Derive the expression for most economic power factor using shunt capacitors when kW demand is constant.

OR

2',(a) Enumerate in brief the causes and effects of low power factor.  
2',(b) An industrial consumer has an annual energy consumption of 201500 kWh at a load factor of 0.35. The tariff is Rs. 4000 + Rs. 1200 per kW of maximum demand + Rs. 2.20 per kWh. Then, (a) find his annual bill. (b) What is the bill if total energy consumption is same but load factor is improved to 0.55? (c) What is the bill if energy consumption is reduced by 25% and load factor remains at the same initial value of 0.35?

3.(a) What is the significance of “No spill rule curve”?  
3.(b) The daily load curve data for a certain area is as under:

<table>
<thead>
<tr>
<th>Time</th>
<th>12-5 AM</th>
<th>5-8 AM</th>
<th>8-12 NOON</th>
<th>12-1 PM</th>
<th>1-5 PM</th>
<th>5-9 PM</th>
<th>9-12 MN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Load</td>
<td>100</td>
<td>150</td>
<td>250</td>
<td>100</td>
<td>250</td>
<td>350</td>
<td>150</td>
</tr>
</tbody>
</table>

It is proposed to install a run off river plant and a steam plant for supplying the above load. The run off data indicates that a flow of 50m$^3$/sec. is available for 975 of the time during the year. The head is 90m, hydro plant efficiency 90% and transmission losses 5%. Determine the capacity of hydro and steam power plant.

OR

3'. A two plant system having a steam plant near load centre and a hydro plant at a remote location is shown in Fig. 1. The load is 700 MW for 14 hours a day and 500 MW for 10 hours a day. The characteristics of units are:

$$C_1 = (24 + 0.02P_1)P_1$$
\[ W_2 = (6 + 0.0025P_2)P_2 \]

Loss coefficient \( B_{22} = 0.0005 \).

Find the generation schedule, daily water used by hydro plant and daily operating cost of thermal plant for \( r_2 = \text{Rs. 2.5 per hour/m}^3\text{ per sec.} \)

4.(a) With the help of neat diagram, briefly explain any two types of bus bar arrangements.

4.(b) Explain in brief the working of a brushless excitation system.

5(a) Describe in brief the main equipments used in EHV substations.

5(b) What is “Earthing”? Write a procedure to prepare an earthing mat.

Fig. 1
1(a) Derive the state space representation of the network of the figure shown below:

1(b) What are the advantages of State Space Representation of a control system?

OR

1’(a) Define the state controllability and observability of the system.

1’(b) Diagonalize the following state model:

\[
\begin{bmatrix}
\dot{x}_1 \\
\dot{x}_2 \\
\end{bmatrix} =
\begin{bmatrix}
0 & 1 \\
-6 & -5 \\
\end{bmatrix}
\begin{bmatrix}
x_1 \\
x_2 \\
\end{bmatrix}
+ \begin{bmatrix}
1 \\
0 \\
\end{bmatrix}
\]
2(a) For a system described by its Z transfer function as:

\[ F(z) = \frac{0.5z}{z^2 - 1.2z + 0.35} \]

Determine the response \( f(nT) \) of the system by using partial fraction expansion method.

2(b) Determine the pulse transfer function of the system shown below:

![System Diagram]

3(a) Determine the transfer function of a digital system having the following state variable description

\[ F = \begin{bmatrix} 2 & -1 \\ 1 & 0 \end{bmatrix}, \quad g = \begin{bmatrix} 1 \\ 0 \end{bmatrix} \]
\[ c = \begin{bmatrix} 3 & 1 \end{bmatrix}, \quad d = [2] \]

3(b) Determine the stability of a discrete data system whose characteristic equation is given by:

\[ z^3 - 1.1z^2 - 0.1z + 0.2 = 0. \]

OR

3'(a) Discuss implementation & benefits of digital controller. Also mention the different methods of realization.

3'(b) Obtain the state transition matrix of discrete time system with system matrix

\[ \begin{bmatrix} 0 & 1 \\ -5 & 6 \end{bmatrix} \]

4(a) Draw the complete block diagram representation of a state observer based control system.
4(b) A second order system is specified as:
\[
\begin{bmatrix}
\dot{x}_1 \\
\dot{x}_2
\end{bmatrix} =
\begin{bmatrix}
0 & 1 \\
0 & 0
\end{bmatrix}
\begin{bmatrix} x_1 \\ x_2 \end{bmatrix} +
\begin{bmatrix} 0 \\ 1 \end{bmatrix} u
\]
\[y = [1 \ 0] [x_1 \ x_2] \]
Find a suitable state feedback gain matrix so as to place both the closed loop poles at \(s = -1\).

OR

4'(a) A system is described by its state model as:
\[
\dot{x} =
\begin{bmatrix}
0 & 1 & 0 \\
0 & 0 & 1 \\
-6 & -11 & -6
\end{bmatrix} x +
\begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} u
\]
\[y = [1 \ 0 \ 0] x \]
Design a reduced state observer for this system having both observer poles at \(s = -10\), assume that the state variable \(x_1\) is available through direct measurement.

4'(b) Explain pole placement design technique.

5(a) Determine the stability of a mass-spring-damper system by assuming a suitable Liapunov's function.

5(b) Define negative definiteness, positive semi-definiteness and indefiniteness of a scalar function, also give example for each.
Note: (i) Attempt all questions. All questions carry equal marks
(ii) You may choose alternative, if indicated by ‘OR’

1. Give the programmable model of 8085 microprocessor and explain the functions of the following registers:
   (i) Instruction Register  (ii) W & Z Registers  (iii) Flag Register
   OR

   (a) Why de-multiplexing of AD7-AD0 is required? How is it achieved with the help of ALE signal?  
   (b) Write a program in 8085 to find the largest of n 8-bit hexadecimal numbers stored in memory.

2. (a) List the various steps of events when one or more interrupt request lines of 8259A go high.  
   (b) Draw the block diagram of 8257 DMA Controller.

3. (a) Write control word and explain the working of 8255 PPI in Mode 2.  
   (b) Draw the interface schematic of AD558 D/A Converter.
   OR

3’. Explain the operating modes of 8254 Interval Timer.

4. (a) Explain the functions of the following in 8086 Microprocessor:
   (i) Instruction Queue (ii) MN/MX (iii) Instruction Pointer
   (b) Explain those flags of 8086 which are not compatible with 8085 microprocessor.
   OR

4’. Describe any six addressing modes of 8086 microprocessor with suitable examples.

5 (a) What do you understand by Pseudo code? Explain with an example.
   (b) Explain the functions of the following instructions of 8086:
      (a) AAA  (b) DDA  (c) MUL src
      OR

   (b’) Explain in brief the hardware interrupt pins in 8086 microprocessor.