EM059

Rajarambapu Institute of Technology, Rajaramnagar

(An Autonomous Institute)

First Year M.Tech. Electrical Engineering (Power Systems) Semester –II Examinations

Power System Planning and Reliability (EE - 502)

Day and Date: Tuesday,15/05/2012

Time: 10.00am to 01.00pm Max Marks- 100

Instructions- (i) ***All* questions are *compulsory***
(ii) *Figures* to the *right* indicate *full* marks
(iii) *Assume* suitable *data* wherever *necessary*

Q1 Solve **any two** of the following

a) Discuss in brief: (i) Long term planning 8
(ii) Medium term planning
(iii)Short term planning.
Explain the differences and applications of each in power system planning..

b) Discuss the classification of loads and growth characteristics of each type. 8

c) Explain : (i) Weather-sensitive load model 8
(ii) Non-weather-sensitive load model.
Discuss how these components are separated from data in practice.

Q2 Solve **any two** of the following

a) Explain the various objectives of the power system planning studies. 8

b) Describe in brief the following methods used for load forecasting: 8
(i)Extrapolation
(ii)Correlation.

c) With reference to the residential and commercial forecasts, explain the following: 8
(i) Peak load forecasting
(ii)Energy forecasting.

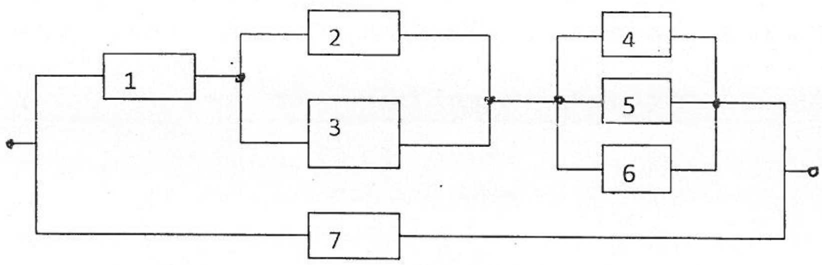
Q3 Solve **any two** of the following

a) Explain: "A bath tub curve" representing total life of a component. For which period of this curve, are the reliability calculations valid? Why? 8

b) Discuss: (i) Probability function of survival P(t) and Failure density function. 8
(ii) Probability function of failure Q(t) and Repair density function.
If the probability function of survival is exponential, having a constant failure rate (λ) and is given by $R(t)=\exp(-\lambda t)$
then prove that

Mean time to failure = $1/\lambda$

c) 8



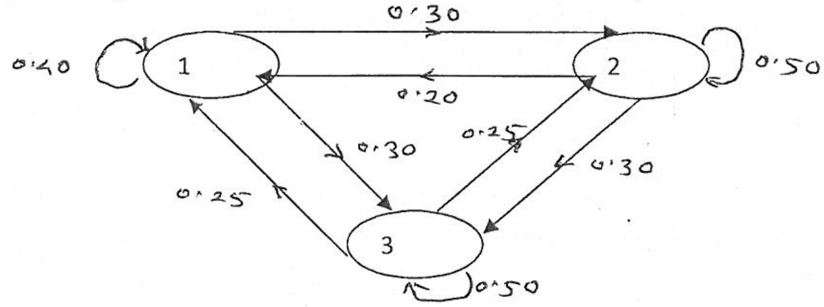
A connection diagram of a system is shown Figure. The reliability of individual components is 0.95. Determine Reliability and Unreliability of the system equivalent.

Q4 Solve **any two** of the following

a) What are the important characteristics of Markov Process? Explain in brief how the Markov Process is used for reliability analysis of power system. 8

b) Discuss: "Stochastic Transition Probability Matrix" and "Limiting values of state probabilities". Explain in detail **any one method** to obtain the limiting values of the state probabilities from the Transition Probability Matrix. 8

c) 8



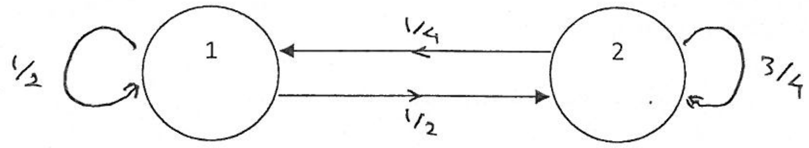
A state space transition diagram with state transition rates is shown in Figure. Determine its "transition probability matrix". Obtain limiting values of the probabilities.(Only **two iterations** need be carried out to illustrate the procedure, if any numerical method is used for the solution.)

Q5 Solve **any two** of the following

a) Explain the Loss of load probability (LOLP) method used for study of the reliability analysis of generating system. 8

b) A generating plant has two 20 MW units and one 30 MW unit. Each unit has a forced outage rate of 0.1. Prepare a capacity outage probability table for this plant. 8

c) 8



A two- state system along with its failure rate and repair rate is shown in Figure. The state probabilities of the system are to be determined **using State Tree Diagram.**

Assuming that the system is initially in "state 1", draw a system tree diagram **up to step- 3** and indicate there on the state probabilities. Prepare a table of step-wise probabilities.

Q6 Solve **any two** of the following

a) Explain: "Frequency and Duration method" used for study of reliability analysis of generating system. 10

b) Explain: "Two-state –time model" representation to describe life-history of a repairable component. 10

With the help of diagram, define:

i)Mean Time to Failure (MTTF)

ii)Mean down time

iii)Mean time between failures (MTBF)

iv)Failure Rate and Repair Rate

v)Cycle, Period and Frequency.

Q 6c) A distribution system consists of a 132/11 kV transformer, 11kV breaker, 11 kV feeder and 11/0.44 kV distribution transformer. It is operating in two- state fluctuating environment, in which the expected values of normal weather period duration and stormy weather period duration are 120hours and 3 hours respectively. 10

The outage rates and repair times under normal, stormy and maintenance are denoted as follows:

λ = Normal weather component failure rate per year,
λ' = Stormy weather component failure rate per year,
λ'' = Component maintenance outage failure rate per year,
r = Expected value of repair time for forced outages, years,
r''= Expected value of maintenance time, years.

The outage rates and repair rates are as under:

Equipment	λ Outages per year	λ'	λ''	r hour	r'' hour
132/11 kV transformer	0.1	0.1	0.5	6	8
Circuit breaker	0.15	0.15	0.4	4	.5
Feeder	1.2	5.2	2.0	5	3
11/0.44 kV transformer	0.3	0.3	0.6	5	4

Find the following: (i) Annual outage rate,
(ii) Down time per outage,
(iii) Total outage time per year of the system.

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EM069

Rajarambapu Institute of Technology, Rajaramnagar
(Autonomous Institute)
M. Tech. Electrical (Power Systems) SEMESTER – II
Power System Dynamics (EE504)

Enroll No.	

Day and Date: Thursday ,17/05/2012
Time: 10.00am to 01.00pm Max Marks - 100

Instructions –

i. All questions are compulsory
ii. Figures to right indicates full marks
iii. Use separate answer books for each section
iv. Use of non programmable calculator is allowed

SECTION I

Q 1	a)	Derive expressions for mutual inductances for stator and rotor circuits	09
	b)	Derive equivalent circuits for direct and quadrature axis using flux linkage equations and write the simplified circuits of rotor and stator	10
Q 2	a)	Incorporate the saturation in equivalent circuits of synchronous machine	09
	b)	Write the dqo transformation and express stator and rotor flux linkages	08
Q 3	a)	Write the basic equations for induction machine in d-q reference frame and obtain the expressions for power and torque	08
	b)	Obtain the synchronous machine modeling neglecting the amortisseurs and derive the phasor diagram under transient conditions	08

SECTION II

Q 4	a)	Explain control protective functions of an excitation system in brief	08
	b)	Explain each type of a.c. excitation system in detail.	08
Q 5	a)	Describe mechanical hydraulic governor with neat diagram and obtain the model	08
	b)	Explain equal are criterion and derive the critical clearing angle	08
Q 6	a)	Figure 1 shows the system representation applicable to a thermal generating station consisting of four 555 MVA, 24 kV, 60 Hz units The network reactance shown in the figure are in per unit on 2220 MVA, 24 kV base. Resistances are assumed to be negligible.	12

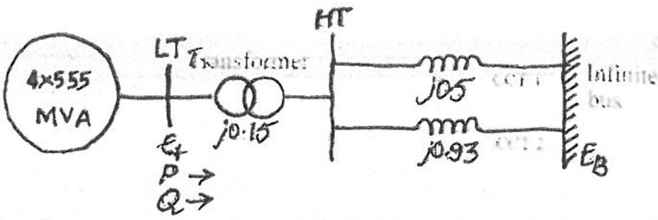


Fig. 1

The objective of this example is to analyze the small-signal stability characteristics of the system about the steady state operating condition following the loss of circuit 2. The post fault system condition in per unit on the 2220 MVA, 24 kV base value as follows:

$P = 0.9 \quad H = 3.5$ MW-s/MVA

a) Write the linearized state equations of the system. Determine the eigenvalues, damped frequency of oscillation in Hz, damping ratio and undamped natural frequency for each of the following values of damping coefficient (in p.u. torque/ speed):
For $K_D = 10$

b) For the case with K_D=10, find the left and right eigenvectors, and participation matrix. Determine the time response if at t=0, $\Delta\delta$=5° and $\Delta\omega$=0.

b) Explain the term voltage collapse and give brief description of typical scenario of voltage collapse 08

EM080

Enroll No.	

Rajarambapu Institute of Technology, Rajaramnagar
(Autonomous Institute)
M. Tech. Electrical (Power Systems) SEMESTER – II
Power System Optimization Techniques (EE506)

Day and Date: Sat. 19/05/2012
Time: 10.00 am to 1.00 pm — Max Marks - 100

Instructions –

i. All questions are compulsory
ii. Figures to right indicates full marks
iii. Use separate answer books for each section
iv. Use of non programmable calculator is allowed

SECTION I

1. Attempt any **TWO** — **20**

a) Maximize $x_1 + x_2$; subject to $2x_1 + x_2 \leq 4;\ x_1 + 2x_2 \leq 3;\ x_1 \geq 0; x_2 \geq 0$

b) Maximize $6x_1 + 14x_2 + 13x_3$;subject to $0.5x_1 + 2x_2 + x_3 \leq 24;\ x_1 + 2x_2 + 4x_3 \leq 60$;

c) Maximize $5x_1 + 3x_2 + x_3 \leq 6$;
subject to $x_1 + x_2 \ + x_2 \leq 6;\ 5x_1 + 3x_2 \ + 6x_2 \leq 15$; $\quad x_1 \geq 0; x_2 \geq 0; x_3 \geq 0$

2. Attempt **Any Two** — **14**

a) Using Lagrangian method solve for economic dispatch. The cost functions are as follows, $C_1 = 0.0008P_1^2 + 0.2P_1 + 5;\ C_2 = 0.0005P_2^2 + 0.3P_2 + 4$
Subject to $P_1 + P_2 = 500$. Neglect losses in system.

b) Find the dimensions of cylinder tin (with top and bottom) made up of sheet metal to maximize its volume such that the total surface area is equal to $A_0 = 24\pi$.

c) Check KT (for necessary and sufficient) conditions for minimum for given function,
$$f = -x_1^3 - 2x_2^2 + 10x_1 - 6 - 2x_2^3$$
Subject to $g_1 = 10 - x_1x_2 \geq 0;\ g_2 = x_1 \geq 0;\ g_3 = 10 - x_2 \geq 0$

3. Attempt **Any Two** — **16**

a) Find the minimum of the function $f(x) = 0.65 - \frac{0.75}{1+x^2} - 0.65\,x\ \tan^{-1}\frac{1}{x}$
Using unrestricted search with a fixed step of 0.1 from the starting point 0.0.

b) Find the minimum of the function $f(x) = 0.65 - \frac{0.75}{1+x^2} - 0.65\,x\ \tan^{-1}\frac{1}{x}$
Using the Cubic Interpolation method with an initial step size of $t_0 = 0.1$

c) Using Gradient method, Minimize $f(x_1, y_2) = x_1 - x_2 + 2x_1^2 + 2x_1x_2 + x_2^2$
starting from the point $x_1 = \begin{Bmatrix}0\\0\end{Bmatrix}$

SECTION II

4. Attempt **Any Two** **14**

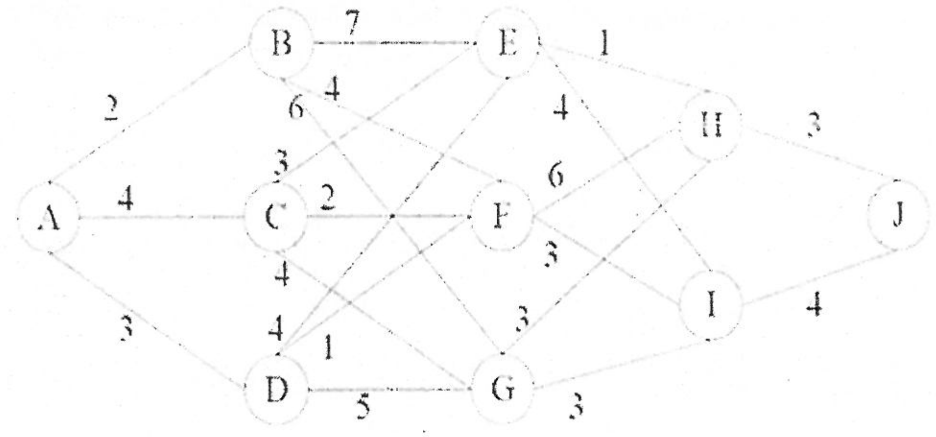
a) Using augmented Lagrange multiplier method,
Minimize $f\,(X) = \;(x_1 - 1)^2 + (x_2 - 1)^2$, subject to $x_1 + 2x_2 - 2 = 0$ with a fixed value of $r_p = 1$. Use a maximum of three iterations.

b) Using augmented Lagrange multiplier method,
Minimize $f\,(X) = \;(x_1 - 1)^2 + (x_2 - 1)^2$, subject to $x_1 + 2x_2 - 2 = 0$ with a fixed value of $r_p = 1$. Use a maximum of three iterations.

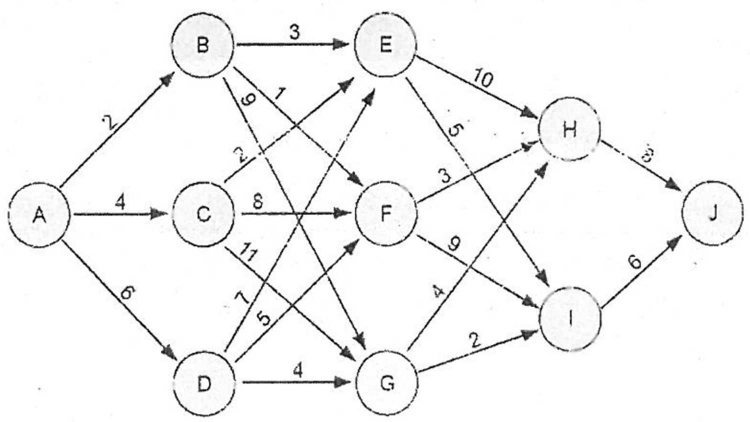
c) Minimize $f(\mathrm{X}) = \;100\,(x_2 - \;x_1^2)^2 + \;(1 - x_1)^2$ and the starting point, $X_1 = \begin{Bmatrix}-1\\1\end{Bmatrix}$. Find the minimum of $f(\mathrm{X})$ along the direction, $\mathrm{S}_1 = \begin{Bmatrix}4\\0\end{Bmatrix}$, using quadratic interpolation method. Use a maximum of two refits.

5. Attempt **Any Two** **18**

a) Using dynamic programming find the shortest distance from A to J through some unsettle areas with minimum cost.



b) Find the cheapest route between 1 and 10.



c) Precision Equipment, Inc., has won a government contract to supply 4 pieces of a high precision part that is used in the fuel throttle-valve of an orbital module. The factory has three different machines capable of producing the item. They differ in terms of setup cost, variable production cost, and the chance that every single item will meet the high-quality standards (Data given in table 1). After the parts are produced, they are sent to the engine assembly plant where they are tested. There is no way to recondition a rejected item. Any parts in excess of four, even if good, must be scrapped. If less than 4 parts are good, the manufacturer has to pay a penalty of $200 for each undelivered item. How many items should be produced on each machine in order to minimize total expected cost?

Machine	*Setup cost* (\$)	*Variable cost* (\$/unit)	*Probability of meeting standards*
A	100	20	0.50
B	300	40	0.80
C	500	60	0.90

6. Attempt **Any Two** **18**

a) Using Gradient Method solve the economic dispatch for a total of 800MW using these generator cost functions

$$F_1(P_1) = 1683 + 23.76\,P_1 + 0.004686\,P_1^2$$
$$F_2(P_2) = 930 + 23.55\,P_2 + 0.00582\,P_2^2$$
$$F_3(P_3) = 234 + 23.70\,P_3 + 0.01446\,P_3^2$$

Use $\alpha = 100\%$ and starting from $P_1^{[0]} = 300\ MW$, $P_2^{[0]} = 200\ MW$, $P_3^{[0]} = 300\ MW$

b) The fuel inputs per hour of two plants are given as

$$F_1(P_1) = 0.00889\,P_1^2 + 10.333\,P_1 + 200\ \text{Rs/h}$$
$$F_2(P_2) = 0.00741P_2^2 + 10.833\,P_2 + 240\ \text{Rs/h}$$

Using Newton method, determine the economic schedule (only one iteration) to meet the demand of 150MW and the corresponding cost of generation. The transmission losses are given by

$$P_L = 0.001\,P_1^2 + 0.002\,P_2^2 - 2 \times 0.0002\,P_1 P_2$$

c) Two units of the system have the following cost curves:

$$C_1 = f(P_1) = 0.05\,P_1^2 + 22\,P_1 + 120\ \text{Rs/h}$$
$$C_2 = f(P_2) = 0.06P_2^2 + 16P_2 + 120\ \text{Rs/h}$$

where P is in MW. Both the units operate at all times and the maximum and minimum loads on each unit are 100MW and 20 MW, respectively. Determine the economic operating schedule of the plants for loads of 80 MW. Use Genetic algorithm

Rajarambapu Institute of Technology, Rajaramnagar **EM090**

(An Autonomous Institute)

Enroll No.	

First Year M. Tech Electrical (Power Systems) SEMESTER – II
Energy Management and Energy Audit Subject Code: EE 510

Day and Date: Tuesday,22/05/2012
Time: 10.00am to 01.00pm

Max Marks - 100

Instructions –

i. All questions are compulsory
ii. Figures to right indicates full marks
iii. Assume suitable data whenever necessary
iv. Use separate answer books for each section

SECTION – I

1. Attempt any **THREE** **(6 x 3 = 18)**

a. List and explain the strategies for better energy security of the nation?
b. What are the managerial functions involved in energy management
c. Briefly describe the economic reforms in Coal, oil and natural gas and electricity sectors.
d. State the importance of energy policy for industries?

2. Attempt any **TWO** **(8 x 2 = 16)**

a. Explain why managerial skills are as important as technical skills in Energy Management
b. Explain the methodologies involve in detailed energy audits?.
c. Explain the role of training and awareness in energy management program?

3. Attempt any **TWO** **(8 x 2 = 16)**

a. Explain briefly the difference between preliminary and detailed energy audits?
b. What are the various steps in the implementation of energy management in an organization.
c. How Sankey diagram is useful for energy analysis

SECTION – II

4. Attempt any **TWO** **(8 x 2 = 16)**

a. Draw a typical input output diagram for a process and indicate the various energy inputs?
b. Draw a process flow chart for any product manufacture
c. What are the requirements of the successful energy management program?

5. Attempt any **TWO** **(9 x2 = 18)**

a. Why is the top management support essential for success of energy management
b. Discuss the importance of training for effective energy management?
c. What is the difference between monitoring and targeting.

6. Attempt any **TWO** **(8 x 2 = 16)**

a. What is the barrier to the use of energy information systems?
b. What do you understand by the term "benchmarking" and list few benefits.
c. Explain energy conservation act-2001 and 2003

Rajarambapu Institute of Technology, Rajaramnagar **EM100**

(An Autonomous Institute)

Enroll No.	

First Year M. Tech Electrical (Power Systems) SEMESTER – II
Distribution System Engineering Subject Code: EE512

Day and Date: Thursday ,24/05/2012
Time: 10.00am to 01.00pm
Max Marks - 100

Instructions –

i. All questions are compulsory
ii. Figures to right indicates full marks
iii. Assume suitable data whenever necessary
iv. Use separate answer books for each section
v. Use of non programmable calculator is allowed

SECTION – I

1. Attempt any **THREE.** **(6 x 3 = 18)**

a. Explain short term and long term planning for distribution system.
b. Explain the characteristics of different loads and load models
c. Explain contribution of distribution generation form renewable energy sources.
d. What are the different types of supply systems that are adopted for transmission of electric power? Give comparison

2. Attempt any **TWO** **(8 x 2 = 16)**

a. How is the design of distribution system done? Discuss the factors that contribute for design.
b. Explain the factors that are to be considered in selecting ideal substations.
c. Give comparison between a 3 wire DC system and single phase Ac system with mid point earthed

3. Attempt any **TWO** **(8 x 2 = 16)**

a. Let points A and B be connected to 250 V dc supply. The length of the feeders are AD=50m, DE=150m,EB=400m,BC=100m and CA=200m The resistance per km=0.2Ω Determine the minimum voltage point.
b. Explain the basic function of booster transformer? How does it increase the line voltage?
c. What is importance of % voltage drop in feeder lines? What are the factors that affect %VD

SECTION – II

4. Attempt any **TWO** **(8 x 2 = 16)**

a. What is series capacitor compensation in feeder lines? How does it improve the regulation of the lines?

b. What are the different locations for p.f. improvement capacitors? Discuss their relative advantages and disadvantages.

c. Why is distribution automation needed? Discuss the different elements with their functional role in distribution automation?

5. Attempt any **THREE** **(6 x 3 = 18)**

a. Compare and explain role of a shunt and series capacitors in p.f. correction
b. How is the voltage level for distribution systems decided
c. Draw single line diagram of 33kv/ 11kv substation
d. What are the different methods for voltage control? Briefly explain them
e. Explain the use of Data management system .

6. Attempt any **TWO** **(8 x 2 = 16)**

a. A single phase distributor 1 km long has resistance and reactance 0.4 Ωand 0.6 Ω (go and return) respectively. At the far end the voltage Vb =240 V and the current is 100A at a p.f. of 0.8 lag. At the mid -point B of the distributor current of 100A is taped at a p.f. of 0.6 lag with reference to Vb at the mid-point. Calculate the supply voltage Vs for the distributor and the phase angle between supply end and receiving end

b. A 2-wire feeder ABC has a load of 60A at C and of 30A at B both at p.f. 0.8 lagging. The impedance AB is (0.8+j0.16) Ω and that of BC is (0.16+j0.24) Ω If the voltage at the far end C is to be maintained at 400V determine voltage at A and voltage at B

c. A 500m long single phase A.C. distributor has a total impedance of (0.02+j0.04) Ω and is fed from one end at 240V. It is loaded as follows : 50A at unity p.f. 200m from feeding point :100A at 0.8 p.f. lagging, 300m from feeding point ; 50Aat 0.6 p.f. lagging at the far end. Calculate total voltage drop and voltage at the far end.