2010–11
M.TECH. (II SEMESTER) EXAMINATION
ELECTRICAL ENGINEERING
(Power System and Drives)
Advance Electric Drives-II
(EE-612)

Maximum Marks: 75
Duration: Three hours

Answer any five questions.
Assume suitable value for missing data, if any

Q.1 (a) Mention the relative features of ac and dc drives. Highlight the superiority of ac drives over dc drives.
(b) Derive an expression for torque, for a frequency controlled Induction Motor drive at constant flux in the range of speed below rated value. Draw the speed-torque characteristics for this case.

Q.2 Explain in detail, the operation of an Induction Motor when fed from non-sinusoidal power supply. Illustrate the behavior of the motor by harmonic equivalent circuit, mathematical expressions and other supporting diagrams.

Q.3 A 440 V, 50 Hz, 6 pole, 960 rpm, Y connected, sq. cage induction motor has following parameters for the approximate equivalent circuit:
Rs = 0.6 Ω, Xs = 1 Ω, Xm = 50 Ω, Rr = 0.3 Ω, Xr = 2 Ω.
The machine is controlled by a six step inverter at a constant (V/f) ratio. Calculate the motor speed at half the rated torque and inverter frequency of 40 Hz. Also calculate the motor input current, efficiency and power factor.
The motor is fed from 400 V, 50 Hz, 3 ph ac source through a phase controlled rectifier connected to a voltage source inverter through a dc link. Calculate the rectifier firing angle, input current and power factor at this operating point.
Neglect friction, windage, core loss, skin effect, motor derating due to harmonics and losses in inverter, filter and rectifier. Assume the rectifier output current to be ripple free.

Q.4 Draw a schematic diagram of Static Scherbius drive and explain its operation. Derive its steady state equivalent circuit. Establish the relationship for the torque. Draw its steady state characteristics and comment on its performance.

Q.5 Mention the salient features of vector control of Induction Motor. Explain the...
principle of vector control of Induction Motor. Illustrate the algorithm of its implementation.

Q.6  (a) With the help of block diagram explain various ways of realizing a 3 phase current source to drive an Induction Motor.
(b) With the help of suitable diagram, briefly explain the basic principle of true synchronous mode and self control mode of operations of synchronous motor.

Q.7  With the help of circuit diagram and relevant waveforms, explain the operation of a self controlled synchronous motor supplied from a 3 phase variable frequency current source inverter. Also describe a closed loop control of a self controlled synchronous motor fed from a current source inverter.
2010 – 2011
M.TECH (II Semester) EXAMINATION
ELECTRICAL ENGINEERING (Power System & Drives)
POWER SYSTEM STABILITY (EE – 633)

Max. Marks: 75

Note: Answer FIVE questions. Question number 6 & 7 are compulsory.
Assume suitably, any missing data.
Symbols have their usual meanings.

1 (a) Distinguish between steady state and dynamic stability. Enumerate the steps to carry out dynamic stability study of a power system.
(b) For the system shown in figure 1, a three phase fault occurs at point F on the short transmission line. The machine is delivering 1 pu power and both the terminal voltage and infinite bus voltage are 1 pu. The pu reactances are marked on the figure. Calculate the critical time for the fault.

(7+8)

2 (a) What is meant by critical clearing angle? How it can be used for planning the operations in restoring the stability of a power system under various fault conditions.
(b) Explain ‘point by point’ method for solving the swing equation. Compare this method with ‘equal area criterion’ method.

(7+8)

3 (a) How can modified Euler’s method be used for transient stability studies? Explain the iterative procedure.
(b) Using the classical model, derive equation of the form \( X = AX + BU \) for a SMIB system.

(7+8)

4 (a) Discuss how PV and QV curves can help in analyzing voltage stability of power system. What are advantages of QV curves?
(b) Discuss how generation system, transmission system and distribution system can be planned for improvement of voltage stability.

(7+8)

5 (a) Define ‘asymptotic stability’ and global asymptotic stability’ of a non-linear system in the sense of Liapunov.
(b) With help of a block diagram explain various components of a practical Power system stabilizers.

(7+8)
Answer any three of the following
(i) Explain why is dynamic instability more probable than transient instability?
(ii) Discuss the aim and the points to be considered for application of PSS.
(iii) Differentiate between voltage stability, voltage security and voltage collapse.
(iv) How are different input signals to a PSS obtained?

For a 50 Hz system consisting of a generator supplying power to an infinite bus, the inertia constant (H) is 5MJ/MVA. The magnitude of generated voltage is 1.17 pu, the initial operating angle is 26.38° with the initial power delivered to infinite bus being 0.8 pu.

Prefault power transfer is given by 1.8 Sinδ
Power transfer during fault is given by 0.65 Sinδ
Post fault power transfer is given by 1.4625 Sinδ

If the fault occurs at t=0 and is cleared in 0.15 seconds, plot the swing curve using step by step method. Take step size of 0.05 seconds.

\[ X_d' = 0.25 \]

\[ f_0 = 0.1 \]

\[ f_0.5 \]

\[ 1.0.5 \]

\[ \text{Infinite bus} \]

**FIGURE: 1**
1. (a) A static compensator of TSC-TCR type is to be designed for 50-Hz transmission line with nominal system voltage of 400-kV. At 1 p.u. voltage the maximum production should be 200-MVAR and maximum absorption should be 100-MVAR. The two sections of identical TSC branches are tuned for 5th harmonics.
   (i) Determine the value of different components of the compensator assuming the transformer has leakage reactance of 15%. Give the schematic of the system and mark the values of each component.
   (ii) Give the following characteristics of the compensator and mark the critical values on it:
   1. sum of TSC currents vs SVC current
   2. TCR current vs SVC current.

(b) With the help of relevant characteristics explain the advantages of having slope in the V-I characteristics of an SVC.

2. (a) Derive the expression for mid-point voltage of a symmetrical transmission line being compensated at mid-point by an SVC, which is represented by a voltage source \( E_c \) behind a reactor \( B_L \). Discuss the power being transmitted when (i) \( E_c = 0 \), and (ii) \( B_L \) tending to infinity.
   (iii) Derive the relation for reactive power generated / absorbed by the SVC in the above.

(b) For a simple single machine infinite bus-bar system explain the principle of PSDC applied to the SVC placed at the mid-point of the transmission line.

3. (a) With the help of neat circuit diagram describe the principle of working of STATCOM. Derive the dq-model of the STATCOM.

(b) How real power flow can be handled in STATCOM? Discuss if real power flow is required for the operation with voltage control objectives. Clearly indicate the way of achieving it, if required.
4. (a) Give the net sketch of the circuit diagram for a practical TCSC showing its different components. Explain the functions of the components.

(b) Explain the principle of operation of TCSC. Derive the expression for the current in the thyristor and voltage across the capacitor of the TCSC in terms of conduction angle ($\sigma$).

5. (a) With the help of neat circuit diagram give the principle of working of SSSC. Compare it with TCSC.

(b) With the help of block diagram, explain how control is achieved for real and reactive power exchange between the transmission line and an SSSC connected at an appropriate location.

6. (a) A three-phase unbalance load is connected in delta. The admittances are $Y_{AB}$, $Y_{BC}$, and $Y_{CA}$. Derive the expressions of the admittances of the compensator required to compensate this load.

(b) Give the neat circuit diagram of UPFC and explain its principle of operation. Give an account of its different capabilities. Explain them with the help of relevant phasor diagram or otherwise.
2010-11
II Semester M. Tech. Examination
Electrical Engineering (Instrumentation & Control)
IDENTIFICATION & ESTIMATION (EE-642)

Maximum Marks: 75
Duration: Three Hours

Question No. 1 is compulsory.
Answer any three questions from question 2 to 6.

1. Distinguish between the following:

i) Identification and Estimation
ii) Markov Process and Memory less Process
iii) Kalman and Wiener Filter
iv) Stationary and Non Stationary Systems
v) Coloured Noise and White Noise

(15)

2. (a) Define:

i) Probability Density Function
ii) Baye’s Estimator
iii) Unbiased Estimator
iv) Filter

(10)

(b) For a single input single output linear system develop a scheme for Impulse response Identification using Wiener Hopf equation.

(10)

3. (a) Discuss the common sources of error in Impulse response identification.

(b) Discuss the estimation method using Pontryagin’s principle when statistical information about the system is not available a priori.

(08) (12)

4. (a) Discuss the significance of expected value operator and explain its properties.

(b) Discuss the role of Kalman Filter in control system analysis and design. Also explain the algorithm of a Discrete Kalman Filter.

(08) (12)

5. (a) What is the role of White noise in modeling of systems? Also discuss its properties.

(b) What is the difference between Kalman and Extended Kalman Filter. Explain the algorithm of Extended Kalman Filter for modeling of a non linear system. The relationship between measurement and system state is also non linear.

(08) (12)

6. Write technical notes on the following

i) Significance of Identification and Estimation in dynamic system analysis.

ii) Different criteria for optimal estimation.

iii) Crammer Rao Lower Bound

(07 + 07 +06)
Question no. 1 is compulsory. Attempt any three of the remaining questions.

Q.1 Write detailed notes on any two of the following: (7½ x 2)
(i) Biomedical Amplifiers
(ii) Transducers for body temp. measurement
(iii) Pulse sensors
(iv) Artificial kidney

Q.2 (a) What is action potential? Discuss the properties of cell membrane? Describe threshold phenomenon in elongated cells. (12)

(b) Explain the importance of active sodium transport. Derive the expression for the energy requirement for active sodium transport. (8)

Q.3 (a) Describe Electrocardiograph. What are its leads systems? Also discuss the effects of artifacts in ECG. (12)

(b) Describe the cardiovascular system with help of neat diagram. (8)

Q.4 (a) How does a muscle function? Explain with the help of block diagram the muscular servomechanism. (12)

(b) What is EMG? Describe the different types of leads used in Electromyographic system. (8)

Q.5 (a) What is a nerve cell? How does impulses are conducted by human nerve cell. (12)

(b) Explain the 10-20 lead system for EEG. What are the various applications of EEG? (8)
Maximum Marks: 75

Note:
(i) Answer four questions.
(ii) Question No. 1 is compulsory carrying 15 marks.
(iii) Question 2 - 6 carry 20 marks each.
(iv) Notations have their usual meaning.

1. Write notes on any three of the following? (3x5)
   (a) Testing of insulating materials & dielectrics.
   (b) Testing of Capacitors.
   (c) Impulse testing of lightning arrestors.
   (d) Need for impulse voltage and current testing.

2. Discuss in detail the detection and location of faults during impulse testing of transformers. (20)

3. (a) Describe the arrangements made for impulse testing of large power transformers. (14)
   (b) Briefly describe the procedure used for impulse testing of transformers. (06)

4. (a) Describe the basic principle of generation of high impulse voltage. Prove that an impulse voltage wave is sum of two exponential waves. (10)
   (b) Derive the equation for time to front and time to tail in terms of impulse voltage generator circuit parameters. (10)

5. (a) Discuss the circuits for impulse current testing of lightning arrestors and establish the relation \( t_f/t_m - \ln \left( t_f/t_m \right) = 1.693 \). (15)
   (b) Discuss the Indian standard wave shape for impulse current testing. Mention the tolerances permitted. (05)

6. (a) “Voltage dividers” as a mean for impulse voltage measurement. Discuss. (10)
   (b) Discuss requirements for Oscillation-free recording of impulse voltage waves and derive conditions for matching. (10)

*****
2010 – 2011
M.TECH.(II-SEMESTER ) EXAMINATION
(ELECTRICAL ENGINEERING)
ARTIFICIAL NEURAL NETWORKS AND APPLICATIONS
(EE – 681 )

Maximum Marks: 75

Attempt any five questions.
First question is compulsory.

1 (a) Compare the performance of a computer and that of a biological neural network.
(b) Give a real life example of a pattern mapping problem.
(c) What is meant by gradient descent methods?
(d) What is the significance of momentum term in backpropagation learning?
(e) Mention three important properties that neuronal signal functions should posses.

2 (a) Compare LMS, Perceptron and Delta learning laws.
(b) What is reinforcement learning? In what way it is different from supervised learning?

3(a) Explain the limitations of backpropagation learning.
(b) Explain the difference between short term memory and long terms memory reference to dynamics models.

4 (a) Describe the Boltzmann Machine. What is the basis for Boltzmann learning law?
(b) What is the Hopfield model of neural networks? Explain the differences between discrete and continuous Hopfield models in terms of energy landscape and stable states.

5(a) How are self-organizing networks different from classical supervised learning feed-forward networks?
(b) What is meant by simulated annealing? What is annealing schedule?

6 (a) What are the salient features of the Kohonen’s self organing learning algorithm?
(b) Write a short notes on any one
   (i) Optical Neural Networks
   (ii) Cognitron Neural Networks
   (iii) Neocognitron Neural Networks

7 Write a detail note on an application of Artificial Neural Networks in the field of Electrical Engineering.
2010 – 2011
M.TECH (II SEMESTER) EXAMINATION
(ELECTRICAL ENGINEERING)
(Power System and Drives/Instrumentation and Control)
Optimization Techniques
(EE-683)

Maximum Marks: 75
Duration: Three Hours

Note:
(i) Answer four questions.
(ii) Question No. 1 is compulsory.
(iii) Symbols carry their usual meaning.
(iv) Assume missing data, if any appropriately.

1. A manufacturing firm produces two products A and B using two limited resources. The maximum amount of resource '1' available per week is 1000 and amount of resource 2 is 250. The production of one unit of A requires 1 unit of resource 1 and 0.2 unit of resource 2 and the production of one unit of B requires 0.5 unit of resource 1 and 0.5 unit of resource 2. The unit cost of resource 1 is (0.375 – 0.00005 u₁) where u₁ is number of units of resource 1 used.

The unit cost of resource 2 is (0.75 – 0.0001 u₂) where u₂ is the number of units of resource 2 used.

The selling prices of one unit of A and B can be taken as:

\[ p_A = 2.0 - 0.0005x_A - 0.00012x_B \]
\[ p_B = 3.5 - 0.0002x_A - 0.0012x_B \]

Where \( x_A \) and \( x_B \) are the number of units sold for products A and B respectively. Assuming the firm is able to sell all the units it manufactures, formulate the optimization problem of maximizing the profit over a week. State also standard mathematical statement of optimization problem formulated.

2. (a) State multivariable optimization problem with equality constraints. Discuss necessary and sufficient conditions to solve such problems by method of Lagrange Multipliers.

(b) Using method of Lagrange multipliers,

Maximize, \( f(\bar{x}) = \pi x_1^2 x_2 \)

Subject to: \( g(\bar{x}) = 2\pi x_1^2 + 2\pi x_1 x_2 - A_0 = 0 \)

where, \( A_0 = 24\pi \)

3. (a) Classify various techniques for unconstrained non-linear optimization problems and describe computational algorithm for optimizing such problems using univariate method.

(b) Explain the following:

(i) Pattern search direction
(ii) Conjugate direction
(iii) Steepest descent search direction.

Contd…..2
4. (a) Write an algorithm for optimizing non-linear programming problems using Variable-Fletcher-Powell method. Explain what do you understand by variable metric nature of this method? (10)

(b) Explain basic approach in Penalty Function method. Describe a computational algorithm using Interior Penalty Function method.

5. (a) State a Linear Programming problem in:

(i) Scalar form
(ii) Matrix form

(b) Explain when an LP problem has:

(i) Unbounded solution
(ii) No solution
(iii) Infinite number of optimal solutions
(iv) Unique and finite number of optimal solution

(c) State the following LP problem in standard form:

Maximize \( F = 2x_1 - x_2 + 5x_3 \)

Subject to constraints

\[
\begin{align*}
x_1 - 2x_2 + x_3 & \leq 8 \\
3x_1 - 2x_2 & \geq -18 \\
2x_1 + x_2 - 2x_3 & \leq 4 \\
x_3 & \geq 0
\end{align*}
\]

6. (a) A progressive university has decided to keep its library open round the clock and gathered that the following number of attendants are required to reshelve the books:

<table>
<thead>
<tr>
<th>Time of day (hours)</th>
<th>Minimum Number of attendants required</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-4</td>
<td>4</td>
</tr>
<tr>
<td>4-8</td>
<td>8</td>
</tr>
<tr>
<td>8-12</td>
<td>10</td>
</tr>
<tr>
<td>12-16</td>
<td>9</td>
</tr>
<tr>
<td>16-20</td>
<td>14</td>
</tr>
<tr>
<td>20-24</td>
<td>3</td>
</tr>
</tbody>
</table>

If each attendant works eight consecutive hours per day, formulate the problem of finding minimum number of attendants necessary to satisfy the above requirements as a LP problem. (10)

(b) With the aid of block – diagram, explain the representation of ‘multistage decision process’ problems and write the necessary design equations. State also mathematically a Dynamic programming problem.