2011-2012
M.TECH WINTER (II SEMESTER) EXAMINATION
ELECTRICAL ENGINEERING
(Power System and Drives)
ADVANCE ELECTRIC DRIVE II
EE-612

Maximum Marks: 60
Duration: Three Hours

"Students governed by the old ordinances will be examined out of 60 marks and their obtained marks shall be proportionally raised"

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

| Q.1 | (a) Explain the variable frequency speed control method of an Induction Motor at constant flux below base frequency and at constant voltage above base frequency. Derive the mathematical expressions for speed-torque characteristics. Highlight the difficulties in the implementation of such a scheme. What are the problems encountered in variable frequency speed control if V/f is held constant instead of flux? Elaborate your answer with the help of mathematical analysis. | (8) |
| (b) A 460 V, 60 Hz, 4 pole, 1720 rpm, Y connected Induction Motor has the following parameters per phase referred to stator: 
\[
R_s = 0.5 \ \Omega, \ R_r = 0.2 \ \Omega, \ X_{ls} = X_{lr} = 1 \ \Omega, \ X_m = 30 \ \Omega
\]

The motor is braked by regenerative braking with variable frequency control at constant rated flux. Calculate the motor speed at half the rated braking torque and 30 Hz. (Use exact equivalent circuit) | (4) |

cont'd... 2
Q.2  (a) Draw the block diagram of closed loop speed control of CSI fed variable frequency Induction Motor drive with slip speed control.

(b) A 3-ph, 400 V, 50 Hz, 6 pole, 10 kW, 960 rpm, star connected, wound rotor Induction Motor has the following parameters:
\[ R_s = 0.4 \, \Omega, \, R_r = 0.6 \, \Omega, \, X_{ls} = X_{lr} = 2 \, \Omega \]
The stator to rotor turn ratio is 2.5

The speed at full load torque is reduced to 500 rpm by injecting a voltage into the slip rings. Calculate the magnitude and frequency of the injected voltage. Assume the injected voltage is in phase with \( V \).

Q.3  (a) Describe the operation of an Induction Motor from a fixed frequency current source. Derive the relevant expressions and find its speed torque characteristics. Highlight its main features.

(b) A 400 V, 50 Hz, 6-pole, 960 rpm, Y connected Induction Motor has the following parameters per phase referred to stator.
\[ R_s = 0.4 \, \Omega, \, R_r = 0.2 \, \Omega, \, X_{ls} = X_{lr} = 1.5 \, \Omega, \, X_m = 30 \, \Omega \]
The motor is fed by variable frequency current source. At all operating points, the motor is made to operate at rated flux. Calculate the frequency and stator current for operation at 500 rpm for the following torque values:
(i) 139 Nm and (ii) -188 Nm.

Q.4  A 460 V, 60 Hz, 4 pole, 1760 rpm, Y connected sq. cage induction motor has following parameters per phase referred to stator:
\[ R_s = 0.14 \, \Omega, \, X_{ls} = 0.4 \, \Omega, \, R_r = 0.08 \, \Omega, \, X_{lr} = 0.8 \, \Omega, \, X_m = 15 \, \Omega. \]
The drive is controlled at a constant (V/f) ratio instead of constant flux. Calculate:

(a) The motor speed, input current, efficiency, power factor and rectifier power factor for an inverter frequency of 40 Hz and 80% of rated torque.

(b) If the minimum inverter frequency is restricted to 6 Hz, calculate the
breakdown torque for motoring as well as breaking at 6 Hz as the ratio of respective breakdown torques at 60 Hz. Also calculate the starting torque as a percentage of starting torque obtained with constant flux control.

Neglect friction, windage, core loss, skin effect, motor derating due to harmonics. Use approximate equivalent circuit.

| Q.5  | (a) Draw the circuit diagram for speed control of Induction Motor by static rotor resistance control. Mention its advantages and disadvantages. Derive the equivalent circuit for the scheme and establish the mathematical expression for the torque. Find the speed-torque characteristics. | (8) |
|      | (b) Compare the relative merits and demerits of static Scherbius and Kramer’s drive.                                                      | (4) |

| Q.6  | (a) Derive the Norton’s equivalent circuit for a wound rotor synchronous motor. On the basis of this draw the corresponding phasor diagram. Also derive the torque expression in terms of stator and field flux linkages. | (8) |
|      | (b) With the help of neat diagram show the constructional details of a trapezoidal magnet machine and explain its operation.                                      | (4) |

| Q.7  | (a) Explain the speed control of synchronous motor in true synchronous mode.                                                          | (4) |
|      | (b) With the help of suitable diagrams, explain the implementation details of a self-controlled operation of a CSI fed synchronous motor.                 | (8) |
2011–2012
M. TECH. (II SEMESTER) EXAMINATION
ELECTRICAL ENGINEERING (Power System & Drives)
POWER SYSTEM STABILITY
(EE 633)

Maximum Marks – 60

Duration: Three Hours

"Students governed by the old ordinance will be examined out of 75 marks and their obtained marks shall be proportionately raised".

Note:

1. Answer any FOUR questions.
2. All Symbols have their usual meaning.
3. Assume missing data, if any.

1. a) A 60 Hz synchronous generator has a transient reactance of 0.2 per unit and an inertia constant of 5.66 MJ/MVA. The generator is connected to an infinite bus through a transformer with reactance of 0.158 per unit and a double circuit transmission line with reactance of 0.8 per unit each, as shown in the Fig. 1. Resistances are neglected. The generator is delivering an active power of 0.77 per unit to bus bar #1. Voltage magnitude at bus #1 is 1.1 per unit. The infinite bus voltage $V_b = 1.0\angle0^\circ$ per unit. Determine the generator excitation voltage and obtain the swing equation in standard form.

b) A 50 Hz synchronous generator is transferring power to a load through a short line. The power angle equation is $P_e = P_{max} Sin\delta$. The generator is delivering a power of $P_e$ when a three-phase fault occurs at its terminals; obtain expression for critical clearing angle. For $P_{max} = 2$ pu, $P_e = 1$ pu and $H = 6$ MJ/MVA, calculate critical clearing angle and critical clearing time.

2. a) Investigate the dynamic stability of the following system at the operating point by eigen-value analysis.

$$\dot{x} = \begin{bmatrix} 0.20 & -26.01 \\ 1.00 & -0.60 \end{bmatrix} x + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u$$

b) Discuss the basic design criterion of Power System Stabilizers. What are different objectives of PSS design? With the help of block-diagram give details of a practical PSS.

3. a) The ABCD constants of a transmission line are: $A = D = 0.95\angle1.3^\circ$, $B = 92.5\angle82.5^\circ$ ohms and $C = 0.0006\angle90^\circ$ $S$. Find the steady state power limit of the line if the voltage at both the end of the line are held at 220 kV. Also calculate the reactive power requirement at the receiving end under this condition if the power factor of the load is unity.

b) Obtain the dynamical equation, in state space form, of the IEEE Type I excitation system as shown in Fig. 2.

4. Utilizing the network Jacobian as the interconnection, obtain dynamical equations, in state-space form, of a multi-machine power system for dynamic stability analysis. Loads may be represented as:

$$P_{hi} = K_p i V_i^{np} \quad \text{and} \quad Q_{hi} = K_q i V_i^{nq}$$

Contd…..2
5. The bus admittance matrix of a three-bus, two-machine power system on 100 MVA base is:

\[
Y_{\text{bus}} = \begin{bmatrix}
6.250 - j18.695 & -5.000 + j15.00 & -1.250 + j3.750 \\
-5.000 + j15.000 & 10.833 - j32.415 & -1.667 + j5.000 \\
-1.250 + j3.750 & -1.667 + j5.000 & 12.917 - j38.695
\end{bmatrix}
\]

The load-flow results of the system and machine data on 100 MVA base are as follows:

<table>
<thead>
<tr>
<th>Bus No.</th>
<th>Bus Voltage</th>
<th>Generation</th>
<th>Load</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Magnitude</td>
<td>Angle</td>
<td>MW</td>
</tr>
<tr>
<td>1</td>
<td>1.06</td>
<td>0.00°</td>
<td>42.50</td>
</tr>
<tr>
<td>2</td>
<td>1.05</td>
<td>1.20°</td>
<td>40.00</td>
</tr>
<tr>
<td>3</td>
<td>1.04</td>
<td>-2.10°</td>
<td>-</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>M/C #</th>
<th>Bus #</th>
<th>H</th>
<th>(T_{do}')</th>
<th>(x_{d}')</th>
<th>(x_d)</th>
<th>(x_q)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>25.00</td>
<td>3.50</td>
<td>0.10</td>
<td>0.35</td>
<td>0.30</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>4.50</td>
<td>4.00</td>
<td>0.50</td>
<td>1.60</td>
<td>1.50</td>
</tr>
</tbody>
</table>

Modify \(Y_{\text{bus}}\) and calculate the internal bus voltages of machines that are required for transient stability analysis. The effect of transient saliency and changes in field flux linkages of the machines can be neglected. The loads are to be represented as constant impedances to ground.

6. a) With the help of V – P and Q – V curves, define voltage stability and voltage collapse of a power system.

b) Discuss the role of reactive power on voltage stability of a power system. Describe various methods of reactive power compensation.
A 400 kV, 50 Hz, 500 km long lossless line is operated at rated voltage. A SSSC is connected at the midpoint of this line. At operating angle $\delta = 30^\circ$, the current at the midpoint is same as the current in the line when a series capacitor with $X_C = 97 \Omega$ is connected. Given, $L = 1 \text{mH/km}$, $C = 11 \times 10^{-9} \text{F/km}$

(a) Compute the reactive voltage injected.

(b) With the voltage calculated above, what is the maximum power flow in the line? What is the value of $\delta$ at this condition?

(c) Compute the power flow at $\delta = 0$. What are line voltages at the two terminals of the SSSC

$\text{OR}$

A three phase, 400 kV, 50 Hz, 800 km long line is operating with $V_S = V_R = V = 1.0$ p.u. and $\delta = 60^\circ$. A SVC is planned to be connected at the midpoint of the line to increase power transfer capability. The limits on the control range correspond to $\delta = 30^\circ$ and $\delta = 90^\circ$.

(a) Find the limits of SVC susceptance if slope $X_S$ of the control characteristics is 0.0 and 0.05 p.u.

(b) What is the maximum power flow for the two cases given above? Given: $Z_n = 300 \Omega$, $\beta = 0.06^\circ/\text{km}$

2. Using suitable figures discuss the various operating modes of a TCSC. Derive the expression for the current in the thyristor and voltage across the capacitor of the TCSC in terms of conduction angle ($\alpha$).
3. (a) What are objectives of series compensation?  
(b) Using suitable figures explain how transient stability enhancement is attained by SVC and STATCOM.

4. (a) What are technical advantages of STATCOM over SVC?
(b) Using equivalent circuit of a line with STATCOM at the midpoint, derive expression for midpoint voltage, current and power transferred.

5. (a) What does UPFC stand for? Using a simple schematic discuss the components of a UPFC.
(b) What are hybrid VAR generators? Discuss V-I characteristics for various hybrid generators.
2011-2012
M.TECH. WINTER (II SEMESTER) EXAMINATION
(ELECTRICAL ENGINEERING)
(Instrumentation and Control)
Identification & Estimation
(EE – 642)

Maximum Marks: 60

Duration: Three Hours

"Students governed by the old ordinance will be examined out of 75 marks and their obtained marks shall be proportionately raised".

Note:
Answer any FOUR questions.

1. (a) Discuss the significance of Identification and Estimation in the analysis of dynamic systems. (07)
   (b) Explain the parameters used to judge the quality of an estimate. (08)

2. (a) Compare the Identification process with the theoretical modeling process. Also explain the constraints in the process of identification. (10)
   (b) Discuss the significance of white noise in Identification and Estimation and mention its important properties. (05)

3. (a) Discuss the classification of estimators (05)
   (b) Explain the least squares method of estimation and derive the expressions involved. (10)

4. (a) Why impulse response is the most common method of identification? What are different sources of error in impulse response identification? (05)
   (b) Derive the equations for deconvolution method of impulse response identification. (10)

5. (a) Discuss various criteria for optimal estimation (05)
   (b) With the help of equations involved discuss the principle of operation and utility of Kalman Filter as a predictor corrector algorithm. (10)

6. (a) Write technical comparative notes on the following:
   (i) Online Identification and offline Identification (15)
   (ii) Parametric Identification and Non Parametric Identification
   (iii) Kalman Filter and Extended Kalman Filter
Q.1(a) Describe with the help of block diagram the working of a digital thermometer. (10) 
(b) Explain the use of gate control flip-flop in measurement of frequency. (5) 

Q.2(a) Explain the operation of logic analyzer with the help of block diagram. (10) 
(b) Describe the digital techniques used for measurement of speed of an induction motor. (5) 

Q.3 What are encoders. Classify different type of encoders and write short notes on incremental and absolute encoder. (15) 

Q.4(a) Explain with the help of circuit diagram a method for measurement of power system frequency. (8) 
(b) Explain the operation of universal counter with the help of block diagram. (7) 

Q.5(a) Describe with the help of block diagram the principle of successive approximation type digital voltmeter. (8) 
(b) Explain the method for digital measurement of power and energy. (7) 

Q.6(a) With the help of block diagram explain the operation of digital LCR meter. (8) 
(b) Describe the operation of flow meter using ultrasonic techniques. (7)
Students governed by the old ordinance will be examined out of 75 marks and their obtained marks shall be proportionately raised”.

Note:  
(i) Answer all questions.  
(ii) Assume suitable value for missing data, if any.  
(iii) Symbols and abbreviations have their usual meaning.

Q1  
Draw an action potential waveform. Label the amplitude and time values. Use the waveform ` to describe the following terms:  
(i) polarization (ii) depolarization (iii) repolarization (iv) absolute and relative refractory period.  

OR  

Q1’  
Enumerate and briefly describe different systems of the human body.

12

Q2  
What are the different lead arrangements in ECG recording? Explain the bipolar leads in brief with proper sketches.

OR

Q2’  
Describe the heart conduction system in detail.

12

Q3(a)  
Explain the function of the four lobes in the cerebrum?

6

Q3(b)  
Explain the electrical action of the sinoatrial node.

6

Q4(a)  
What are the different frequency bands in the EEG?

6

Q4(b)  
How are the potentials in muscle fibres measured?

6

Q5(a)  
What are the factors that decide the choice of a particular transducer to be used for the study of a specific phenomenon?

6

Q5(b)  
What is the principle of pressure transducers?  

OR

Q5(b’)

Discuss the biomedical applications of piezoelectric transducers.

6
Students governed by the old ordinance will be examined out of 75 marks and their obtained marks shall be proportionately raised”.

Note: (i) Answer **FOUR** questions.
(ii) All questions carry equal marks.
(iii) Notations have their usual meaning.

Q.1 Describe in detail the arrangements made and procedure used for impulse testing of large power transformers.

Q.2 An impulse voltage wave is sum of two exponentials. Derive equation to prove it.
Examine the double-exponential wave-shape for $t_f$, $t_i$ and $V_p$ given that $E = 1.035$, $a = 14.5 \times 10^3$ and $\beta = 2.45 \times 10^6$.

Q.3 Define time to front and time to tail of an impulse voltage wave. Derive equations to evaluate time to front and time to tail in terms of circuit parameters.

Q.4 Discuss the need for impulse current testing. Describe the basic principle of working and circuit of an impulse current generator. Show that
\[ \ln \frac{t_i}{t_m} = \frac{t_i}{t_m} - 1.693. \]
Define $t_i$ and $t_m$.

Q.5 Describe the basic ingredients of oscillation free recording of impulse voltage waves. Discuss the circuits used for oscillation free recording of impulse voltages.

Q.6 Write short notes on any three of the following:
   (i) Impulse testing of lightning arresters.
   (ii) A multistage impulse voltage generator.
   (iii) Circuit for Partial discharge testing.
   (iv) Testing of Cables/ Capacitors.
2011 – 2012
M.TECH. WINTER (II-SEMESTER ) EXAMINATION
(ELECTRICAL ENGINEERING)
ARTIFICIAL NEURAL NETWORKS AND APPLICATIONS
(EE – 681)

Maximum Marks: 60
Duration: 03 Hours

Attempt any five questions.
First question is compulsory.

Note: Students governed by the old ordinance will be examined out of 60 marks and their obtained marks shall be proportionately raised.

1. Write short notes on the following: Afferent neurons, Efferent neurons, Inter neurons, Dendrites, Receptors and Synapses.

2 (a) Explain competitive and cooperative learning laws.
(b) What is reinforcement learning? In what way it is different from supervised learning?

3 (a) Discuss the Hopfield network with an example.
(b) Explain the difference between Hereto associative memory and auto associative memory models.

4 (a) Describe the various types of nonlinear activation operators.
(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) Explain the momentum coefficient and learning coefficient.
(b) What is meant by simulated annealing? What is annealing schedule?

6 (a) Explain action potential and its propagation.
(b) Write a short notes on any one
   (i) Optical Neural Networks
   (ii) Cognitron Neural Networks
   (iii) Neocognitron Neural Networks

7. The training data for a particular problem is given in Table-I. Use BPN to train the training data for output to input, hidden, and output neurons as well as error.
How the weights W & V are modified? Use learning coefficient and momentum factors as 0.6 and 0.9 respectively.

Table-I

<table>
<thead>
<tr>
<th>Inputs</th>
<th>Outputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.16</td>
<td>0.12</td>
</tr>
<tr>
<td>0.12</td>
<td>0.24</td>
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<td>0.16</td>
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<td>0.04</td>
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