1. Draw an exact equivalent circuit of an induction motor. Also draw the complete phasor diagram based on this equivalent circuit. Draw the waveforms of air gap flux linkage, rotor conductor induced voltage, rotor conductor induced current and rotor mmf waves.

2. A 460 V, 60 Hz, 1176 rpm, 6 pole, Y connected sq cage IM has the following equivalent circuit parameters per phase ref to the stator: \( R_s = 0.29 \, \Omega \), \( X_b = 0.21 \, \Omega \), \( X_m = 13.3 \, \Omega \), \( R_t = 0.145 \, \Omega \) and \( X_t = 0.5 \, \Omega \).

   The motor is supplied from a CSI. The flux is maintained constant at the rated value. Calculate:

   (a) The stator current and dc link current when the machine operates at rated torque and 60 Hz.
   (b) The inverter frequency and dc link current for a speed of 600 rpm and rated torque.
   (c) The motor speed, stator current and dc link current for half of the rated torque and inverter frequency of 30 Hz.

3(a) Briefly describe the effects on the performances of an induction motor when supplied from a non-sinusoidal power supply instead of pure sinusoidal source.

3(b) A 460 V, 60 Hz, 4 pole, 1720 rpm, Y connected Induction Motor has the following parameters per phase referred to stator:

   \( R_s = 0.3 \, \Omega \), \( X_s = 2 \, \Omega \), \( a_{TT} = 2 \), the stator impedance and magnetizing reactance may be ignored. The motor is fed by a non-sinusoidal supply. Calculate the motor torque, current and efficiency at the rated speed, if the fundamental, fifth and seventh harmonics per phase are 254 V, 100 V and 40 V respectively. Neglect higher harmonics, friction, windage, core losses and skin effect.

4. A 400 V, 50 Hz, 4-pole, 1485 rpm, Y-connected sq. cage induction motor has the following parameters for the exact equivalent circuit:

   \( R_s = 0.03 \, \Omega \), \( X_s = 0.32 \, \Omega \), \( X_m = 7 \, \Omega \), \( R_t = 0.024 \, \Omega \), \( X_t = 0.48 \, \Omega \)

Contd....
The motor is fed from a current source inverter, which in turn is fed from a chopper with a dc link voltage of 600 V. The dc link inductor has a resistance of 0.001 Ω.

The motor is operated at constant flux of rated value. Calculate the duty ratio of chopper for rated motor torque and a speed of 1000 rpm.

5(a) Compare the relative performances of a synchronous motor with dc as well as induction motors.

5(b) Formulate the Thévenin's equivalent circuit of a cylindrical rotor synchronous motor, draw the corresponding phasor diagram and derive the expression for torque in terms of stator and rotor flux linkages.

6(a) Explain the properties of permanent magnet materials used in PMSM.

6(b) With the help of neat diagram explain the construction and operation of Sinusoidal Interior Permanent Magnet Synchronous Motor (IPM)

7 With the help of suitable diagrams and relevant waveforms explain the constructional details and working of switched reluctance motor. Mention its advantages and disadvantages.
A 100 MVA, 50 Hz generator is connected to an infinite bus through a double circuit line. The generator has inertia constant of 4.0 MJ/MVA at rated speed and the transient reactance is 0.25 pu. Each transmission circuit has a reactance of 0.40 pu on 100 MVA base and negligible resistance. The power received at the infinite bus is 50 MW at 0.90 lagging power factor and the infinite bus voltage is 1.0∠0°. A three-phase short circuit occurs at the terminals of the generator. Calculate the critical clearing angle. Derive the formula used. Also calculate critical clearing time.

2 With the help of a flow chart, explain how the transient stability analysis is carried out in a multi-machine power system. Discuss the function of each block. Synchronous machine can be represented as constant voltage source behind transient reactance and loads can be represented as constant impedance.

3(a) Write dynamical equations, in state space form, of synchronous machine and excitation system separately as used in small signal stability of the power system. Combine the above equations to get overall dynamical equation of a generating unit.

3(b) What is a Power System Stabilizer? Give the block-diagram of a practical PSS and discuss the function of various blocks.

4 The ABCD constants of a transmission line are: \( A = D = 0.90∠1.5°, B = 90∠80.5° \) ohms and \( C = 0.0008∠90° \) S. Find the steady state power limit of the line if the voltage at both the end of the line are held at 400 kV. Also calculate the reactive power requirement at the receiving end under this condition if the power factor of the load is unity. If the reactive power calculated above, is reduced by 30%, and voltage is maintained at 400 kV at both the ends of the line, how much active power can be received. Comment on the result.
The state-space equation of a simple power system, at an operating point, is given by

\[
p \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} = \begin{bmatrix} 0.20 & -26.00 \\ 1.00 & 0.25 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u
\]

\[
y = \begin{bmatrix} 0 & 1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}
\]

Show that the system is unstable at the operating point by eigen value analysis. Calculate the stability of the closed loop system with the control law \( u = -5 \, y \).

Write short notes on any TWO of the following:

a) \( P - V \) curves for voltage stability assessment.
b) Voltage collapse proximity indicator.
c) Voltage stability index.

Drive the system model, in state space form for dynamic stability, of a single machine infinite bus system shown in figure 1. Effect of damper windings may be neglected. Excitation system of figure 2 may be considered.
Maximum Marks: 60  Duration: Three Hours

Note:
1. Answer FIVE questions.
2. Symbols and abbreviations have their usual meanings.
3. a) Derive the expression for no load reactive power for a line connected to unity power factor load.
   b) By deducing suitable expressions show that distributed shunt compensation reduces charging reactive power while distributed series compensation has little effect on charging reactive power.

2. a) Derive the expression for power flow for shunt capacitor connected at midpoint of the line.
   b) Discuss the 'power swing damping control' and 'power scheduling control' of TCSC.

3. a) A three phase 400 kV, 50 Hz, 900 km long line is operating at \( V_S = V_R = V = 1.0 \text{pu} \) 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 \( \delta = 90^\circ \). Find the limits of SVC susceptance if the slope of the control characteristics is 0.05 p.u.
   b) Using suitable diagram discuss the configuration of SVC. Also state objectives of using SVC.

4. a) With the help of diagrams discuss a three phase six pulse STATCOM.
   b) What is a SSSC? Using suitable representations and expressions compare variable series compensation and SSSC.
5. (a) What is the objective of using interline power flow controllers? Discuss.

(b) Discuss the technical advantages of STATCOM over a SVC and synchronous condenser.

6. (a) Discuss the various modes of operation of TCSC.

(b) Using a block diagram explain a basic SVC controller.

7. (a) What are custom power devices? Why are they used? State five CPD used in distribution system.

(b) A 400 kV, 50 Hz, 500 km long symmetrical line has inductance of 1mH/km and capacitance of 12 nF/km. Find the midpoint voltage of the line when the line carries theoretical maximum power. Also calculate the value of capacitor required at the midpoint to double the power transmitted.
2012-13
M.TECH. (WINTER SEMESTER) EXAMINATION
ELECTRICAL ENGINEERING (INSTRUMENTATION & CONTROL)
IDENTIFICATION & ESTIMATION
EE-642

Maximum Marks: 60  
Credits: 04  
Duration: Three Hours

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

<table>
<thead>
<tr>
<th>Q.No.</th>
<th>Question</th>
<th>M.M.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Distinguish the following:</td>
<td>[12]</td>
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<tr>
<td></td>
<td>i) Parametric and Non parametric Identification</td>
<td></td>
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<td></td>
<td>ii) Grey Box and Black Box Identification</td>
<td></td>
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<td></td>
<td>iii) Least Squares Estimate and Maximum Likelihood Estimate</td>
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<td></td>
<td>iv) Kalman Filter and Wiener Filter</td>
<td></td>
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<tr>
<td>2(a)</td>
<td>Show that for a fixed signal containing white Gaussian noise, the sample mean is the minimum variance unbiased estimate.</td>
<td>[06]</td>
</tr>
<tr>
<td>2(b)</td>
<td>Discuss the common sources of error in impulse response identification.</td>
<td>[06]</td>
</tr>
<tr>
<td>3(a)</td>
<td>What is the role of white noise in modelling of systems? Also discuss its properties.</td>
<td>[05]</td>
</tr>
<tr>
<td>3(b)</td>
<td>Explain the operation of a discrete Kalman filter as predictor-corrector algorithm.</td>
<td>[07]</td>
</tr>
<tr>
<td>4</td>
<td>For a single input single output linear system develop a scheme for impulse response identification using Wiener Hopf equation.</td>
<td>[12]</td>
</tr>
<tr>
<td>5</td>
<td>Derive an expression for the blending factor of a discrete Kalman filter.</td>
<td>[12]</td>
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<tr>
<td>6</td>
<td>Derive the expressions for a linear least square estimation.</td>
<td>[12]</td>
</tr>
<tr>
<td>7</td>
<td>Write technical notes on the following:</td>
<td></td>
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<tr>
<td></td>
<td>i) Crammer Rao Bound</td>
<td></td>
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<tr>
<td></td>
<td>ii) Markov process</td>
<td></td>
</tr>
<tr>
<td></td>
<td>iii) Best Linear Unbiased Estimator (BLUE)</td>
<td>[12]</td>
</tr>
</tbody>
</table>
Attempt Five questions in total.
Assume suitable data if missing.
Notations used have their usual meaning.

Q.No. | Question | M.M.
---|---|---
1(a) | Find the successive approximation of analog to digital output for a four bit convertor to 3.17 volt input if the reference is 5 volt. | [04]
1(b) | Discuss about the gating error while making frequency and time measurement. Show that the effect of one count gating error can be minimized by making frequency measurement above $\sqrt{f_c}$ and period measurement below $\sqrt{f_c}$ where $f_c$ is the crystal frequency of the counter. | [08]
2(a) | How will you convert four bit binary code to gray code and vice versa with the help of exclusive OR-gate. | [04]
2(b) | Explain the operation of ratio frequency meter with the help of block diagram. | [08]
3(a) | Discuss about trigger level error occurring due to measurement. | [04]
3(b) | Describe with the help of block diagram the principle and operation of integrating type digital voltmeter. | [08]
4(a) | Differentiate between $3^1/2$ digit and 4 digit displays. What are their resolutions. | [04]
(b) | Describe the operation of flow meter using ultrasonic techniques. | [08]
5 | What are encoders? Classify different type of encoders and write shot notes on incremental and digital encoder. | [12]
6 | Describe the operation of logic analyzer with the help of block diagram. Write its advantages and disadvantages also. | [12]
7 | Explain with the help of block diagram the operation of digital LCR meter. | [12]
Answer any five of the seven questions given below. Assume suitable data if missing. Notations used have their usual meaning.

Q.No. 

1(a) What is electrode potential? Define Nernst equation and explain its terms. 

1(b) Explain the function of the following parts of the brain: 
(i) Medulla (ii) Pons (iii) Cerebellum (iv) Thalamus

2 Explain the operation of the heart. Support your answer with relevant diagrams.

3 How is ECG recorded? Explain the working of an electrocardiograph. Describe various lead systems.

4(a) Explain the Mechanism and prevention of electric-field pickup from Power line while sensing the bio-electric potential.

4(b) Explain the working of X-Y recorder using schematics.

5 What is patient monitoring System? Explain the Interfacing of Computer/Microprocessor with Biomedical Instrumentation using block Diagram. Mention the factors concerned with Interfacing.

6 Describe the principle of operation of Magnetic Resonance Imaging (MRI). Sketch and explain the block diagram.

7 An instrumentation amplifier has a gain of 20. Using the schematic shown, R5 = R7; R4=R6; R2 = R3. If R5 = 10KΩ and R4 = 1KΩ, the current across R2 is 4 mA and Vinput is 1V. Voutl = -2V. Find R2 and R1.
1. Discuss the basic Marx Circuit to obtain impulse Voltages. Derive equations to show that an impulse Voltage wave can be represented as sum of two exponentials. Mention the assumptions made. [12]

2. Discuss time to front, time to tail, peak value and polarity of an impulse voltage wave. Mention the Indian standards for impulse voltage and current wave shapes. Also mention the tolerances allowed and need to allow for tolerances. [12]

3. (a) There is a limit to the highest voltage (ac) transmission. Discuss. [04]
   (b) With the help of a schematic diagram explain the working of a multistage impulse voltage generator and discuss its advantages and limitations. [08]

4. Discuss oscillation free recording of impulse voltage waves describing the importance of voltage divider and delay cable. [12]

5. Draw the schematic diagram of an impulse current generator and explain its working. Correlate $t_m$ with the circuit parameters. Discuss the applications of impulse current generator. [12]

6. Describe the procedure of impulse testing of power transforms. Discuss the need for impulse testing of power transformers and the arrangements to be made. [12]

7. Write Notes on:
   (a) Controlled tripping of impulse voltage generator. [3]
   (b) Voltage doubler circuit. [3]
   (c) Use of long air gaps in High Voltage. [3]
   (d) Impulse testing of lighting arrestors. [3]

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1. (a) Discuss the technologies and their advantages that were enabled by Superconductivity. 

(b) A type I superconductor with $T_c = 7$ K has slope $dB_c/dT = -25 \times 10^{-3} \text{ T/K}$ at $T_c$. Estimate its critical field at 6 K. [06]

2. Discuss the breakdown of mechanism of liquid nitrogen viewed from area and volume effects. What is the effect on breakdown strength of liquid nitrogen when (SEA)$_{90}$ and (SLV)$_{90}$ is varied? [12]

3. Discuss the loss behaviour of liquid nitrogen in uniform fields. [12]

4. Discuss the factors which influence dielectric strength of electrical insulating materials and hence deduce the breakdown strength equation as suggested by Swanson. [12]

5. Discuss the desired properties of electrical insulating materials at cryogenic temperature. Why mechanical and thermal properties of insulating materials are more demanding at cryogenic temperatures? [12]

6. Discuss the loss index and breakdown strength of electrical insulating materials at cryogenic temperature. What is the influence of loss index of solid insulation on the refrigeration load? [12]

7. Discuss the deterioration and breakdown of solid dielectrics by internal discharges at cryogenic temperature. What are the factors which reduce the discharge repetition rate at low temperatures? [12]
2012-13
M.TECH. (WINTER SEMESTER) EXAMINATION
ELECTRICAL ENGINEERING
PARTIAL DISCHARGES IN POWER APPARATUS
EE-669

Maximum Marks: 60
Credits: 04
Duration: Three Hours

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

Q.No. | Question                                                                                                                                                                                                 | M.M.
------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------
1(a)  | Differentiate and distinguish between various types of discharges that occur in high voltage insulation systems.                                                                                           | [06] |
1(b)  | Explain the occurrence of partial discharges in cavities below the inception voltage when an insulating medium is subjected to an AC voltage.                                                           | [06] |
2(a)  | With neat sketches, explain the phenomena of inception of positive and negative Corona discharges and their recurrence.                                                                               | [06] |
2(b)  | Explain the ABC-model of discharges occurring in a cavity within a dielectric.                                                                                                                          | [06] |
3     | What are the limitations of this model?                                                                                                                                                                   |      |
4     | Explain the recurrence of discharges when an insulating medium is subjected to an AC voltage and hence explain the phenomena of interaction of two discharges in a cavity by transverse leakage. | [12] |
5     | Discuss the electrical and non-electrical methods for locating partial discharges in high voltage equipment. Also draw the basic diagram of electrical discharge detection circuit and explain it. | [12] |
6     | Discuss the different mechanism of deterioration of dielectrics when partial discharges are present.                                                                                                   | [12] |
7     | Explain in detail the phenomena of occurrence of partial discharges and its detection in any one of the following: (a) Capacitors (b) Cables (c) Bushings, (d) Transformers (e) Synchronous Generators | [12] |
Q.No. Question

1(a) Compare the performance of a computer and that of a biological neural network. [3]
(b) Give a real life example of a pattern mapping problem. [3]
(c) What is meant by gradient descent methods? [3]
(d) What is the significance of momentum term in backpropagation learning? [3]

2(a) Explain competitive and cooperative learning laws. [6]
(b) Discuss the Hopfield network with an example. [6]

3(a) Describe the various types of nonlinear activation functions. [6]
(b) Explain the momentum coefficient and learning coefficient. [6]

4(a) Explain the difference between short term memory and long term memory reference to dynamics models. [6]
(b) What is reinforcement learning? In what way it is different from supervised learning? [6]

5(a) How are self-organizing networks different from classical supervised learning feedforward networks? [6]
(b) What is meant by simulated annealing? What is annealing schedule? [6]

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

<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>
</tr>
</tbody>
</table>

7(a) Write short notes on any one
i. Optical Neural Networks
ii. Cognitron Neural Networks
iii. Neocognitron Neural Networks

(b) Prove that “the use of multiple ADALINES helps to counter the problem of non-linear separability” with suitable example. [6]
M.TECH. (WINTER SEMESTER) EXAMINATION
ELECTRICAL ENGINEERING
OPTIMIZATION TECHNIQUES
EE-683

Maximum Marks: 60
Credits: 04
Duration: Three Hours

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

Q.No. Question
1(a) Explain the classical optimization techniques for determining the optimum value of
a function. What are the assumptions made and which type of problems can be
handled by these techniques?

1(b) Minimize

\[ f(x) = \frac{1}{2} (x_1^2 + x_2^2 + x_3^2) \]

subjected to

\[ g_1(x) = x_1 - x_2 \] and
\[ g_2(x) = x_1 + x_2 + x_3 - 1 \]

using Lagrange multiplier

2 Find the maximum of the function \( f(x) = x(1.5- x) \) in the interval \((0, 1)\) by golden
section method. Explain the steps involved in finding the solution.

3 Find the minimum value of the function \( f(x)=4x_1^2+3x_2^2-5x_2x_2-8x_1 \) starting from the
point \( X_1^0 = [0, 0] \) using univariate method.

4(a) Explain the importance of gradient of a function in determining the optimum value.

4(b) Minimize the function \( f(x_1, x_2) = 4x_1^2 - 4x_1 x_2 + 2x_2^2 \) with initial value point
\( X_1^0 = [2, 3] \) using steepest descent method.

5 Minimize the function \( f(x_1, x_2) = 4x_1^2 - 5x_1 x_2 + 3x_2^2 - 8x_1 \) starting from the point \([0, 0]\)
using (a) Newton’s Method (b) Fletcher and Reeve’s Method

6. What is simplex algorithm? Draw the flow chart and explain every stage of flow
chart for simplex algorithm.

7. Minimize the function \( f(x_1, x_2) = (50x_1 + 0.2x_1^2) + (50x_2 + 0.2x_2^2) + 8(x_1 - 80) \)
subjected to

\[ x_1 \geq 80; \]
\[ x_1 + x_2 = 200 \]
\[ x_1 \geq 0, \ x_2 \geq 0 \]

using dynamic programming method
2012-13
M.TECH. (ELECTRICAL ENGG) II SEMESTER EXAMINATION
HIGH VOLTAGE ENGINEERING
Lightning Physics and Lightning Protection (EE – 687)
Credits: 04
Maximum Marks: 60 Duration: Three Hours

Answer any FIVE questions.

Q.N. Question M.M.
1.(a) Discuss Shock Wave Theory and derive second order differential equations for voltage and current waves of a High Voltage Transmission line. Discuss the assumptions made. [6]

(b) What do you understand by “Characteristic Impedance” of a High Voltage line. What parameters do affect this impedance. Derive an expression for the same. [6]

2.(a) Distinguish clearly between direct and indirect lightning strokes and their effects on High Voltage lines. [6]

(b) Drawing neat diagrams to discuss protection of lines against lightning using one as well as two over head ground wires. [6]

3.(a) Show that the sum of energies contained in reflected and refracted waves at a junction of a transmission line is equal to the energy of incident wave at a junction. [6]

(b) Why it is necessary to have a low value of tower footing resistance. How the driven ground rods help to reduce the tower footing resistance. [6]

4. (a) Differentiate between heat storms and frontal storms. Discuss the charging process of clouds during frontal storms. [6]

(b) Discuss the temporal development of a lightning flash to open grounds. [6]

5.(a) Discuss the lightning strokes to high rise buildings. In what respects this discharge differs from lightning to open grounds. [6]

(b) Discuss the protection of transmission lines against mid-span flashovers. [6]

Contd……
6. (a) Giving suitable examples along with the concerned wave shapes differentiate between power frequency over-voltages and lightning over-voltages.

(b) What are 'Isokeraunic Charts'? Why and how are they prepared? Giving an example, explain an isokeraunic chart.

7. Write notes on any THREE of the followings.

(a) Lightning performance of High Voltage lines
(b) Selection of Basic Impulse Insulation Level
(c) Volt – Time curves
(d) Protection of alternators against lightning.