2013-14
M.TECH. (WINTER SEMESTER) EXAMINATION
ELECTRICAL ENGINEERING
(Power System and Drives)
Advance Electric Drives II
EE-612

Maximum Marks: 60
Credits: 04
Duration: Three Hours

Answer any FIVE questions.
Assume suitable value for missing data if any.
Notations used have their usual meaning.

Q.No. Question M.M.

1(a) Draw a complete labeled phasor diagram of an Induction Motor based on exact [4]
equivalent circuit.

(b) A 3 phase, Y connected, 400 V, 6 pole, 50 Hz, 960 rpm, induction motor has the [8]
following parameters per phase referred to the stator:
Rs = 0.4 Ω, Rr = 0.2 Ω, Xls = Xlr = 1.5 Ω, Xm = 30 Ω

(i) If the motor is used for regenerative braking, determine the maximum braking
    torque and the speed at which it is obtained.

(ii) If the motor is used for plugging, determine the value of braking torque at
    1000 rpm.

Use exact equivalent circuit.

2 A 460 V, 60 Hz, 4 pole, 1760 rpm, Y connected sq cage induction motor has [12]
following parameters per phase referred to stator:
Rs = 0.14 Ω, Xs = 0.4 Ω, Rr = 0.08 Ω, Xr = 0.8 Ω, Xm = 15 Ω.
The motor is fed by a 6 step inverter, which in turn is fed by a 6 pulse fully
controlled rectifier with an ac supply of 460 V, 60 Hz.

The motor is controlled by a variable frequency source at a constant flux.
(a) Calculate the inverter frequency, motor input current and rectifier firing angle
    for 1200 rpm and the rated torque.

(b) If the minimum inverter frequency is restricted to 6 Hz, calculate the starting
    torque and motor current as ratio of their values when the motor is started at
    the rated voltage and frequency.
3. Explain the operation of an Induction Motor with a constant frequency current source. In which region of the speed-torque characteristics the operation is preferred and why? How the flux is maintained as constant? Derive the expression for torque at constant flux.

4. A wound rotor induction motor is running at rated speed. It is to be braked to zero speed by injecting a voltage source at the slip ring. Describe the whole operation, step wise with the help of speed – torque characteristics and equivalent circuit.

5. Draw a labeled circuit diagram of a static Scherbius Drive. Derive its equivalent circuit. Establish the mathematical expression for torque and draw its speed-torque characteristics. Highlight the salient feature of its performances.

6(a) Compare the merits and demerits of VSI and CSI controlled drives.
(b) Describe various ways of practical realization of a current source.

M.TECH. (WINTER SEMESTER) EXAMINATION
ELECTRICAL ENGINEERING (Power System and Drives)
POWER SYSTEM STABILITY
EE 633

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 equal-area criterion for the transient-stability of an alternator connected to an infinite bus bar through an inductive network.

1(b) A power deficient area receives 40 MW over a tie-line from another area. The maximum steady-state limit of the tie-line is 100 MW. If the load requirement in the power deficit area is increased to 70 MW, calculate the maximum excursion of torque angle around new steady operating point.

2 Give the mathematical formulation of a multi-machine power system for transient stability studies. Using modified Euler’s method for the solution of swing equations and Gauss-Siedel technique for network solutions, give an algorithm for obtaining swing-curves. Synchronous machines may be represented as constant voltage source behind transient reactance and loads as constant impedance.

3(a) The equivalent circuit of a single-machine infinite bus system is given in Fig. 1. Express Park’s components of armature currents ($i_q$ and $i_d$) in terms of state-variables ($I_d$ and $\delta$). Linearize the expressions around an operating point to get:

\[
\Delta i_q = K_1 \Delta I_d + K_2 \Delta \delta
\]

\[
\Delta i_d = K_3 \Delta I_d + K_4 \Delta \delta
\]

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

4(a) For a multi-machine power system, the network equation can be expressed as:

\[
[\Delta S_G] = [J_{GG} \ J_{GL}] [\Delta Z_G]
\]

\[
[\Delta S_L] = [J_{LG} \ J_{LL}] [\Delta Z_L]
\]

and the loads can be represented as: \( P_{li} = K_p V_i^{\text{mp}} \) and \( Q_{li} = K_q V_i^{\text{mp}} \)

Eliminate the load buses from the network equation.

4(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.

contd . . . . 2
5. The ABCD constants of a transmission line are: \( A = D = 0.95 \angle 1.5^\circ, B = 92.5 \angle 84.5^\circ \) \text{[12]} \) ohms and \( C = 0.0006 \angle 90^\circ \) S. Find the steady state power limit of the line if the voltage at both the ends of the line are held at 220 kV. If the power factor of the load at maximum power limit is unity, calculate the shunt reactive power requirement at the receiving end. If the reactive power compensation is removed, what will be the receiving-end voltage?

6(a). With the help of \( P-V \) and \( Q-V \) curves, define voltage stability and voltage collapse of a power system. \text{[06]}

6(b). What is meant by voltage stability index? Derive the condition for voltage stability. \text{[06]}

7(a). An 11 kV, 50 Hz synchronous generator is delivering power to infinite bus through a transmission network at rated speed. The generator has H = 4.0 sec and \( x'_d = 0.72 \) per unit. The dynamical equations of the system are:

\[
\frac{ds}{dt} = \omega_0 - \omega \quad \text{and} \quad \frac{d\omega}{dt} = 1.8 \sin \delta - 1.5 \omega
\]

At any point of time the generator output is 50% of its capacity. Show that the system is dynamically stable at the operating point. Also calculate the frequency of rotor oscillations.

7(b). For a simple power system, derive expression for voltage collapse proximate indicator. \text{[07]}

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**Figure - 1**

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**Figure - 2**
Maximum Marks-60

credit-04

time- 3 Hours

NOTE:
(i) Answer any five questions.
(ii) Notations used have their usual meaning.
(iii) Assume suitable data, wherever necessary.

1. (a) What do you mean by FACTS? What are its objectives? Discuss, in brief, the various types of FACTS Controllers. 10

(b) Differentiate between variable impedance type and voltage source converter type based FACTS controllers. 02

2. (a) What do you mean by transmission line compensation? What are active and passive compensators? Explain the meaning of controlled series compensation? 08

(b) Discuss how series compensation leads to improvement of stability. 04

3. (a) Give the schematic diagram of UPFC? Why is it superior to other conventional FACTS devices? Discuss its operating principle. 08

(b) Write a note on TCPAR. 04

4. Discuss the operation of TCSC (Thyristor Controlled Series Capacitor), clearly explaining its various operating modes. Derive the expression for impedance offered by the TCSC (X_{TCSC}). Discuss its applications. 12

5. (a) Why do you prefer voltage source converters in FACTS devices? Discuss the operating principle of an SSSC. How is it different from a TCSC? 08

(b) Discuss in brief the role of GCSC in power system. 04

6. (a) Discuss the operation of a STATCOM. Compare the control characteristics of STATCOM with SVC. How is it useful in improving the stability of the system? 06

(b) Enumerate the custom power devices that can be used in distribution systems. Discuss, briefly, the role of each device. 06

7. (a) Discuss the role of DVR in distribution system. Explain briefly how load compensation is carried out using DSTATCOM. 08

(b) What role does UPQC play in improving the Power Quality of the distribution system. 04
**2013-14**  
**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>
</tr>
<tr>
<td></td>
<td>i) Online and Offline Identification</td>
<td></td>
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<tr>
<td></td>
<td>ii) Best Linear Unbiased Estimate and Maximum Likelihood Estimate</td>
<td></td>
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<td></td>
<td>iii) Predictor model and Probabilistic model</td>
<td></td>
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<tr>
<td></td>
<td>iv) FIR model and output error model</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>Compare the Identification process with the theoretical modeling process. Also explain the constraints in the process of identification.</td>
<td>[06]</td>
</tr>
<tr>
<td>3(a)</td>
<td>Explain the parameters used to judge the quality of an estimate.</td>
<td>[07]</td>
</tr>
<tr>
<td>3(b)</td>
<td>Show that reasonable approximations are significant in the process of Identification.</td>
<td>[05]</td>
</tr>
<tr>
<td>4</td>
<td>With the help of equations involved discuss the principle of operation and utility of Kalman Filter as a predictor corrector algorithm.</td>
<td>[12]</td>
</tr>
<tr>
<td>5</td>
<td>Derive an expression for gain of a discrete Kalman filter.</td>
<td>[12]</td>
</tr>
<tr>
<td>6</td>
<td>Draw the structure of Box-Jenkins model and explain the terms used in it. What modifications in this model are required to obtain: (i) ARMAX model (ii) Output Error model (iii) ARMA model (iv) AR model</td>
<td>[12]</td>
</tr>
<tr>
<td>7</td>
<td>Write technical notes on the following:</td>
<td>[12]</td>
</tr>
<tr>
<td></td>
<td>i) Crammer Rao Bound  ii) Grey Box Identification  iii) Identifiability</td>
<td></td>
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</tbody>
</table>
Q.No. | Question | M.M.
--- | --- | ---
1(a) | What are the advantages of Digital instruments over Analog instruments? Explain quantization and coding involved in analog to digital conversion. | [06]
1(b) | What are Synchronous Decade counters? How a Mod-1000 counter can be obtained using decade counters? | [06]
2(a) | Develop the timing diagram of SRG4 for the data input and clock waveforms as shown in Figure-1. Assume positive edge triggering and that the register contains all 1s initially. | [06]

![Figure-1](image)

2(b) | With the help of block diagram, describe the principle of operation of any two of the following:
(i) Successive approximation type.
(ii) Integrating type.
(iii) Potentiometric type.
(iv) Continuous balance type. | [06]

3(a) | Describe the operation of digital thermometer. | [06]
3(b) A digital voltmeter uses $4\frac{1}{2}$ digit display
   
   (i) Find its resolution
   
   (ii) How would 11.87 V be displayed on a 10V range?
   
   (iii) How would 0.5573 be displayed on 1V and 10V ranges?

4(a) Explain digital measurement of frequency. If the number of pulses totalled by the counting register in digital frequency meter is 5000 and the selected gate time is 1ms, what is the frequency of the input signal?

4(b) Write a note on Digital Multimeter using block diagram.

5(a) Discuss any two of the following:
   
   (i) Optical encoder.
   
   (ii) Magnetic encoder.
   
   (iii) Tachometer encoder.

   What degree of resolution can be obtained using a 4 track optical encoder?

5(b) In a measurement of blood flow in a patient, ultrasound of frequency 5 MHz is made incident at an angle of $30^\circ$ to the blood vessel and a Doppler shift in frequency of 4.4 KHz is observed. If the velocity of ultrasound is taken as 1.5 Km/s and the blood vessel is of diameter 1.0 mm. Calculate

   (a) The blood flow velocity.
   
   (b) The volume rate of blood flow.

6 Describe the operation of the following flow meters:

   (i) Transit time flow meter
   
   (ii) Doppler flow meter
   
   (iii) Cross-correlation flow meter

7 What is a Logic Analyser? Discuss using suitable diagrams.
## II SEMESTER M.TECH. EXAMINATION
(ELECTRICAL)
BIOINSTRUMENTATION  
(EE-655)

Maximum Marks: 60  
Duration: Three Hours

**Answer any five of the seven questions given below.**
Assume suitable data if missing.
Notations used have their usual meaning.

<table>
<thead>
<tr>
<th>Q.No.</th>
<th>Question</th>
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</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Describe the propagation of action potential. Explain the terms resting potential, action potential, absolute refractory period and relative refractory period.</td>
<td>[12]</td>
</tr>
<tr>
<td>2</td>
<td>Explain the operation of the heart and the cardiovascular system briefly. Draw an analogous electric circuit.</td>
<td>[12]</td>
</tr>
<tr>
<td>3(a)</td>
<td>What are 300 and 10 second rules in ECG measurement? Describe in brief.</td>
<td>[06]</td>
</tr>
<tr>
<td>3(b)</td>
<td>Define the types of electrode used to record EMG. Explain the situations in which each type is used.</td>
<td>[06]</td>
</tr>
<tr>
<td>4</td>
<td>Explain the 10-20 lead system for EEG. What are the different frequency bands in EEG?</td>
<td>[12]</td>
</tr>
<tr>
<td>5</td>
<td>Write a short note on bioelectrodes. Explain their properties and materials. Draw neat sketches of different kinds of electrodes commonly used.</td>
<td>[12]</td>
</tr>
<tr>
<td>6(a)</td>
<td>How is ultrasound used for measuring blood flow? Describe the working of the ultrasound blood flow meter.</td>
<td>[06]</td>
</tr>
<tr>
<td>6(b)</td>
<td>What are the medical applications of MRI? Describe the advantages and limitations of MRI.</td>
<td>[06]</td>
</tr>
<tr>
<td>7(a)</td>
<td>What is a CT scan? Where it is used.</td>
<td>[06]</td>
</tr>
<tr>
<td>7(b)</td>
<td>How are X rays produced? Explain the applications of X rays in medicine.</td>
<td>[06]</td>
</tr>
</tbody>
</table>
Answer Any FIVE questions. Assume suitable data if missing. Notations used have their usual meaning.

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<tr>
<th>Q.No.</th>
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</thead>
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<tr>
<td>1(a)</td>
<td>What are miller indices? How does it describe the crystallographic plane? How a crystallographic plane can be identified for a given silicon wafer?</td>
<td>[04]</td>
</tr>
<tr>
<td>1(b)</td>
<td>Explain the following phenomena in a thin film:</td>
<td>[08]</td>
</tr>
<tr>
<td></td>
<td>(i) Extrinsic stress,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(ii) Intrinsic stress,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(iii) Thermal stress and</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(iv) Adhesion.</td>
<td></td>
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<tr>
<td>2(a)</td>
<td>Describe MEMS fabrication cycle.</td>
<td>[08]</td>
</tr>
<tr>
<td>2(b)</td>
<td>Differentiate Isotropic and Anisotropic etching.</td>
<td>[04]</td>
</tr>
<tr>
<td>3</td>
<td>Compare the following evaporation method for thin film deposition.</td>
<td>[12]</td>
</tr>
<tr>
<td></td>
<td>(i) Resistive heating evaporation,</td>
<td></td>
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<td></td>
<td>(ii) Inductive heating evaporation,</td>
<td></td>
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<tr>
<td></td>
<td>(iii) Electron Beam Evaporation.</td>
<td></td>
</tr>
<tr>
<td>4(a)</td>
<td>Give a cross sectional view of micro valves/micro pumps and describe its working principle.</td>
<td>[04]</td>
</tr>
<tr>
<td>4(b)</td>
<td>Illustrate the fabrication process of linear motion micro actuators.</td>
<td>[08]</td>
</tr>
<tr>
<td>5</td>
<td>Explain the principle of operation of thin film anemometer flow sensor and describe its design and fabrication procedure.</td>
<td>[12]</td>
</tr>
<tr>
<td>6(a)</td>
<td>Mention the problems associated with high temperature annealing and its remedies?</td>
<td>[04]</td>
</tr>
<tr>
<td>6(b)</td>
<td>Explain the silicon fusion bonding mechanism.</td>
<td>[08]</td>
</tr>
<tr>
<td>7(a)</td>
<td>Discuss the role of interface electronics with integrated MEMS sensors.</td>
<td>[06]</td>
</tr>
<tr>
<td>7(b)</td>
<td>Describe the sensor circuit integration and its advancement.</td>
<td>[06]</td>
</tr>
</tbody>
</table>
2013-14
M.TECH. II$^{nd}$ SEMESTER EXAMINATION
M.Tech (Electrical)
Power System & Drives/High Voltage & Insulation Engineering
High Voltage Testing Techniques
EE-663
Credits: 04
Duration: Three Hours

Maximum Marks: 60

1(a) Using a circuit of a typical impulse current generator, explain its operation and applications.
1(b) Briefly discuss the high voltage testing of insulators and bushings.

2(a) Explain the methods for producing switching impulses in test laboratories.
2(b) With the help of a circuit, explain a multi stage impulse generator.

3(a) Discuss the switching impulse testing of transformer.
3(b) Describe the construction of a uniform field spark gap and discuss its advantages and disadvantages.

4(a) What are the requirements of an oscillograph for impulse and high frequency measurement in high voltage test circuits?
4(b) With the help of a block diagram discuss the components of impulse voltage test system.

5(a) Discuss the lightning impulse testing of transformer.
5(b) Why is controlled tripping of impulse generator necessary? Explain operation of a trigatron gap.

6(a) What are delay cables? Explain how delay cable is connected to a resistive and a capacitive voltage divider to avoid distortion.
6(b) Discuss the impulse current test performed on lightning arresters. How do you conclude that the arrester has passed the test?

7(a) What is meant by insulation coordination? How are protective devices chosen for optimal insulation level in a power system?
7(b) Explain how a sphere gap can be used to measure the peak value of voltages. What are the parameters and factors that influence such measurements?
1 (a) Discuss the electric power applications of superconductivity. Also list the technologies that were enabled by superconductivity. [06]

(b) Discuss the environment, safety and health impact of HTS power equipment. [06]

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

3 Discuss the loss behaviour of liquid nitrogen in uniform fields. Why loss index of solid insulation is an important parameter to be considered at cryogenic temperature? [12]

4 Discuss the factors which influence dielectric strength of electrical insulating materials and hence deduce the breakdown strength equation as suggested by Swanson. Also explain how thickness ‘t’ is incorporated in the breakdown strength equation. [12]

5(a) Discuss the desired properties of electrical insulating materials at cryogenic temperature. What is the role of radiation resistance at cryogenic temperature? [06]

(b) Discuss the pressure dependence of dielectric breakdown in liquid nitrogen. [06]

6 Discuss the PDI characteristics in artificial air filled voids at room and liquid nitrogen temperatures. [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]
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   Enumerate the types of discharges that occur in high voltage insulation systems.
    Differentiate and distinguish between various types of partial discharges that occur in
electrical systems. [12]
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 and
    hence explain the phenomena of intermittent discharge in an asymmetrical cavity.
    How the ABC-model gets modified for surface discharges? [06]
3   Explain various quantities related to the magnitude of discharges. Derive an
    expression for discharge magnitude and discharge energy from a single discharge
    due to breakdown of a void in a solid insulation. [12]
4   Explain the recurrence of discharges when an insulating medium is subjected to an
    AC voltage. Explain why the repetition rate under DC voltage is several orders
    lower than at AC voltage? [12]
5   Enumerate various methods for partial discharge detection in high voltage
    equipment. With the help of a neat sketch explain the principle of electrical
    discharge detection circuits. [12]
6   Explain the detection of partial discharges in any one of the following:
    (a) Capacitors
    (b) Cables
    (c) Transformers [12]
7   Discuss different mechanisms of deterioration of insulation due to presence of
    partial discharges in electrical equipment. [12]