USN | | | | | | | | | | 10EE61

## Sixth Semester B.E. Degree Examination, June/July 2016
# Power System Analysis and Stability

Time: 3 hrs. Max. Marks:100

**Note:** ***Answer any FIVE full questions, selecting atleast TWO questions from each part.***

### PART – A

1 a. Show that per unit impedance of two winding transformer will remain same referred to primary as well as secondary. **(06 Marks)**

b. List the advantages of per unit system. **(04 Marks)**

c. A 300 MVA, 20 KV, 3 phase generator has subtransient reactance of 20%. The generator supplies two synchronous motors through a 64 km transmission line having transformers at both ends as shown in Fig. Q1(c), $T_1$ is a 3 phase transformer and $T_2$ is composed of 3 single phase transformers of rating 100 MVA each, 127/13.2 KV, 10% reactance. Series reactance of transmission line is 0.5 ohm/km. Draw the reactance diagram with all reactances marked in per unit. Select generator rating as base values. **(10 Marks)**

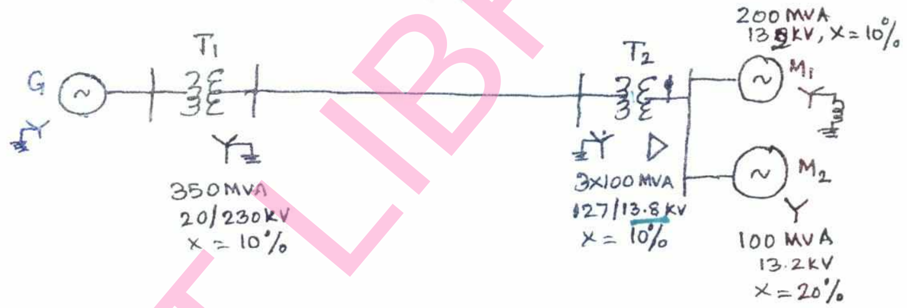


Fig. Q1(c)



2 a. A sudden three phase short circuit takes place at the terminals of an unloaded three phase alternator. Discuss briefly on different reactance's that are met with assuming that the damper windings are provided at the pole faces of the alternator. **(08 Marks)**

b. A synchronous generator and motor are rated 30 MVA, 13.2 KV and both have subtransient reactances of 20%. The line connecting them has a reactance of 10% on the base of the machine ratings. The motor is drawing 20MW at 0.8 power factor leading and a terminal voltage of 12.8 KV when a symmetrical three phase fault occurs at the motor terminals. Find the subtransient current in the generator, motor and the fault by using internal voltages of the machines. **(12 Marks)**

3 a. The phase voltages of a three phase system are $V_a = 100\angle 0$, $V_b = 33\angle -100$, $V_c = 38\angle 176.5$ all in volts. Compute the symmetrical components of voltages. **(06 Marks)**

b. Obtain the relationship between line and phase sequence components of voltages in star connection. Give the relevant phasor diagrams. **(08 Marks)**

c. Obtain an expression for power interms of sequence components of line to neutral voltages and line currents. **(06 Marks)**

4 a. A delta connected resistive load is connected across a balanced three phase supply of 400 V as shown in Fig.Q4(a). Find the symmetrical components of line currents and phase currents. **(08 Marks)**

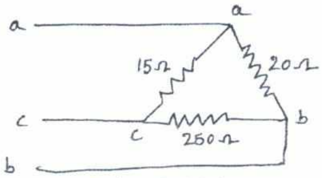


Fig. Q4(a)

b. Show that in symmetrical systems, currents of a given sequence produce voltage drops of the same sequence. **(06 Marks)**

c. Explain measurement of negative sequence impedance of synchronous generator. **(06 Marks)**

## PART – B

5 a. For a double line to ground fault on an unloaded generator, derive the equation for the fault current and draw the interconnected sequence network. **(10 Marks)**

b. A 400V, star connected, neutral grounded three phase generator is subjected to various types of faults. The fault currents for various types of faults are :
i) Three phase, 120 ampere ii) Line to line, 150 amp iii) line to ground, 250 amp. If the resistances are neglected, determine the three sequence impedances and fault current for a double line to ground fault. **(10 Marks)**

6 a. An alternator is connected to a synchronous motor through two transformers and a transmission line as shown in Fig. Q6(a). The constants of all the apparatus in p.u are :
Generator : $x_1 = 03$, $x_2 = 0.2$ and $x_0 = 0.2$
Transformers $T_1$ and $T_2$ : $x_1 = x_2 = x_0 = 0.1$ each
Transmission line : $x_1 = x_2 = 0.1$ $x_0 = 0.2$
Synchronous motor : $x_1 = 0.2$, $x_2 = 0.1$ and $x_0 = 0.1$
A line to ground fault occurs at the middle of the transmission line. The system is on no load and the voltage at the fault point before fault is 1.0. Determine the fault currents. **(12 Marks)**

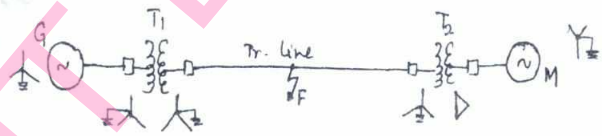


Fig. Q6(a)

b. Explain open conductor faults in power systems. **(08 Marks)**

7 a. Define the following :
i) Steady state stability
ii) Transient stability
iii) Steady state stability limit
iv) Transient stability limit. **(08 Marks)**

b. Derive swing equations with usual notations. **(06 Marks)**

c. Explain equal area criterion concept, when a power system is subjected to sudden increase in load. **(06 Marks)**

8 a. Analyse the operations of three phase induction motor when one line gets opened. Derive the torque and output power equations. **(10 Marks)**

b. A 400V, 6 pole, 50 Hz, 3 phase induction motor with $R_s = R_r = 0.5\Omega$ and $x_s = x_r = 2\ \Omega$ runs at a slip at 0.06. When are line gets open? Determine the power output and torque developed. **(10 Marks)**

* * * * *

USN | | | | | | | | | | |     **10EE62**



# Sixth Semester B.E. Degree Examination, June/July 2016
# Switchgear and Protection

Time: 3 hrs.     Max. Marks:100

**Note: 1.** ***Answer any FIVE full questions, selecting atleast TWO questions from each part.***
**2.** ***Missing data, if any, may be suitably assumed.***

## PART – A

1 a. State any five differences between a circuit breaker and a fuse. **(05 Marks)**
b. With a neat sketch explain the construction and working of a HRC fuse. **(08 Marks)**
c. In a 220 KV system having a line to ground capacitance of 0.015 μF and an inductance of 3.5H, determine the voltage appearing across the pole of the circuit breaker if a magnetizing current of 6.5A (instantaneous) is interrupted. Determine also the value of the resistance to be used across the contacts to eliminate the restriking voltage. **(07 Marks)**

2 a. Explain the principle of DC circuit breaking indicating the V – I characteristics and relevant operating zones. **(05 Marks)**
b. For a 132 KV system, the reactance and capacitance up to the location of the circuit breaker is 3 Ω and 0.015 μF respectively. calculate :
i) Frequency of transient oscillation
ii) Maximum value of restriking voltage across breaker contacts
iii) Maximum RRRV. **(07 Marks)**
c. A 50 Hz 3 – phase alternator with grounded neutral has an inductance of 1.6 mH per phase and is connected to bus bar through a circuit breaker. The capacitance to earth between the alternator and circuit breaker is 0.003 μF per phase. The circuit breaker opens when rms value of current is 7500A. Determine : i) Maximum RRRV ii) time for maximum RRRV iii) Frequency of oscillations. **(08 Marks)**

3 a. Explain the working of an air blast circuit breaker with reference to :
i) Axial blast ii) cross blast. **(08 Marks)**
b. Name any ten significant advantages of $SF_6$ breakers. **(06 Marks)**
c. Explain short circuit breaker test layout with a single line diagram. **(06 Marks)**

4 a. What are the advantages of synthetic testing of circuit breakers? **(08 Marks)**
b. Explain direct and indirect lightening strokes. **(08 Marks)**
c. State any four essential requirements of a 'Surge Diverter'. **(04 Marks)**

## PART – B

5 a. With a diagram, explain the zones of protection in a typical power system. **(08 Marks)**
b. Name any six essential characteristics of a protective relay. **(06 Marks)**
c. Determine the actual time of operation of a 5A, 3 second over current relay having a current setting of 125% and a time multiplier of 0.6 connected to a supply circuit through a 400/5 CT when the circuit carries a fault current of 4000A. The operation time of the relay is 3.5 sec. for the estimated value of PSM. **(06 Marks)**

6 a. Describe the operation of the following relays with neat sketches :
i) shaied pole type induction relay ii) watt hour meter type induction relay. **(12 Marks)**
b. Explain the working principle and characteristics of an impedance relay. **(08 Marks)**

7 a. Explain the Merz – Price protection for Y – connected alternator. What are the advantages? **(10 Marks)**

b. A synchronous generator rated for 20 KV protected by circulating current system having neutral grounded through a resistance of 15Ω. The differential protection relay is sat to operate when there is an out – of – balance current of 3A. The CTs have a ratio of 1000/5A. Determine,

i) Percentage of unprotected winding

ii) Value of earth resistance to achieve 75% protection of winding. **(10 Marks)**

8 a. Explain the working of a Buchholtz's relay for transformer protection with neat diagram. **(10 Marks)**

b. Explain single phasing preventer for induction motor with a diagram. **(10 Marks)**

* * * * *

USN | | | | | | | | | | |  **10EE63**

## Sixth Semester B.E. Degree Examination, June/July 2016
# Electrical Machine Design

Time: 3 hrs. Max. Marks:100

**Note: 1.** ***Answer FIVE full questions, selecting at least TWO questions from each part.***
**2.** ***Design data manual may be used, if necessary.***





**PART – A**

1 a. Define 'Specific Magnetic loading' and 'Specific electric loading'. What are advantages and disadvantages of using higher specific loadings? **(10 Marks)**

b. What are desirable properties of insulating materials? Explain classification of insulating materials based on maximum temperature rise mentioning at least 2 examples in each. **(10 Marks)**

2 a. With usual notations, derive output equation for a d.c. machine. **(06 Marks)**

b. A 5 KW, 250 V, 4 pole, 1500 rpm shunt generator is designed to have a square pole face. The specific loadings are – average flux density in the gap = 0.42 Wb/$m^2$; Ampere conductors per meter length of armature periphery = 15000 Amp.cond/m; Full load efficiency = 87%; Ratio of pole arc to pole pitch = 0.66. Calculate the main dimensions of the machine. **(06 Marks)**

c. During the design of a 1000 KW, 500 V, 10 pole, 300 rpm compound generator, the following data have been obtained. External diameter of armature = 1.4 m. Gross core length = 0.35 m. Flux per pole = 0.105 Wb. Based on above design data, calculate the following details referring to design of field system:
i) Axial length of the pole ii) Width of the pole iii) Height of the pole
iv) Pole arc.
Permissible loss per cooling surface may be assumed as 700 watts/$m^2$; Assume leakage coefficient for the pole $K_l$ = 1.2 ; Flux density in the pole = 1.6 Tesla; Iron factor $K_i$ = 0.95; Voltage drop as 2% of terminal voltage; $AT_f = 1.2\ AT_a$; Copper space factor = 0.6 and depth of field winding as 0.05 mt. Thickness of pole shoe = 4 cm. Ratio of pole arc to pole pitch = 0.68. Axial length of pole 1 cm less than gross length of armature. Winding is lap connected. **(08 Marks)**

3 a. Derive the output equation for a 3 phase transformer. **(10 Marks)**

b. Calculate dimensions of the core, number of turns and area of cross section of the conductors for the primary and secondary windings of a 125 KVA, 6600 V/460 V, 50 Hz single phase core type distribution transformer. The data are $B_m$ in core = 1.2 Wb/$m^2$ and current density $\delta = 250\ A/cm^2$. Assume cruciform (or stepped core) for the assembled core allowing 8% for the insultation between laminations. Take yoke cross section 15% higher than the core. Net cross section of copper = 0.225 times net cross section of iron in the core and window space factor $K_W$ = 0.3. Assume ratio of height of window to width of window = 2. Draw a neat sketch of core indicating the dimensions. **(10 Marks)**

4 a. Derive the equation for calculation of no load current of single phase transformer. **(08 Marks)**

b. A single phase 400 V, 50 Hz, transformer is built from core stampings having a relative permeability of 1000. The length of the flux path is 2.5 m. The gross area of cross section of the core is $2.5\times10^{-3}\,m^2$ and the primary winding has 800 turns. Calculate the maximum flux and the no load current of transformer. The iron loss at the maximum flux density is 2.6 W/kg. Iron weighs $7.8\times10^3$ kg/m$^3$ and stacking factor is 0.9. **(07 Marks)**

c. A 300 KVA, 6600 V/ 400 V, 50 Hz delta-star, 3 phase, core type transformer has the following data:
Width of HV winding = 25 mm; Width of LV winding = 16 mm; Height of coils 0.5 m; Length of mean turn = 0.9 m; hv winding turns = 830. Width of duct between hv and lv winding = 15 mm.
Calculate the leakage reactance of the transformer referred to the hv side. **(05 Marks)**

## PART – B

5 a. With usual notations, derive output equation for a 3 phase induction motor. **(10 Marks)**

b. Calculate the following design information for a 30 kW, 440 V, 3 phase, 6 pole, 50 Hz, delta connected squirrel cage induction motor. (i) Main dimensions (ii) Number of stator slots. (iii) Number of turns/phase in stator winding (iv) Number of conductors per slot.
The available data are:
Specific magnetic loading = 0.48 Tesla; Specific Electric loading = 26000 Amp Conductors/m; Full load efficiency = 88%; Full load power factor = 0.86; Winding factor $K_{WS}$ = 0.955; No. of slots / pole / phase = 3. **(10 Marks)**

6 a. What are factors to be considered for estimating the length of air gap for induction motors? Explain these factors. **(10 Marks)**

b. A 15 kW, 3 phase, 6 pole, 50 Hz, squirrel cage induction motor has the following data:
Stator bore diameter = 0.32 m; Axial length of stator core = 0.125 m; Number of stator slots = 54; Number of conductors per stator slot = 24; Current in each conductor = 17.5 A; Full load power factor = 0.85 lag. Design for a suitable cage rotor, number of rotor slots, Section of each bar and section of each end ring. The full load speed is about 950 rpm approximately. Use copper for rotor bars and the end rings. Resistivity of copper is 0.02 Ω mm$^2$/m. Assume current density in rotor bars and end rings 7 A/mm$^2$. **(10 Marks)**

7 a. Explain the factors that influence the selection of "Specific magnetic loading" and "Specific electric loading" for synchronous machines. **(10 Marks)**

b. Calculate the main dimensions of a 1000 KVA, 50 Hz, 3 phase, 375 rpm alternator. The average air gap flux density is 0.55 Wb/m$^2$; Ampere conductors/meter are 28,000. Assume ratio of core length to pole pitch = 2 and winding factor = 0.955. Permitted maximum peripheral speed is 50 m/s. **(10 Marks)**

8 a. Define "Short Circuit Ratio" (SCR) for a synchronous generator. Explain effects of SCR on synchronous machine performance. **(10 Marks)**

b. A 500 KVA, 3.3 KV, 50 Hz, 600 rpm, 3 phase salient pole alternator has 180 turns / phase. Calculate the length of the air gap, if the average flux density is 0.54 Wb/m$^2$; ratio of pole arc to pole pitch 0.66; SCR is 1.2 ; the gap contraction factor is 1.15 and winding factor is 0.955. The mmf required for air gap is 80% of no load field mmf. **(10 Marks)**

* * * * *

USN | | | | | | | | | | **10EE64**

# Sixth Semester B.E. Degree Examination, June/July 2016
## Digital Signal Processing

Time: 3 hrs. Max. Marks: 100

**Note:** ***Answer FIVE full questions, selecting at least TWO questions from each part.***





### PART – A

**1** a. Compute the N – point DFT of $x[n] = a^n$ for $0 \le n \le N-1$. Also find the DFT of the sequence $x[n] = 0.5^n u[n]\ ;\ 0 \le n \le 3$. **(07 Marks)**

b. Find the DFT of a sequence $x[n] = \begin{cases} 1 \text{ for } 0 \le n \le 3 \\ 0 \quad \text{otherwise} \end{cases}$

For N = 8. Plot magnitude of the DFT x(k). **(10 Marks)**

c. If $x[n] \xleftrightarrow[N]{DFT} x(k)$ then prove that DFT $\{x(k)\}$ = N x(-ℓ) **(03 Marks)**

**2** a. The first values of an 8 point DFT of a real value sequence is {28, -4.966j, 4+4j, -4+1.66j, -4}. Find the remaining values of the DFT. **(04 Marks)**

b. Obtain the circular convolution of $x_1[n]$ = [1, 2, 3, 4] with [1, 1, 2, 2]. **(06 Marks)**

c. A long sequence x[n] is filtered though a filter with impulse response h(n) to yield the output y[n]. if x[n] = {1, 4, 3, 0, 7, 4, -7, -7, -1, 3, 4, 3}, h(n) = {1, 2} compute y[n] using overlap add technique. Use only a 5 point circular convolution. **(10 Marks)**

**3** a. Prove the symmetry and periodicity property of a twiddle factor. **(04 Marks)**

b. Develop an 8 point DIT – FFT algorithm. Draw the signal flow Graph. Determine the DFT of the sequence x[n] = {1, 1, 1, 1, 0, 0, 0, 0,} using signal flow graph. Show all the intermediate results on the signal flow graph. **(12 Marks)**

c. What is FFT algorithm? State their advantages over the direct computation of DFT. **(04 Marks)**

**4** a. Find 4 point circular convolution of x[n] and h[n] using radix 2 DIF FFT algorithm x[n] = [1, 1, 1, 1] and h[n] = [1, 0, 1, 0]. **(08 Marks)**

b. Calculate the IDFT of x(k) = {0, 2.828 – j2.828, 0, 0, 0, 0, 0, 2.82 + j 2.82} using iniverse radix 2 DIT FFT algorithm. **(12 Marks)**

### PART – B

**5** a. The transfer function of an analog filter is given as $H_a(s) = \dfrac{1}{(s+1)(s+2)}$ : obtain H(z) using impulse invariant method. Take sampling frequency of 5 samples/sec. **(05 Marks)**

b. Obtain H(z) using impulse invariance method for following analog filter $H_a(s) = \dfrac{1}{(s+0.5)(s^2+0.5s+2)}$. Assume T = 1 sec. **(10 Marks)**

c. Convert the analog filter into a digital filter whose system function is $H(s) = \dfrac{2}{(s+1)(s+3)}$ using bilinear transformation, with T = 0.1 sec. **(05 Marks)**

6 a. Design a Digital Butterworth filter using the bilinear transformation for the following specifications: **(12 Marks)**

$$0.8 \le |H(e^{jw})| \le 1 \quad \text{for } 0 \le w \le 0.2\pi$$

$$|H(e^{jw})| \le 0.2 \quad \text{for } 0.6\pi \le w \le \pi$$

b. Determine the order of a Chebyshev digital low pass filter to meet the following specifications: In the passband extending from 0 to $0.25\pi$ a ripple of not more than 2dB is allowed. In the stop band extending form $0.4\pi$ to $\pi$, attenuation can be more than 40dB. Use bilinear transformation method. **(08 Marks)**

7 a. The frequency response of a filter is given by $H(e^{jw}) = jw; -\pi \le w \le \pi$. Design the FIR filter, using a rectangular window function. Take N = 7. **(12 Marks)**

b. The desired frequency response of the low pass FIR filter is given by

$$H_d(e^{jw}) = H_d(w) = \begin{cases} e^{-j3w}; & |w| < 3\pi/4 \\ 0 \quad ; & 3\pi/4 < |w| < \pi \end{cases}$$

Determine the frequency response of the FIR filter if the hamming window is used with N = 7. **(08 Marks)**

8 a. A FIR filter is given by $y[n] = x[n] + \frac{2}{5}x(n-1) + \frac{3}{4}x(n-2) + \frac{1}{3}x(n-2)$. Draw the direct and linear form realization. **(10 Marks)**

b. Obtain the direct form II and cascade realization of the following function. **(10 Marks)**

$$H(z) = \frac{8z^3 - 4z^2 + 11z - 2}{(z-0.25)(z^2 - z + 0.5)}$$

* * * * *

USN | | | | | | | | | | 10EE666

# Sixth Semester B.E. Degree Examination, June/July 2016
## Electrical Engineering Materials

Time: 3 hrs. Max. Marks:100

**Note: 1.** ***Answer FIVE full questions, selecting at least TWO questions from each part.***
**2. Support your answers with relevant diagram and Equations if necessary.**

**PART – A**

1 a. With neat sketches explain Fermi Dirac distribution at different temperatures. **(08 Marks)**
b. Explain different types of materials used for the manufacturing of electric resistors. **(08 Marks)**
c. Calculate the resistance of a wire at 50°C which is300 m long and has an area of cross section of 25 $mm^2$. The wire is made up of aluminum; resistivity of aluminum at 15°C is 2.78Ωm. Temperature coefficient of aluminum is 0.004Ω/degree C at 0°C. **(04 Marks)**

2 a. Explain the different types of semi-conductors. **(08 Marks)**
b. Write a note on origin of permanent magnetic dipole moments. **(08 Marks)**
c. The following data are given for intrinsic germanium at 300K. $n_i = 2.4\times10^{19}/m^3, \mu_e = 0.39 m^2v^{-1}s^{-1}, \mu_n = 0.19 m^2v^{-1}s^{-1}$. Calculate the resistivity of the sample. **(04 Marks)**

3 a. What is polarization? List the different types of polarization and explain any two types in detail. **(10 Marks)**
b. Write a note on the following : i) Dipolar relaxation ii) Dielectric loss **(10 Marks)**

4 a. Classify insulating materials on the basis of physical and chemical structure and explain any four in brief. **(10 Marks)**
b. Why oil is used in transformer? With a neat diagram explain a method to test dielectric strength of transformer oil. **(10 Marks)**

**PART – B**

5 a. With a neat diagram explain with working of solar photo voltaic cell and also draw the equivalent circuit and V-I characteristics. **(12 Marks)**
b. Explain the following : i) Cold mirror Coatings ii) Heat Mirror Coatings. **(08 Marks)**

6 a. Explain atomic absorption spectroscopy with a neat diagram. **(10 Marks)**
b. Explain the concept of Nuclear Magnetic Resonance (NMR), with the help of NMR spectrometer. **(10 Marks)**

7 a. Explain the phenomenon of Piezo electricity. Discuss essential properties and applications of piezoelectric materials. **(08 Marks)**
b. What is rheology? Explain magneto rheological fluid with their modes of operation. **(08 Marks)**
c. Write a brief note on shape memory alloy's. **(04 Marks)**

8 a. List the applications of ceramics as conductors and explain any four. **(08 Marks)**
b. What are plastics? Explain AC and DC electrical properties for the same. **(10 Marks)**
c. Write any two differences between thermoplastics and thermosetting plastics. **(02 Marks)**

* * * * *