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**10EE61**

## Sixth Semester B.E. Degree Examination, Dec.2018/Jan.2019

# Power System Analysis and Stability

Time: 3 hrs. Max. Marks:100

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



## PART – A

1 a. Draw the PU Reactance diagram for power system shown in Fig.Q1(a). Select the base values of 20 MVA, 6.6 KV in the generator 1 circuit. The ratings of various components are:
Generator 1: 10 MVA, 6.6 KV, $X'' = 0.1$ p.u
Generator 2: 20 MVA, 11.5 KV, $X'' = 0.1$ p.u
Transformer $T_1$ = 10 MVA, 3 phase, 6.6/115 KV, X = 0.15 p.u.
Transformer $T_2$ = 3 single phase units each rated 10 MVA, 7.5/75 KV, X = 0.1 pu.

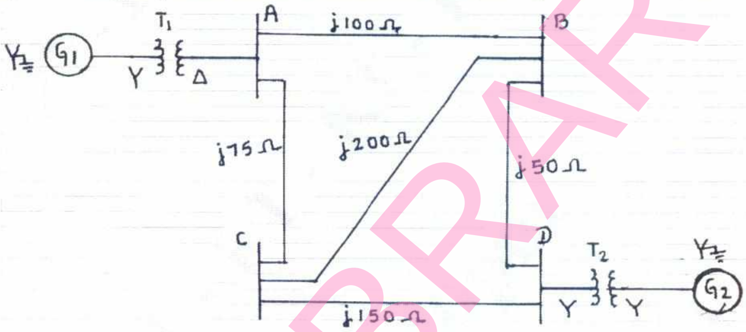


Fig.Q1(a) **(12 Marks)**

b. What are the advantages of per unit quantities? Show that:

$$\text{PU reactance}_{new} = \text{PU reactance}_{given} \frac{\text{base MVA}_{new}}{\text{base MVA}_{old}} \times \frac{\text{base KV}^2_{old}}{\text{base KV}^2_{new}}.$$ **(08 Marks)**

2 a. Explain in detail the transients on a transmission line due to short circuit. **(08 Marks)**

b. A transmission line of inductance L = 0.1 H and resistance R = 5Ω is suddenly short circuited at t = 0, at the far end of the line as shown in Fig.Q2(b). If the source voltage is $v = 100\sin(100\pi t + 15)$. Obtain the following:
i) Expression for the short circuit current, i(t)
ii) Value of the first current maximum (maximum momentary current).
iii) Instant of short circuit so that DC off set current is zero.
iv) Instant at which DC offset current is maximum.

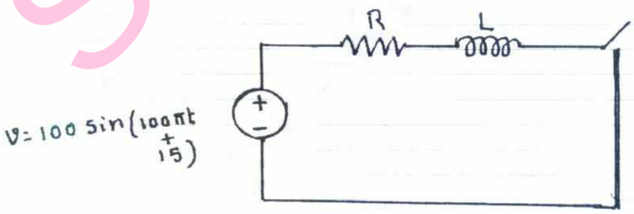


Fig.Q2(b) **(12 Marks)**

3 a. Derive the relation between sequence components of phase and line voltages in star connected systems. **(08 Marks)**

b. A delta connected balanced resistive load is connected across an unbalanced 3 phase supply as shown in Fig.Q3(b). With currents in lines A and B specified, find the symmetrical components of line currents. Also, find the symmetrical components of delta currents (phase-currents).

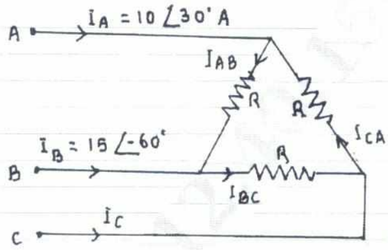


Fig.Q3(b) **(12 Marks)**

4 a. Draw the positive, negative and zero sequence network for the power system shown in Fig.Q4(a). Choose a base of 50 MVA, 220 KV in the j50Ω transmission line and mark all reactances in per unit. The ratings of generators and transformers are
Gen 1: 25 MVA, 11 KV, X″ = 20%
Gen 2 : 25 MVA, 11 KV, X″ = 20%
Transformers (each) : 20 MVA, 11Y/220Y KV, X = 15%. The negative sequence reactance of each synchronous machine is equal to the sub transient reactance. The zero sequence reactance of each machine is 8%. Assume that the zero sequence reactance of lines are 250% of their positive sequence reactance.

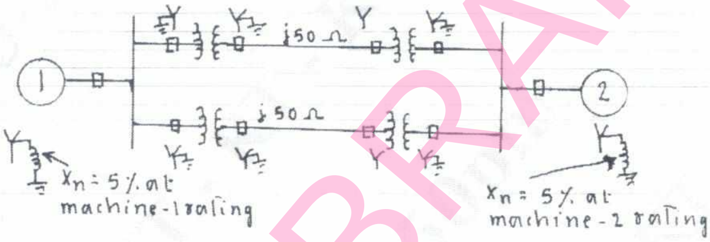


Fig.Q4(a) **(14 Marks)**

b. Derive an expression for complex power in terms of symmetrical components. **(06 Marks)**

## PART – B

5 a. Derive an expression for fault current in case of double line to ground fault on an unloaded generator. Draw the interconnection of sequence network. **(10 Marks)**

b. A 3 phase generator with constant internal voltages gave the fault current values 1.4 KA for a L-L fault and 2.2 KA for a L-G fault. If $E_{as}$ = 2 KV, $X_1$ = 2Ω, determine the reactance $X_2$ and $X_0$. **(10 Marks)**

6 a. A salient pole generator without dampers is rated 20 MVA, 13.8 KV and has a direct axis subtransient reactance of 0.25 per unit. The negative and zero sequence reactances are 0.35 and 0.10 per unit respectively. The neutral of the generator is solidly grounded. Determine the subtransient current in the generator and the line to line voltages for subtransient conditions when a single line to ground fault occurs at the generator terminals with the generator operating unloaded at rated voltage. Neglect resistance. **(14 Marks)**

b. Write a note on series type of faults. **(06 Marks)**

7 a. Derive an expression for swing equation. **(10 Marks)**

b. A loss free alternator supplies 50 MW to an infinite bus. The SSSL being 100 MW, determine if the alternator will remain stable if the input to the prime mover of the alternator is abruptly increased by 40 MW. **(10 Marks)**

8 a. Explain equal area criterion when there is sudden change in input. **(10 Marks)**

b. Analyze in detail the 3 phase induction motor with unbalanced voltage. **(10 Marks)**

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# Sixth Semester B.E. Degree Examination, Dec.2018/Jan.2019

# Electrical Machine Design

Time: 3 hrs. Max. Marks:100

**Note: 1. *Answer any FIVE full questions, selecting at least TWO questions from each part.***
**2. *Design data book may be used.***
**3. *Assume missing data suitably.***

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg. 42+8 = 50, will be treated as malpractice.



## PART – A

1 a. What are the important considerations for the design of electrical machines? Explain in brief and what are its limitations. **(10 Marks)**

b. i) Show that the output of a d.c. generator with single turn coils is given by the expression

$$P' = \frac{0.03E'VqA}{PN} KW$$

where E′ = average voltage between adjacent conductor segments.
V = peripheral speed of the generator m/sec.

ii) Find the maximum output for a lap wound d.c. generator running at 600 rpm and provided with 40,000 ampere conductors per meter of armature periphery. **(10 Marks)**

2 a. Derive the output equation of DC machine. **(10 Marks)**

b. During the design of armature of a 1000 KW, 500 V, 10 pole, 300 rpm, d.c. compound generator, following information has been obtained:

- External diameter of armature 1.4 m
- Gross core length, 0.35 m
- Flux per pole, 0.105 wb.

Based on the above, design information, find out the following details regarding the 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 square meter of the cooling surface may be assumed 700 W/mt$^2$. Assume missing data as per the rating of the machine. **(10 Marks)**

3 a. Show that with usual notations Volts/turn $E_t = K\sqrt{K.V.A}$ in the case of a transformer. Explain the factors to be taken into account while selecting the value of constant K. **(10 Marks)**

b. Calculate: (i) Net cross section of core (ii) Gross area of the core (iii) Core dimensions (iv) Window area (v) dimensions of the window, for a 200 kVA, 6600/250 V, 50 Hz single phase, shell type, oil immersed, self cooled, distribution transformer based on the following design parameters.

Window space factor, $K_w = 0.28$ Maximum flux density in the core, $B_m = 1.1$ Tesla
Average current density, $\delta = 2.2$ A/mm$^2$ Window proportion = 2.5:1
Rectangular core proportion = 1.8:1
Net cross-section of copper in the window is 0.2 time the net cross section of iron in the core. **(10 Marks)**

4 a. Explain the step by step procedure for the design of cooling tubes and calculation of temperature rise in a transformer. **(10 Marks)**

b. A 300 KVA, 11000/440 V, 50 Hz, 3 phase, delta/star, core type oil immersed, self cooled transformer give the following results during the design calculations of magnetic frame and windings.
Centre to centre distance between the cores = 36 cm ; Height of the window = 44 cm;
Height of the yoke = 17 cm ; Total weight of the magnetic frame = 700 kg ;
Average specific loss (Iron) = 2.1 W/kg ; Outer diameter of HV winding = 35 cm
Resistance of LV winding per phase = 0.0047 ohm ; Resistance of HV winding per phase = 9.74 ohms. Based on the above design data, calculate the following:
i) The dimensions of the tank
ii) The temperature rise of the transformer with plain tank
iii) Number of cooling tubes, if the temperature rise is not to exceed 35°C. **(10 Marks)**

## PART – B

5 a. Deduce for a 3 phase induction motor expression showing the relationship between H.P output, its main dimensions, speed, the specific electric and magnetic loadings, efficiency and power factor. **(10 Marks)**

b. Determine the main dimensions, number of radial ventilating ducts number of stator slots and the number of turns per phase of a 3.7 KW, 400 V, 3ϕ, 4 pole, 50 Hz, cage induction motor to be shorted by a star-delta shorter. Assume $B_{av}$ = 0.45 Wb/mt$^2$, ac/m = 23000, efficiency = 0.85 and power factor = 0.84 lagging. **(10 Marks)**

6 a. Discuss in detail, the criteria to be considered for determining the number of rotor slot of a cage induction motor. **(10 Marks)**

b. A 3 phase, 3000 volts, 260 KW, 50 Hz, 10 pole squirrel cage induction motor gave the following results during its preliminary design.
Internal diameter of stator = 75 cm Gross length of stator = 35 cm
Number of stator slots = 125 Number of conductor per slot = 10
Based on the above detail, calculate the following for the squirrel cage rotor.
i) Total losses in the rotor bars
ii) Losses in the end rings
iii) Equivalent resistance of the rotor in terms of stator. **(10 Marks)**

7 a. Explain the design procedure to determine the pole dimensions for a salient pole synchronous machine. **(10 Marks)**

b. During the design of stator of 3 phase, 7.5 KVA, 6.6 KV, 50 Hz, 3000 rpm, turbo generator following information have been obtained.
Internal diameter of stator = 0.75 m
Gross length of core = 0.9 m
Number of stator slots per pole per phase = 7
Sectional area of stator conductor = 190 mm$^2$
Number of conductors per slot = 4
Based upon the above data, calculate the following:
i) Flux per pole ii) Specific magnetic loading
iii) Specific electrical loading iv) Current density for the stator winding. **(10 Marks)**

8 a. Derive the output equation of synchronous generator. **(10 Marks)**

b. Design the field coil of a 3 phase, 16 poles, 50 Hz salient pole alternator based on the following design information:
Diameter of stator at the gap surface = 1.0 m Gross length of stator core = 0.3 m
Section of pole body = 0.15m × 0.3m Height of the pole = 0.15 m
Ampere turns per pole = 6500 Exciter voltage = 110
Assume suitable data wherever necessary. **(10 Marks)**

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## Sixth Semester B.E. Degree Examination, Dec.2018/Jan.2019
# 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. (i) If DFT $[x(n)] = X(K)$, then show that DFT $[x((c-n))_N] = X((c-K))_N$.

(ii) DFT $[x^*(n)] = X^*(n-K)$

(iii) DFT $[x(n)e^{j2\pi ln/N}] = X((K-l))_N$. **(12 Marks)**

b. Find DFT of the sequence, $x(n) = \begin{cases} 1; & 0 \le n \le 2 \\ 0; & \text{Otherwise} \end{cases}$ for N = 4, plot $|X(K)|$ and $\underline{|X(K)}$. **(08 Marks)**

2 a. Make a comparison between circular convolution and linear convolution. Given $x_1(n) = \{1, -1, -2, 3, -1\}$ and $x_2(n) = \{1, 2, 3\}$. Find the circular convolution of $x_1(n)$ and $x_2(n)$. **(10 Marks)**

b. What are the two methods of sectional convolution? Explain them. **(10 Marks)**

3 a. Let x(n) be a finite length sequence with $X(K) = (10, -2+j2, -2, -2-j2)$. Using the properties of DFT find the DFT's of the following sequence:

(i) $x_1(n) = x((n+2))_4$ and (ii) $x_2(n) = x(4-n)$ **(08 Marks)**

b. If $x(n) = \{1, 2, 0, 3, -2, 4, 7, 5\}$, evaluate the following :

(i) X(0) (ii) X(4) (iii) $\sum_{K=0}^{7} X(K)$. (iv) $\sum_{K=0}^{7} |X(K)|^2$ **(08 Marks)**

c. What are the difference and similarities between DIT and DIF-FFT algorithms? **(04 Marks)**

4 a. Compute the 8-pt DFT of the sequence, $x(n) = \{0.5, 0.5, 0.5, 0.5, 0, 0, 0, 0\}$ using the inplace radix-2 DIT algorithm. **(10 Marks)**

b. Derive the Radix-2 DIF-FFT algorithm to compute the DFT of a N = 8 pt. sequence and draw the complete signal flow graph. **(10 Marks)**

## PART – B

5 a. Develop a transformation for the solution of a first order linear constant coefficient difference equation by using trapezoidal approximation for the internal approximation. High light the features of transformation. **(08 Marks)**

b. Design a digital LPF with a passband magnitude characteristic that is constant within 0.75 dB for frequencies below $w = 0.2613\pi$ and stop band attenuation of atleast 20 dB for frequencies between $w = 0.4018\pi$ and $\pi$. Determine the transfer function H(z) for the lowest order butterworth design which meets the specifications. Use bilinear transformation. Assume T = 2 sec. **(12 Marks)**

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

6 a. The transfer function of analog filter is given by $H_a(s) = \frac{1}{(s+1)(s+2)}$. Find H(z) using impulse invariance method, if $F_S = 5$ samples / sec. **(06 Marks)**

b. Distinguish between butterworth and chebyshev (Type I) filters. **(04 Marks)**

c. Describe the transformation relation used for converting an analog LPF into, (i) LPF (ii) HPF (iii) BPF (iv) BSF both in Analog domain and Digital domain. **(10 Marks)**

7 a. What are the advantages and disadvantages with the design of FIR filters using window function? **(06 Marks)**

b. The frequency response of a FIR filter is given by, $H(e^{jw}) = jw; \quad -\pi \le w \le \pi$. Design the filter, using a rectangular window function. Take N = 7. **(08 Marks)**

c. The frequency response of a linear phase FIR filter is given by, $H(e^{jw}) = e^{j3w}[2 + 1.8\cos 3w + 1.2\cos 2w + 0.5\cos w]$. Find the impulse response sequence of the filter. **(06 Marks)**

8 a. Let the coefficients of a three stage FIR lattice structure be $K_1 = 0.1$, $K_2 = 0.2$, $K_3 = 0.3$. Find the coefficients of direct form FIR filter and draw its block diagram. **(08 Marks)**

b. A discrete time system H(z) is expressed as,

$$H(z) = \frac{10\left(1-\frac{1}{2}z^{-1}\right)\left(1-\frac{2}{3}z^{-1}\right)\left(1+2z^{-1}\right)}{\left(1-\frac{3}{4}z^{-1}\right)\left(1-\frac{1}{8}z^{-1}\right)\left[1-\left(\frac{1}{2}+j\frac{1}{2}\right)z^{-1}\right]\left[1-\left(\frac{1}{2}-j\frac{1}{2}\right)z^{-1}\right]}.$$

Realize parallel and cascade forms using second order sections. **(12 Marks)**

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# Sixth Semester B.E. Degree Examination, Dec.2018/Jan.2019
## Electrical Engineering Materials

Time: 3 hrs. Max. Marks:100

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



## PART – A

1 a. Explain free electron theory for metals. **(05 Marks)**
b. Explain Fermi – Dirac distribution for conducting materials. **(05 Marks)**
c. What are the properties of Lamp filaments? **(05 Marks)**
d. What are the properties of fuse material? **(05 Marks)**

2 a. List out types of semi conductor and name any four compound semiconductors. **(05 Marks)**
b. Explain Hall effect with diagram. **(05 Marks)**
c. Explain properties of Hard and Soft magnetic materials. **(05 Marks)**
d. What is the importance of permeability? **(05 Marks)**

3 a. Compare electronic and Ionic polarizations with necessary equations for both static and alternating fields. **(10 Marks)**
b. Explain the necessary equations and diagram dipolar relaxation and dielectric loss. **(10 Marks)**

4 a. Explain properties and applications of mica and porcelain. **(10 Marks)**
b. Write short note on transformer oil. **(05 Marks)**
c. Write short note on SF6 gaseous insulating materials. **(05 Marks)**

## PART – B

5 a. What are the selective coating properties? **(05 Marks)**
b. Explain Alkaline Fuel cell operation with neat diagram. **(05 Marks)**
c. Write short note on solar cell. **(05 Marks)**
d. What are applications of different kind of fuel cells? **(05 Marks)**

6 a. Explain nuclear magnetic resonance. **(05 Marks)**
b. Explain electron spin resonance. **(05 Marks)**
c. Explain optical microscopy. **(05 Marks)**
d. Explain atomic absorption spectroscopy. **(05 Marks)**

7 a. What are properties and applications of magnetostrictive materials? **(05 Marks)**
b. What are the properties and applications of piezoelectric materials? **(05 Marks)**
c. What are the properties and applications of shape memory alloys? **(05 Marks)**
d. What are the properties and applications of smart hydrogels? **(05 Marks)**

8 a. What are the different applications of ceramic material as conductor and insulators? **(05 Marks)**
b. Write short notes on thermoplastics? **(05 Marks)**
c. What are the properties of thermostats? **(05 Marks)**
d. What are general properties of ceramic materials? **(05 Marks)**

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