BITS,Pilani-Dubai
International Academic City
Dubai
1st Semester,2008-09
Subject: Advanced Power Systems (EEEC462)
4th year(EEE)—Test 1-F.M.=25(25%)---Duration=50 min.- -Date -12/10/2008

1.(a)Explain the operation of a Thermal Power Generation System, drawing necessary block diagram and Temperature-Entropy diagram.
(b) Why is superheated steam used as input to the steam-turbine,in context to the part(a) question?
[5+2 Marks]

2. Derive the solutions for voltage and current as functions of space(along the length) of a long transmission line, starting from fundamentals and using the method of Laplace Transform. Draw the necessary diagram also. [10 Marks]

3.Using the nominal-T method,find the sending end voltage(line to line) of a 200 kilometre,three phase ,50 Hz transmission line . At the receiving end,the power is 23.5 MVA at 0.8 power factor(lagging) . The receiving end voltage is 132 kilo-volts(line to line). Line inductance =1.15 mH/km and line capacitance =0.0085 μF/km and line resistance= 0.14 ohm/km. Derive the necessary relations (equations) also, based on the necessary circuit diagram to be drawn.
[8Marks]

BITS, Pilani – Dubai
International Academic City – Dubai
IV year EEE, Ist Semester 2008-09

Course Title - Advanced Power Systems (EEE C 462)

Test – II (Open Book) Full Marks – 20 (Weight age 20 %)
Date: 23-11-2008

Instructions:
Prescribed text Books and hand written class notes only allowed.

1. A Synchronous generator is feeding 250MW to a large 50Hz network over a double Circuit transmission line. The maximum steady state power that can be transmitted under different conditions, are as follows :-

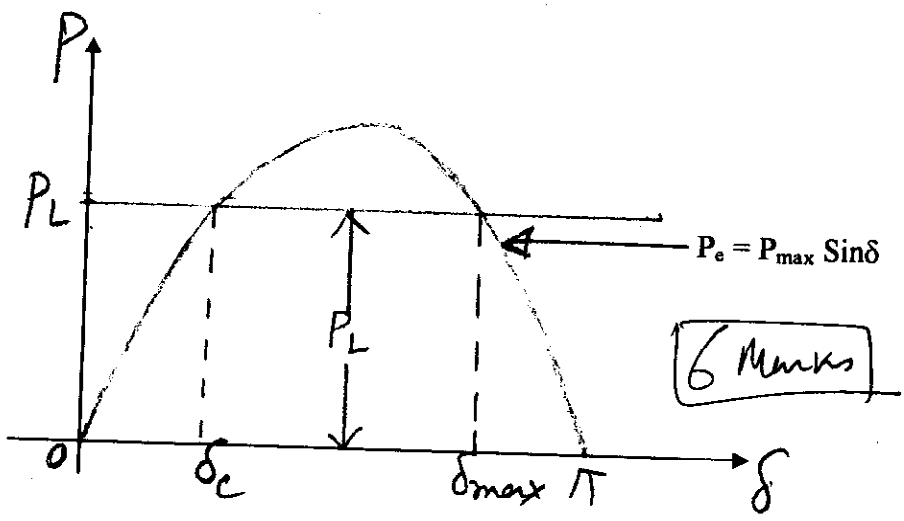
   Prefault ---------- 500MW

   During Fault--------175 MW

   Post Fault ---------- 350MW

   Estimate the critical clearing angle in which the circuit breakers must trip so that synchronism is not lost. Consider that the maximum load angle (δmax) is the angle at the point of intersection by the 250MW line with the post-fault P- δ curve. Apply the "Equal Area Criterion" method. 7 Marks

2. With reference to the following figure, suddenly the load P_L is put on the synchronous machine. Applying Equal Area Criterion, prove that $\tan(\delta_c/2) = 1/(\pi - \delta_c)$.



6 Marks

P.T.O

3. Two 25 MVA, 11KV synchronous generators are connected to a common bus bar which supplies a feeder. The star point of one of the generator is solidly grounded while that of the other generator is isolated. The sub transient direct axis and quadrature axis synchronous reactances, X_d'' and X_q'', of each generator are j 0.1 and j 0.2 per unit, respectively. A line - to - ground fault occurs at the far end of the feeder. The impedances to sequence currents of each generator and feeder are given as follows ;-

Each Generator (per unit)		Feeder (Ohms /Phase)	
Positive sequence	j 0.2	Positive sequence	j 0.4
Zero Sequence	j 0.08	Negative sequence	j 0.4
		Zero sequence	j 0.8

Determine ;

a. the fault current (in per unit).
b. the voltage to ground of any one of the sound(healthy) phases of the feeder at the fault point (in per unit).

4+3 Marks

BITS,Pilani-Dubai
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1st Semester,2008-09
Subject:Advanced Power Systems (EEEC462)
4th year(EEE)--Quiz I--F.M.=5(5%)---Duration=15 min.- -Date -21/09/2008
Set-B

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1. In a long transmission line , it is given that:
$A = \cos h\gamma l$ and $B = Z_c \sin h\gamma l$, where the symbols have their usual meanings. Prove that, on the basis of these given expressions , approximately it can be written as: $A = 1+(YZ/2)$ and $B = Z[1+(YZ/6)]$. Specify the approximations also.
[3 Marks]

2. Why Synchronous Generators used in Thermal Power Plants are , mostly of 2-(Two)poles?-----Explain. **[2 Marks]**

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Subject:Advanced Power Systems (EEEC462)
4th year(EEE)--Quiz I--F.M.=5(5%)---Duration=15 min.- -Date -21/09/2008
Set-A

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1. **Derive the expressions for "A" and "B" for a Nominal-T(or, Nominal-π) Representation of Medium Transmission line, with necessary circuit diagrams. [3 Marks]**

2. **Why does the variable(Discharge=W) appear in the expression for Power available from a hydro plant, as given by:**

$$P = 981\ \rho\ W\ H,$$

where the symbols have their usual meanings? Explain or prove, mathematically. [2 Marks]

BITS,Pilani-Dubai
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1st Semester,2008-09
Subject:Advanced Power Systems (EEEC462)
4th year(EEE)--Quiz II--F.M.=5(5%)---Duration=15 min.- -Date -26/10/2008
Set-A

Name---------- Id No----------

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1. **In context to the theory of symmetrical components, if $V_a = V_a e^{j0}$ and $V_b = (\alpha)^2 V_a$, then V_c = -------. Fill up the blank.** **[1Mark]**

2. **Zero sequence components are co-phasal -------- TRUE/FALSE?** **[1Mark]**

3. **$1+\alpha+(\alpha)^2 = 3$---TRUE/FALSE?** **[1Mark]**

4. **Prove that the symmetrical component transformation is POWER INVARIANT.** **[2 Marks]**

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4th year(EEE)--Quiz II--F.M.=5(5%)---Duration=15 min.- -Date -26/10/2008
Set-B

Name---------- Id No----------

1. **It is given that,$[V_p] = [A]\,[V_s]$,where $[V_p]$ is the vector of original phasors and $[V_s]$ is the vector of symmetrical components. Writ the expression for $[A]$. [1Mark]**

2. **Zero sequence components have a phase sequence opposite to that of positive sequence component vector -------- True or False? [1Mark]**

3. **Write the expression for negative sequence reactance of three phase synchronous machine. [1Mark]**

4. **Prove that $[A]^T [A]^* = 3[U]$, where $[U]$ is the unit matrix . [2Marks]**

BITS, Pilani – Dubai
International Academic City – Dubai
IV year EEE, Ist Semester 2008-09

Course Title - Advanced Power Systems (EEE C 462)
Comprehensive Examination
Full Marks – 80 (Weight age 40 %) Duration—3 hours
Date: 29-12-2008

1(a) Explain the operation of a Nuclear Power Station with necessary diagrams.
(b) Write the merits and demerits of a Nuclear Power Station. [8+2 Marks]

2. A 50 Hz. Transmission line has a total series impedance of 40+j125 ohms and a total shunt admittance of 0.001 mho. The receiving end load is 50 MW at 220 kV(line voltage) with 0.8 power factor(lagging).Calculate the sending end voltage and sending end current using: (i) Nominal T-representation and(ii) Using approximate equations: A=D =1+(YZ/2) , B=Z[1+(YZ/6)] , C=Y[1+(YZ/6)] [5+5 Marks]

3.A Synchronous generator is feeding 275MW to a large50Hz network over a double circuit transmission line. The maximum steady state power that can be transmitted under different conditions, are as follows :-

Prefault ---------- 500MW
Post Fault ---------- 350MW

A solid three phase symmetrical fault occurring at the network-end of one of the lines causes it to trip. Estimate the critical clearing angle in which the circuit breakers must trip so that synchronism is not lost. Consider that the maximum load angle (δmax) is the angle at the point of intersection by the 275 MW line with the post-fault P- δ curve. Apply the "Equal Area Criterion" method. [10 Marks]

4(a) Starting from fundamentals, develop the "Swing Equation" of a synchronous machine as a power system component. Each step of the analysis should be presented.

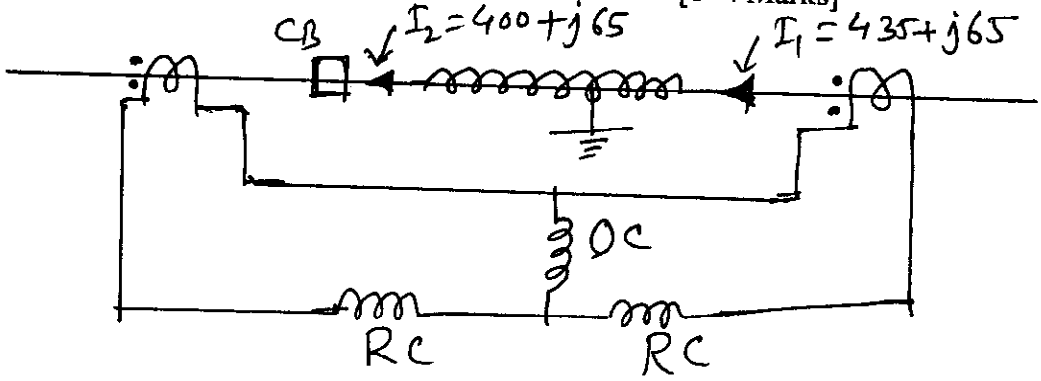
(b)Based on the "Swing Equation" of question 4(a) , derive the mathematical expression for "Equal Area Criterion". [8+2 Marks]

5. A three phase star connected synchronous generator has positive, negative and zero sequence reactance of each being j0.08, j0.07 and j0.1 p.u. The neutral is solidly grounded. A double line- to –ground fault occurs on terminal of the generator(phase "b" and phase "c" windings shorted within themselves and connected to ground ,with Z^f =0.2+j0 ohm).Calculate the voltage of the healthy phase and negative sequence component of the current through that phase. Assume that E_a =1+j0 and I_a =0. . [10 Marks]

6. Explain the operation of a Vacuum Circuit Breaker(VCB) with necessary diagrams. [8 Marks]

7(a) Derive the equation of locus (in R-X plane)of a Modified Impedance Relay, with all necessary diagrams.

(b) The following figure shows the connections of a percentage differential relay to protect one phase of a generator. The relay has $N_r / N_o = 0.1$. A high resistance fault occurs with the current distribution shown. Will the relay operate under conditions indicated in the figure? [6+4 Marks]



8(a) Explain the concept of "Constant Flux Linkage Theorem" and the concepts of sub-transient and transient reactances and negative sequence reactance of three phase Synchronous Machine.

(b) Starting from fundamentals, derive the expression for fault current in the case of a single line-to-ground fault. Draw the necessary diagram. [6+6 Marks]