BITS, Pilani – Dubai
International Academic City – Dubai
IV year EEE, Semester-II/ 2013-14
Course Title - Advanced Power Systems (EEE C 462)
Comprehensive Examination
Full Marks – 80 (Weightage 40 %) Duration—3 hours
Date: 29-05-2014
Notes: Highlight all your answers by enclosing in boxes

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(1) A three phase overhead transmission line (star connected system) has resistance and reactance of 5.0 and 20.0 ohm(per phase), respectively. The total load at the receiving end is 25.2 MW at 0.82 power factor(lagging) . The load current is 537.68 amps. The power factor angle is defined with respect to the receiving end voltage.
(a)Calculate the sending end voltage (line value)
(b) A three phase capacitor bank of 15 MVAR (leading) rating has been connected at the load (receiving) end. Will this rating be sufficient to maintain a zero voltage regulation at the same receiving end voltage? If not, calculate the MVAR rating of the additional capacitor to be connected. Derive the necessary equation ,from fundamentals, in context to zero voltage regulation, with necessary phasor diagram. . [2+ 2+2+4 Marks]

2.) A three phase synchronous generator has positive, negative and zero sequence reactances per phase respectively, of 1.0, 0.8 and 0.4 Ω . The winding resistances are negligible. The phase sequence of the generator is R-Y-B (c.c.w), with a no-load voltage of 11.0 kv between lines. A short circuit occurs between lines Y and B and earth(ground) at the generator terminals. Calculate sequence currents in phase R and current in the earth return circuit:---(a) if, the generator is **SOLIDLY EARTHED/GROUNDED** ; and (b) if, the generator neutral is **ISOLATED** . [Use R-phase voltage as reference and Fault Impedance is **ZERO** . Proper system diagram and sequence network connection diagram must be drawn with labeling] –[8+4 marks].

3.) A Synchronous generator is feeding 250 MW 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 250 MW line with the post-fault P- δ curve. Apply the "Equal Area Criterion" method. [8Marks]

4) Develop the sub-transient equivalent circuit of a three phase salient pole synchronous generator (as a power system component) along the quadrature (q-) axis. Start the analysis from fundamentals (also the small perturbation model is to be used) and draw the necessary primitive machine models/diagrams. All figures/diagrams should be labeled. ---[8 marks]----------[P.T.O]

5.) (a) Derive the expression for "Transient Recovery Voltage across a Circuit Breaker[e_{TRV} (t)]" with labeled circuit diagrams and explanations.. Use the method of Laplace Transform. Assumptions, (if any) are to be stated.
(b) In context to "Transient Recovery Voltage [e_{TRV} (t)] of a circuit breaker" : L= 9.0 Henry , C= 0.02 μF and supply voltage per phase (r.m.s value) =220 KV.
Calculate: (i) Maximum value of Transient Recovery Voltage [e_{TRV} (t)]
(ii) Maximum value of RRRV [6+3+2 Marks]

6. (a) Explain the process of development of "ARC" in a Circuit Breaker with necessary diagrams.
(b) Draw only a neat diagram (labeled) of a SF_6 circuit breaker OR Vaccum Circuit Breaker(VCB) . Also explain , in brief the principle of operation (any one). [4+2+3Marks]

7.) Present the complete mathematical derivations for development of Relay Locus in R-X plane for : (i) Impedance Relay , and (ii) Reactance Relay [5+5 Marks]

8.) In context to the **" Load Frequency Control (Single Area Case) of a Power System":**
(a) Draw only the diagram (labeled) of Turbine Speed Governing System—no explanation
(b) Based on part (a) ,develop the block diagram representation(in Laplace domain) of Speed Governor System, after applying the Laplace Transform Operator to the system equations developed in time domain .
[3+9 Marks]

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BITS, Pilani – Dubai
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IV year EEE, II Semester 2013-14
Course Title - Advanced Power Systems (EEE C 462)
Test 1
Full Marks – 25 (Weightage 25 %) Duration—50 min
Date: 10---03—2014

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(1) A short transmission line with a reactance of 18.0 ohm per phase(resistance of the line being considered as zero) supplies a load at0.85 power factor(lag). For a transmission line current of 1100 Amps. per phase, the receiving- and sending-end voltages are to be maintained at 230KV(line-to-line) . Calculate the required MVAR rating of synchronous capacitor to be installed . Active power drawn by the synchronous capacitor may be neglected.
The necessary expression (formula) for zero voltage regulation may be directly used and the necessary circuit diagram must be drawn. [7 Marks]

(2) Derive the expressions (in detail) for A,B,C,D parameters, in a nominal "π" OR in a nominal "T" circuit representation of a medium transmission line with relevant circuit diagram (using any method OR combination of different methods) and verify that $AD - BC = 1$ ---[8+2 marks]

(3)With reference to Fig.1, the given data are(phase angles given in degree unit):
$V_{an} = 100\, e^{j\,0}$, $V_{bn} = 60\, e^{j\,60}$, $V_{cn} = 60\, e^{j\,120}$, $jX_{ab} = jX_{bc} = jX_{ca} = j5.0$ ohms , $j\,X_s = j12.0$ ohms.
Calculate I_a and I_b using the theory of Symmetrical Components. [4+4 Marks]

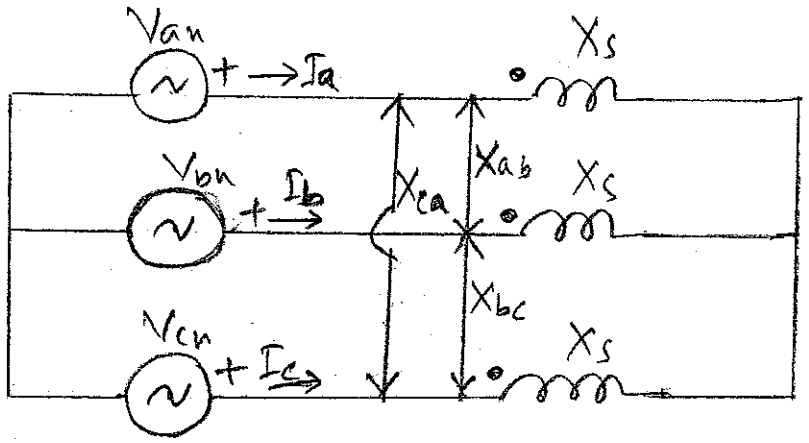

Fig.-1

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