編號： 180

國立成功大學 106 學年度碩士班招生考試試題

系　所：電機工程學系

考試科目：電力工程

考試日期：0213，節次：2

※ 考生請注意：本試題可使用計算機。　請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

1. (20%) The operating cost function of the generating unit is $C_i = \alpha_i + \beta_i P_i + \gamma_i P_i^2$.

For the area contains *n* generators to provide load demand P_T, the total cost of generation is

$$C_t = \sum_{i=1}^{n} C_i$$

Transmission loss formula is shown as follows: $P_L = \sum_{i=1}^{n} B_{ii} P_i^2$.

The optimal dispatch of the power generation is to find P_i such that Lagrange function *L* shown below is minimal, where λ is the Lagrange multiplier. $L = C_t + \lambda\left(P_T + P_L - \sum_{i=1}^{n} P_i\right)$

I. (10%) **Prove** that minima of Lagrange function *L* has an optimal λ_{opt}, such that

and

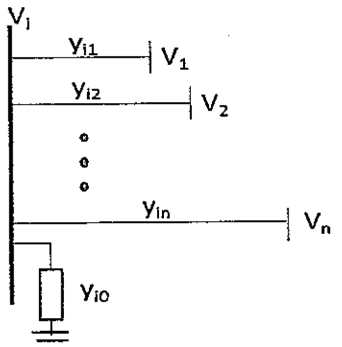
II. (10%) Given the operating cost in \$/h and the ratings for the two generators as follows:

Unit	Rating	Fuel-cost function in \$/h
Area 1	600	$C_1=500+6P_1+0.010P_1^2$, P_1 in MW
Area 2	800	$C_2=400+5P_2+0.004P_2^2$, P_2 in MW

System loss is approximated as $P_L=0.0002P_1^2+0.0004P_2^2$ MW.

If the system is operating at optimal λ_{opt} of \$20/MWh, please find optimal generation outputs, **P_1 and P_2** in MW, **system load P_T** in MW , and **total cost C_t** in \$/h.

2. (20%) Given the snapshot of a bus system shown below:



I. (5%) Assume the bus i is delivering active power P^{sch} and reactive power Q^{sch}, **prove** that the power flow equation has the following form:

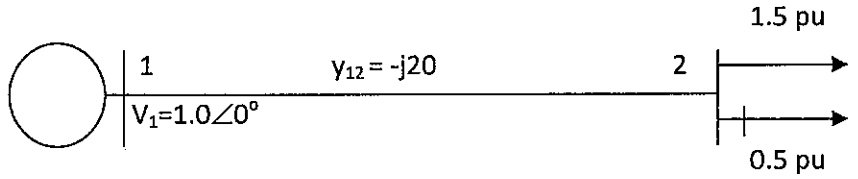
$$\frac{P_i^{sch} - jQ_i^{sch}}{V_i^*} = V_i \sum_{j=0}^{n} y_{ij} - \sum_{j=1}^{n} y_{ij} V_j \qquad j \neq i$$

II. (5%) Assume an initial estimate of $V_i^{(k)}$ is given to run the Gauss-Seidel algorithm to update $V_i^{(k+1)}$, **prove** that:

$$V_i^{(k+1)} = \frac{\dfrac{P_i^{sch} - jQ_i^{sch}}{V_i^{*(k)}} + \sum_{j=1}^{n} y_{ij} V_j^{(k)}}{\sum_{j=0}^{n} y_{ij}} \quad j \neq i$$

III. (10%) A two bus system is shown in the figure below. Bus 1 is a slack bus with $V_1=1.0\angle 0^\circ$ and bus 2 is a load bus with complex power $S_2=1.5+j0.5$ pu. Using the Gauss-Seidel method to **determine the update of V_2** with an initial estimate of $V_2^{(0)}=1+j0$. **Perform two iterations.**

Two-bus system:



3. (10%) Use the Amp-Second Balance Equation to derive the output voltage ripple ratio for the ideal CCM DC-DC Buck converter.

4. (10%) Use the Amp-Second Balance Equation to derive the output voltage ripple ratio for the ideal DCM DC-DC Buck converter.

5. (10%) Use the Amp-Second Balance Equation to derive the output voltage ripple ratio for the ideal CCM DC-DC Boost converter.

6. (10%) Use the Amp-Second Balance Equation to derive the output voltage ripple ratio for the ideal DCM DC-DC Boost converter.

7. Given one 220-V, three-phase, six-pole, 400-Hz induction motor is running at a slip of 4.0 percent, find the follows:
   (a) (2%) Speed of the magnetic fields in revolutions per minute
   (b) (2%) Speed of the rotor in revolutions per minute
   (c) (3%) Slip speed of the rotor
   (d) (3%) Rotor frequency in hertz

8. Given one 200V, 50kW long-shunt compound DC generator has a brush voltage drop of 5V, a series field resistance of 0.01 Ω, a shunt field resistance of 100 Ω, and an armature circuit resistance of 0.05 Ω. When rated current is delivered at rated speed of 1800 rpm, calculate the follows:
   (a) (5%) Armature current.
   (b) (5%) Generated armature voltage.