國立中山大學102學年度碩士暨碩士專班招生考試試題

科目名稱：電力工程【電機系碩士班丁組】　　題號：431011

※本科目依簡章規定「可以」使用計算機（廠牌、功能不拘）　　

1. A 230/115-V, 1-kVA transformer has been tested to determine its equivalent circuit. The results of the tests are shown below.

Short-circuit test	Open-circuit test
$Vsc = 21V$	$Voc = 230V$
$Isc = 9.57A$	$Ioc = 0.45A$
$Psc = 51.2W$	$Poc = 30W$

(a)Calculate the parameters and draw the equivalent circuit of this transformer referred to the low-voltage side of the transformer. (15%)
(b)Calculate the voltage regulation at rated conditions with Power Factor (PF) 1.0. (5%)

2. A power station consists of four 100-MVA, 69-kV, 0.9-PF lagging synchronous generators operating in parallel with identical speed droop characteristics. The governors on the generators' prime movers are adjusted to produce a 3-Hz drop from no load to full load. Three of these generators are each supplying a steady 75 MW at a frequency of 60 Hz, while the fourth generator handles all incremental load changes on system while maintaining the system's frequency at 60 Hz.
(a)The total system loads are 260 MW at a frequency of 60 Hz. Calculate the no-load frequencies of each generator. (10%)
(b)Calculate the new system frequency if the system load rises to 290 MW. (10%)

3. The fuel cost function in \$/h for four units of a plant are

$f_{g1} = 0.006P_{g1}^2 + 9.0P_{g1} + 345$　　$f_{g2} = 0.0048P_{g2}^2 + 6.0P_{g2} + 475$

$f_{g3} = 0.004P_{g3}^2 + 8.0P_{g3} + 625$　　$f_{g4} = 0.0034P_{g4}^2 + 10.0P_{g4} + 527$

Assume that all four units operate economically to meet the total plant load of 700MW, find the incremental cost of the plant and the required output of each unit (20%).

4. The following equations are the real power and reactive power injected into a bus:

$$P_i = \sum_{n=1}^{N} |Y_{in}V_iV_n| \cos(\theta_{in} + \delta_n - \delta_i), \quad Q_i = -\sum_{n=1}^{N} |Y_{in}V_iV_n| \sin(\theta_{in} + \delta_n - \delta_i).$$

Calculate the derivatives of $\frac{\partial P_i}{\partial \theta_i}$, $\frac{\partial P_i}{\partial \theta_j}$, $\frac{\partial P_i}{\partial V_i}$, $\frac{\partial P_i}{\partial V_j}$, $\frac{\partial Q_i}{\partial \theta_i}$, $\frac{\partial Q_i}{\partial \theta_j}$, $\frac{\partial Q_i}{\partial V_i}$ and $\frac{\partial Q_i}{\partial V_j}$ for Newton-Raphson Load Flow. (25%)

5. A three-phase, 60-Hz, 250-MVA, 13.8-kV, generating unit has an H constant of 4.0 p.u.-s. The mechanical power supplied by prime mover and electrical power output of the generator in p.u. are p_m and p_e, respectively. Initially, this unit is operating synchronously at $p_m = p_e = 2.0$ with power angle $\delta = 10^\circ$.
(a) Give the per-unit swing equation for this unit. (5%)
(b) Calculate the power angle 4 cycles after a short circuit causes $p_e = 0$.(10%)