(本試卷選擇題答錯倒扣)

Transformer

1. We have available a 1 ϕ 480/120 volt 30kVA two winding transformer for use on an existing 480V system. Show what should the connection be to provide 600 volt service and what is the resulting rating? (10%)

Sequence Components

2. In the sequence filter below (Figure 1), point O is at the center of bc winding.

   (a) Find the value of R in terms of X such that V_{op} is zero for a pure positive sequence voltage. (5%)

   (b) With the above selected resistance and suppose that the line voltage contains a pure negative sequence voltage $\sqrt{3}V_2$, i.e., $V_{ab} = V_{bc} = V_{ca} = \sqrt{3}V_2$, find V_{op}=? (5%)

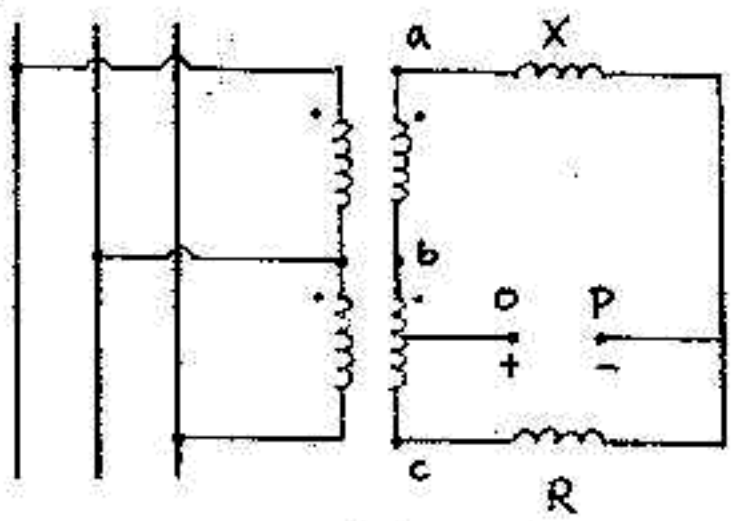

Figure 1

Power Flow

3. While making load flow analysis, what data are required and what output can be obtained? (10%)

Voltage Drop and High Frequency Components

4. (a) A 60Hz, 2000kVR, 20kV, three-phase capacitor bank is to be installed at the end of a three-phase distribution feeder 2km in length. The impedance of the feeder is 2+j1 Ω/km. Calculate the percentage of voltage rise due to this capacitor. (10%)

   (b) A power system supplies a 60Hz, 200kVA, 500V, harmonic producing load that has the harmonic spectrum shown below:

Frequency	rms line current
300Hz	$0.22I_1$
420Hz	$0.11I_1$
660Hz	$0.045I_1$

Where I_1 is the rms fundamental line current. Determine the total harmonic distortion (THD). (5%)

Transients

5. A 60Hz, 1000kVAR, 5kV capacitor bank is installed on a plant bus. The plant bus is supplied from a 60Hz, 5000kVA, 69kV-5Y/2.89kV transformer having an impedance of 10%. Neglecting the impedance of the 69kV source and resistance, determine the maximum instantaneous value and the frequency of the inrush current. ($\sqrt{2}\approx 1.1414$, $\sqrt{3}\approx 1.732$, $\sqrt{2}/\sqrt{3}\approx 0.816$, $2\pi\times 60\approx 377$, $1/(2\pi\times 60)\approx 0.00265$)

(15%)

Line Model and Fault Analysis

6.

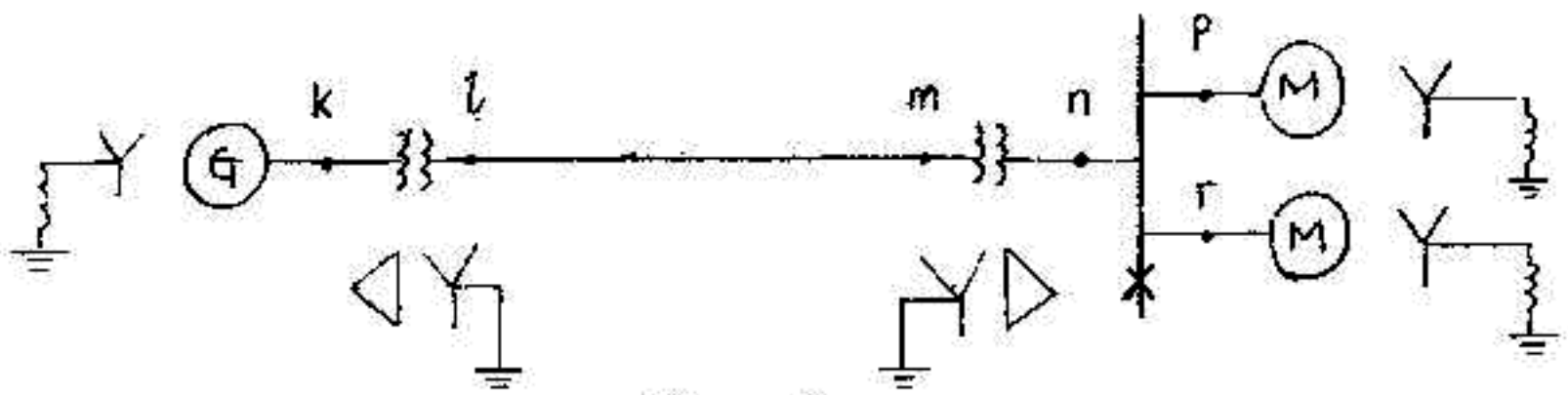

Figure 2

Figure 2 depicts the one-line diagram of a faulted power system. Under the prefault condition, generator k supplies power via an extra-high voltage (ehv) transmission line to two motors: a synchronous motor p and an induction motor r. Let X_s, X_s' and X_s'' denote the synchronous, transient and subtransient reactances respectively for both the generator and motors. Let X_t and X_L denote the transformer leakage reactance and the ehv line reactance respectively. Assume system parameters X_s, X_s', X_s'', X_t and X_L are all in per unit on the same system base.

(a) Draw a reactance diagram for the unfaulted power system and indicate the system parameters on the diagram (Use k, p, r, kl, mn and lm as parameters'

lower subscripts to indicate the generator, two motors, two sets of transformers and the ehv line respectively). (5%)

(b) Give your choice for the correct statements among the following (You can give multiple choices).

(1) X_L is the phase reactance of the ehv line.

(2) X_L is the positive-sequence reactance of the ehv line.

(3) $X_L < X_{self}$, where X_{self} is the self-reactance of the ehv phase conductor.

(4) For the cylindrical-rotor type of synchronous machine, $X_s" = X_2$, where X_2 is the negative-sequence reactance for the same machine.

(5) Suppose a 3-ϕ fault occurs at the $\overline{npr}$ bus. The fault current component supplied from motor r decays faster than the component from motor p.

(6) None of the above is correct. (5%)

(c) During the 3ϕ faulted duration, the voltage at location m drops by ΔV_m. Calculate ΔV_m in percentage of rated voltage. (5%)

(d) Suppose the fault at bus $\overline{npr}$ is a phase a to ground (1-ϕ-G) fault. Draw the sequence network for the faulted power system. (5%)

(e) Let V_b denote the phase b voltage for the 1-ϕ-G faulted power system. The voltage location is at the mid-point of ehv line. Decide $V_b < 1.0$, $V_b = 1.0$, or $V_b > 1.0$, and give your reasons for your choice. (5%)

Protection and Stability

7. In the following answers, if you are requested to give selection, you can give multiple choices.

(a) Let V_w, V_a, V_n, and V_o denote system withstanding voltage (or BIL), arrester conduction voltage, normal system crest voltage, and system overvoltage respectively. Select correct relations among the following:

(1) $V_o > V_w > V_a > V_n$

(2) $V_w > V_a > V_n$

(3) $V_w > V_o > V_a > V_n$

(4) None is correct. (3%)

(b) A power fuse has three important characteristic curves for the minimum melting time (T_{melt}), the maximum clearing time (T_{clear}) and the destroy time (T_{dstry}) respectively. Select correct relations among the following:

(1) $T_{melt} > T_{clear} > T_{dstry}$

(2) $T_{melt} > T_{clear}$

(3) $T_{melt} < T_{clear}$

(4) $T_{melt} < T_{clear} < T_{dstry}$

(5) None is correct. (3%)

(c) In-rush current could cause maloperation of transformer differential protection relay. Three characteristics of the in-rush current can be applied to avoid the maloperation. Give these three characteristics (Note: you are not requested to give explanation for your answer). (3%)

(d) Four characteristics can be observed for detection of generator's loss of excitation. Give these four characteristics (You are not requested to explain). (3%)

(e) What are the underlying assumptions in application of the equal area method for transient stability analysis. Give four assumptions (You are not requested to explain). (3%)