First Mid-term Examination

Sub :- EHV AC/DC Transmission

Question

1.(a) Explain Corona and factors affecting corona.

(b) A 3 phase line has conductor 2cm in diameter. Spaced equilaterally 1m apart. If the dielectric strength of air is 30kV(max) per cm. Find the disruptive critical voltage for the line take air factor $\delta = 0.952$ and irregularity factor $m_0 = 0.9$.

2.(a) Explain the characteristics of speed governor of Generating unit.

(b) A 300MW unit with 0.04 p.u. turbine operates in parallel with a 500MW unit of identical turbine regulation. For a specified amount of power demand increase, find the ratio of sharing of the load by the units, system frequency is 50Hz.

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1.(a): Corona :- The phenomenon of corona is accompanied by a hissing noise sound production of ozone, power loss and radio interference. The higher the voltage is raised, the larger and higher the luminous envelope become and greater are the sound, power loss and the radio noise.

* Factors affecting the Corona :-

(i) Atmosphere : As corona is formed due to ionization of the air surrounding the conditions of the conductor, it is affected by physical state of atmosphere.

(ii) Conductor size : The corona effect depends upon the shape and condition of the conductor. The rough and irregular surface will give rise to more corona.

(iii) Spacing between conductor : If the spacing between the conductor is made very large compared to their diameter, there may not be corona effect.

(iv) Line voltage : The line voltage greatly affect corona. If it is low there is no change in condition of air surrounding the conductors & hence no corona is formed.

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1. (b): Conductor radius = $\frac{2}{2}$ = 1 cm

Conductor spacing = d = 1 m = 100 cm

Dielectric strength of air = g_o = 30 kV/cm (max

= 21.2 (rms) per cm.

Disruptive critical voltage, V_d

$$V_d = m_o g_o \delta r \log(d/r) \text{ kV/phase}$$

$$= 0.9 \times 21.2 \times 0.952 \times 1 \times \log(100/1)$$

$$= 83.64 \text{ kV/phase.}$$

Line voltage = $\sqrt{3} \times 83.64$

⇒ Line voltage = 144.8 kV

2. (a): Characteristic of speed governor of generating unit :-

→ Governors typically have a speed regulation of 5-6% from zero to full load.

$$\% \text{ Regulation} = \frac{\text{change in frequency}}{\text{change in power}} \times 100$$

$$\% R = \frac{\Delta f}{\Delta P} \times 100$$

W_{NL} = Steady state speed at No-load

W_{FL} = steady state speed at Full-load

W_o = Rated speed.

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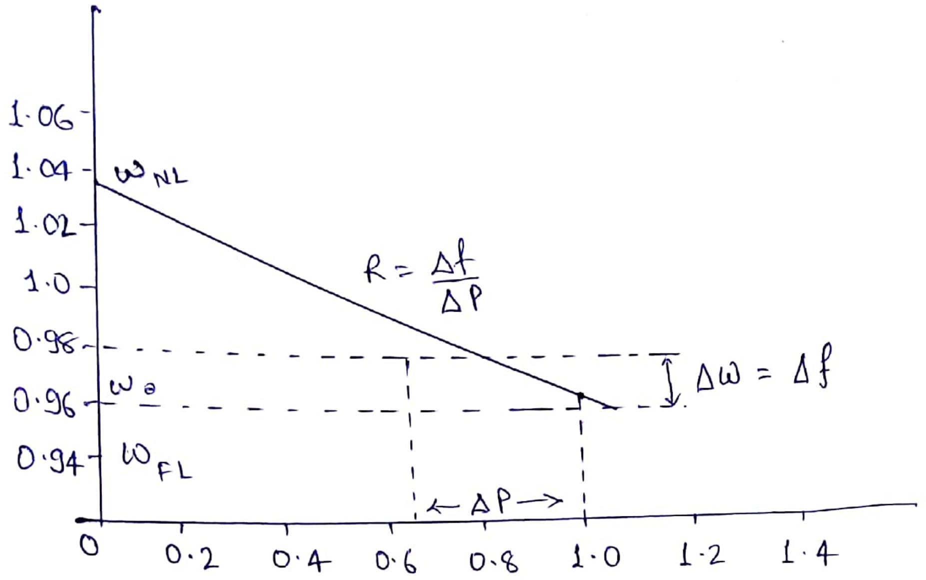

Fig:- Graph between speed and output power (per unit)

→ For stable operation of governor, the governess are designed to permit the spead to droop as the load is increased. The steady-state characteristics of a governer is shown in above figure.

2.(b): For unit I given is,

Output power $= P_1 = 300 MW$

turbine regulation $= 0.04$

Now, the change in frequency

$$\Delta f = 50 \times 0.04$$
$$= 2.0 \text{ Hz}$$

$$R_1 = \frac{\Delta f}{P_1}$$
$$= \frac{2}{300}$$

$$\Rightarrow R_1 = 0.0066 \text{ Hz/MW}.$$

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For unit II given is

Output power = P_2 = 500 MW

turbine regulation = 0.04

$$\Delta f = 0.04 \times 50 = 2.0 \text{ Hz}$$

$$R_2 = \frac{2.0}{500}$$

$$\Rightarrow R_2 = 0.004 \text{ Hz/MW}$$

$$\Delta P_1 = \frac{\Delta f}{R_1} \quad \text{---- (i)}$$

& $$\Delta P_2 = \frac{\Delta f}{R_2} \quad \text{---- (ii)}$$

After solving equation (i) & (ii),

$$\frac{\Delta P_1}{\Delta P_2} = \frac{R_2}{R_1}$$

$$= \frac{0.004}{0.0066}$$

$$\frac{\Delta P_1}{\Delta P_2} = \frac{2}{3} \text{ (approx.)}$$

Hence, $\frac{2}{3}$ is the ratio of sharing of the load by units, system frequency is 50 Hz.

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