1. Operation of power system with large frequency deviation is not desirable. If large frequency deviations occur, which of the following statement is false:

    (a) Turbine blades may get damaged.
    (b) Power output of many loads deviate from their rated value.
    (c) Transformers may get saturated (at lower frequencies).
    (d) Skin effect becomes significant .

2. A generator-governor system has a droop of 4% corresponding to 50 Hz . Assume that the machine rating is 1.0 p.u. This means that the frequency of the system

(a) decreases by 2 Hz when the load increases by 1.0 p.u.

(b) increases by 2 Hz when the load increases by 1.0 p.u.

(c) increases by 4 Hz when the load increases by 1.0 p.u.

(d) decreases by 4 Hz when the load decreases by 1.0 p.u.

3. A lossless power system is shown in the figure below, with $\phi_A - \phi_B = 30^o$. In order to reduce this phase angle difference without changing the system frequency,

(a) Machine A should increase generation and machine B reduce generation.
(b) Machine B should increase generation and no action be taken by machine A.
(c) Machine A should reduce generation and machine B increase generation.
(d) Both generators should increase their generation.

4. Two alternators A and B are connected in parallel to supply a common load of 1.0 p.u.The speed governor on generator A is equipped with Proportional controller and that on generator B is with an Integral controller. If the common load (which is not frequency dependent) increases by 0.01 p.u, and the speed references of both governors are the same, then

(a) generator A and B share the new load change equally.
(b) generator A alone takes-up the new load change.
(c) generator B alone takes-up the new load change
(d) generator A and B share the new load change proportional to their ratings.

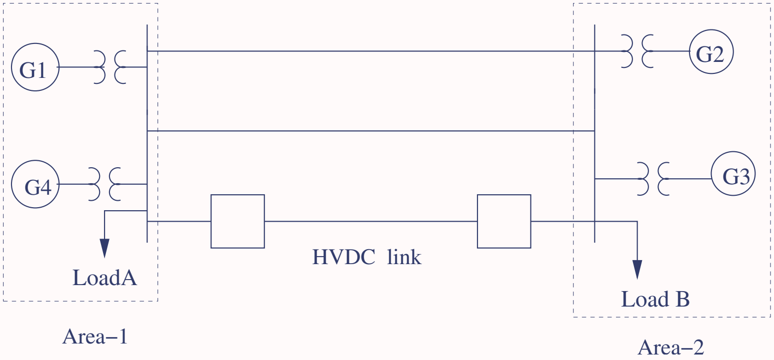
5. Two large multi-generator and multi- load systems, initially not interconnected, desire to exchange a **fixed amount of power**. They decide to connect the two systems through a line to exchange the power. Which of the following methods may be used to do this ?

   (a) speed controller on the generator(s) of one systems alone using local generator speed as the control signal.
   (b) speed controller on the generator(s) of both systems using local generator speed as the control signal.
   (c) Automatic Generation Control in both systems using signals from the tie line.
   (d) Connecting the two AC systems by an HVDC link instead of an AC line.

6. An isolated 100 MVA generator operates on rated u.p.f. load at a frequency of 50 Hz. The load is suddenly reduced to 50 MW . Due to the dead-time associated with the speed governor system, the steam valve begins to close after 0.4 s. Determine the change in the system frequency, before the governor comes into action. The generator has a inertia constant, H = 5 MJ/MVA. Assume that the load is not voltage or frequency dependent

(a) 1 Hz
(b) 0.1 Hz
(c) 2 Hz
(d) 10 Hz

7. For the combined AC-DC system shown in the figure below, under normal operation, which **TWO** statements of the following are **TRUE**



(a) The frequency of Area-1 and Area-2 must be the same.

(b) Assuming speed-governors on all generators, if there is a change in load-B, then all generators share the change in load depending on their droop characteristics

(c) The frequency of Area-1 and Area-2 can be different.

(d) To carry out loadflow study for the above system we need to specify two slack buses, one in Area-1 and another in Area-2.

8. A lossless power system consists of 4 generators having inertia constant (H in MJ/MVA) of 5.0, 5.4, 6.0 and 6.4 respectively. Their constant mechanical input powers are 0.7 p.u. , 0.7 p.u., 0.8 p.u. and 0.9 p.u. The base frequency of the system is 50 Hz. The real power loads which are independent of voltage and frequency on the system are 0.65 p.u., 0.55 p.u, 0.40 p.u., 0.95 p.u. and 0.80 p.u. For this condition, the rate of variation of Center of Inertia speed (which is defined as $\frac{\sum H_i \omega_i}{\sum H_i}$) in rad/s^2 is:

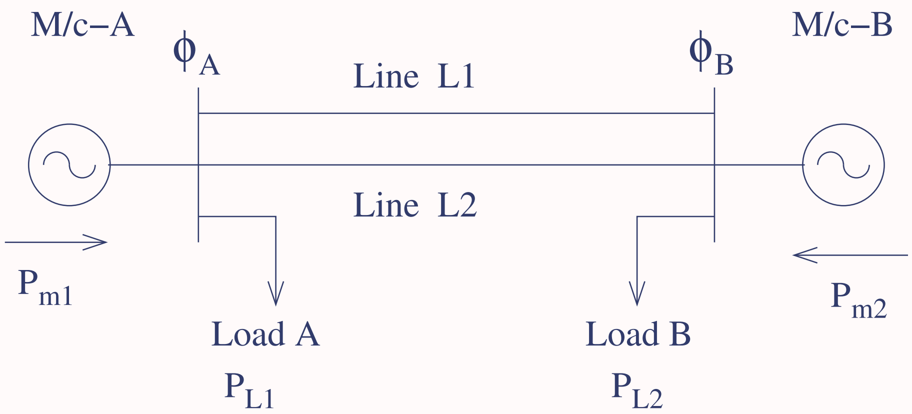
(a) -1.722

(b) 0.25

(c) 3

(d) -1.5

9. Consider a power system shown in the figure below, which is in steady state with mechanical input powers P_{m1} and P_{m2}, and loads P_{L1} and P_{L2} which are practically independent of voltage and frequency. Match the speed responses of generators (ω_1 and ω_2), for the following disturbances.



Disturbances -

(i) P_{L1} is increased by 100% and P_{m1} and P_{m2} are constant.

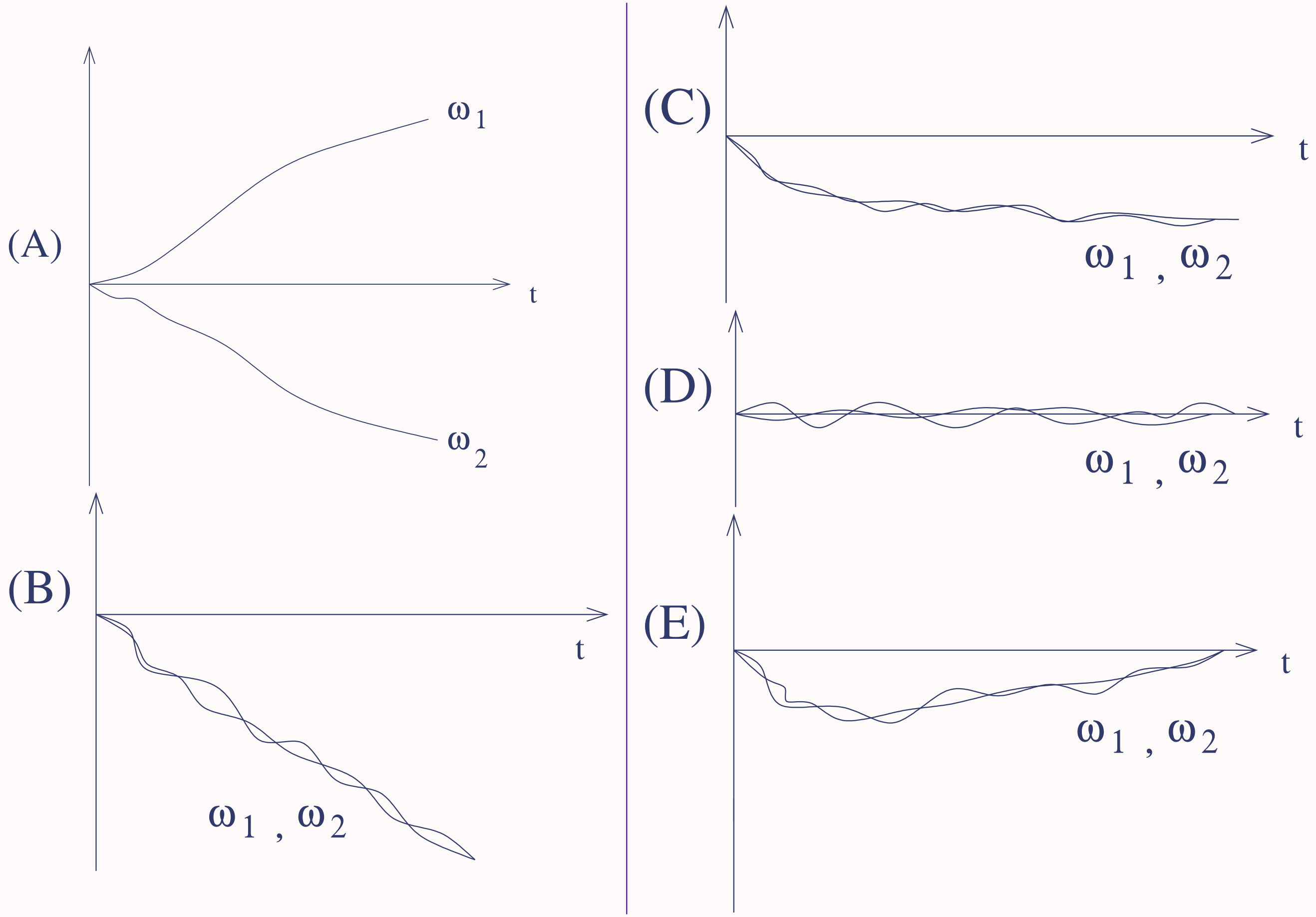
(ii) P_{L1} is increased by 10%. Generators G_1 and G_2 have speed governors with 4% and 5% droop characteristics.

(iii) Line L_1 is tripped to clear a fault. P_{m1} and P_{m2} are constant. It is assumed that the system is stable for this disturbances.

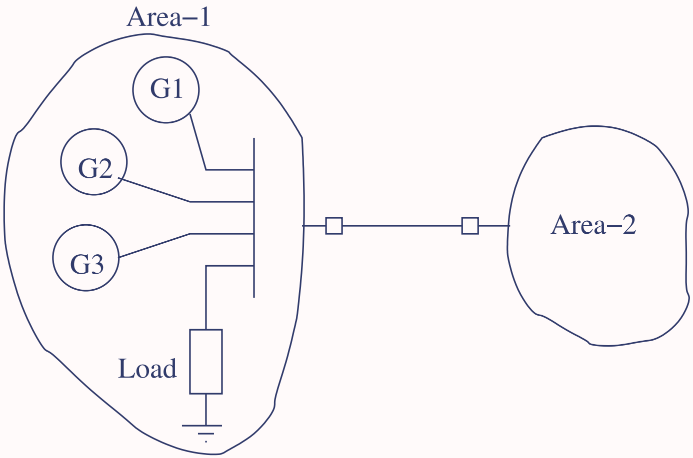
(iv) P_{L2} is increased by 10% and generator G_1 has an integral controller speed governor and G_2 has a proportional type governor with a droop of 5%. The system is assumed to be stable.

(v) Line L_1 is tripped to clear a fault. P_{m1} and P_{m2} are constant. The system losses synchronism for this disturbance.

Response (Speed) -



10. A interconnected power system consisting of 2 areas is shown in figure below. The system is operating at 50 Hz. The inertia constants (H) for the three generators in area 1 are: 2, 3 and 4 MJ/MVA.



The total load in area 1 is frequency dependent and is given by :

$$3.0 \times (1 + 1.5\frac{\Delta f}{f_o}) \text{ pu.}$$

The total generation in area 1 is frequency dependent due to speed governors and is given by $2.0 \times (1 - 10\frac{\Delta f}{f_o})$ pu (all quantities are on a base of 100 MVA, f_o = 50 Hz).

Due to some reason, the two areas are separated by tripping the tie lines. Answer the following questions.

1. What value will frequency settle to in area-1?
2. Neglecting the dynamics associated with the turbine and loads, sketch the centre of inertia (COI) frequency vs time and compute the settling time. During transients the centre of inertia frequency, $\frac{\omega_{COI}(t)}{2\pi}$, may be assumed to be equal to $\Delta f(t)$ where $\omega_{COI} = \frac{\sum H_i \omega_i}{\sum H_i}$.
3. What is the amount of load to be shed if frequency should settle to 49.5 Hz ?

Note : Swing equation for each generator is given by: $\frac{2H}{\omega_B}\frac{d\omega}{dt}$ = Pm - Pe
where powers are in p.u. and $\omega_B = 2 \times \pi \times 50$ rad/s.