There are 5 problems. They carry equal marks.

$$(5 \times 2 = 10)$$

1. Consider the following equations.

$$10x_1 \sin x_2 - 0.8 = 0$$
$$10x_1^2 - 10x_1 \cos x_2 - 0.6 = 0$$

Suppose the solution of the variables x_1 and x_2 is obtained by employing Newton-Raphson method, find x_1 and x_2 after first iteration. Assume $x_1^0 = 1$ and $x_2^0 = 0$.

2. The fuel cost functions in rupees/hour for two 600 MW thermal power plants are given bleow.

$$\text{Plant 1} \; : \; C_1 = 350 + bP_1 + 0.004P_1^2$$
$$\text{Plant 2} \; : \; C_2 = 450 + 6.2P_2 + 0.003P_2^2$$

where P_1 and P_2 are power generated by plant 1 and plant 2, respectively in MW and b is a constant. The incremental cost of power (λ) is 8 rupees per MWh. The two thermal power plants together meet a total power demand of 550 MW. Find the optimal generation of plant 1 and plant 2 in MW.

3. In an unbalanced three phase system, phase currents $I_a = 1.1\angle0°$ p.u. and $I_c = 1\angle120° + 0.1$ p.u. If $I_{b0} = 0.1\angle0°$ p.u., find the phase current I_b in p.u.

4. A 5 kVA, 415 V, 50 Hz, generator has the positive, negative, and zero sequence reactances of 0.25 p.u., 0.15 p.u., and 0.05 p.u., respectively. The neutral of the generator is grounded with a resistance so that the fault current for a bolted (solid) line to ground fault and that of a bolted (solid) three-phase fault at the generator terminal are equal. Find the value of grounding resistance in ohms.

5. A 20 MVA, 11.2 kV, 4-pole, 50 Hz alternator has an inertia constant of 15 MJ/MVA. If the input and output powers of the alternator are 15 MW and 10 MW, respectively, find the angular acceleration in mechanical degree/s^2.