EE 340 – Spring 2019 – Final exam – Take home Portion

Name: ……

Consider the power system below. The system data is as follows:

Nominal Voltage: 138 kV, frequency: 60 Hz

Load data:
Load @ bus 1: 70 MW, 15 MVAR
Load @ bus 3: 110 MW, 40 MVAR
Load @ bus 4: 90 MW, 20 MVAR
Transmission line data:
Line 1-2: R = 0.2 pu, X = 0.8 pu, rated MVA: 50
Line 2-3: R = 0.2 pu, X = 0.8 pu, rated MVA: 50
Line 3-4: R = 0.2 pu, X = 0.8 pu, rated MVA: 50
Line 1-4: R = 0.2 pu, X = 0.8 pu, rated MVA: 50
Line 2-4: R = 0.1 pu, X = 0.4 pu, rated MVA: 50
Generator data:
G1: Voltage setpoint: 1 pu, 20 MW <P<200 MW, cost model: $500 + 20P + 0.02P^2$, internal positive sequence impedance: X = 0.2 pu.
G3: Voltage setpoint: 1 pu, 50 MW <P<150 MW, cost model: $400 + 22P + 0.02P^2$, internal positive sequence impedance: X = 0.2 pu.
G4: Voltage setpoint: 1 pu, 30 MW <P<120 MW, cost model: $300 + 24P + 0.02P^2$, internal positive sequence impedance: X = 0.2 pu.

1) Draw the circuit diagram in Powerworld, the conduct an Optimal Power Flow study (this is essentially an economic dispatch the losses included, as well as line MVA limits). Show the resulting active and reactive power supplied by each of the 3 generators, as well as the total system active and reactive power losses.
2) Determine the 3-phase balanced fault current (in Amps) at Bus 2, the fault current contribution by each generator, and the resulting voltages at the other buses.
3) Repeat 2) above if the 3-phase balanced fault occurs at Bus 4.