FEDERAL UNIVERSITY OF TECHNOLOGY, OWERRI

SCHOOL OF ENGINEERING AND ENGINEERING TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

2009/10 HARMATTAN SEMMESTER EXAMINATION 4th MAY, 2010

PSE 513: POWER SYSTEMS PLANNING AND RELIABILITY TIME ALLOWED: 3HRS

INSTRUCTION: Attempt only 5 questions

1a. Define Demand Forecasting in Power System. Explain the essence and the processes involved in Electricity forecasting.

b. Table 1 shows the loads in Gigawatts during a successive 5-minute interval for a given power system. Using the values, determine the coefficient of *a* and *b*, by using the exponential model, $y=e^{a+bx}$, and forecast the load demand during period 75, via triangular decomposition technique.

INTERVAL	LOAD (GW)
50	20.69
51	20.91
52	21.28
53	21.76
54	22.21

2a. Explain the following methods of forecasting, stating the range of forecasting where applicable: Macro-economic method, Field survey, Use of expert system, and Weighted moving averages (ARIMA).

b. In system reliability studies, the following terms are commonly used: Outage, Forced Outage, Scheduled Outage, Transient forced Outage, Interruption and Persistent forced Outage. Explain these terms.

c. Given that a fixed number of components N_0 are subjected to test between the interval 0 to *t*, components $N_f(t)$ failed, and $N_s(t)$ components survived after time. Starting from the probability of survival, R(t), show that the hazard rate is given as the ratio of probability density function f(t), to probability of the component survival, R(t).

3 a. State the assumptions made in Reliability Analysis using Approximate method.

b. Given that a double circuit power system transmission line, rated 220kV operates in a 2-state fluctuating environment having expected normal weather and stormy weather durations of 140 hours and 8 hours respectively. Both circuits being similar, the outage data for each circuit is:

Λ = 5 outages/year of normal weather

Λ' = 12 outages/year of stormy weather

Λ'' = 3 outages/year; r=8hours, r''=10 hours.

Determine (i) the annual outage rate (ii) down-time per outage (iii) total outage time per year

4a. State 2 necessary assumptions for Load-flow studies using the Direct Current method.

b. The diagram in Fig 1 shows a 3-bus system with all parameters in per-unit on a system base of 100MVA. Compute using the DC load flow technique: (i)the voltage angles (ii)the Megawatts flowing in each circuit (iii)the percent loading in each circuit, assuming the MW capacity to be 80MW.

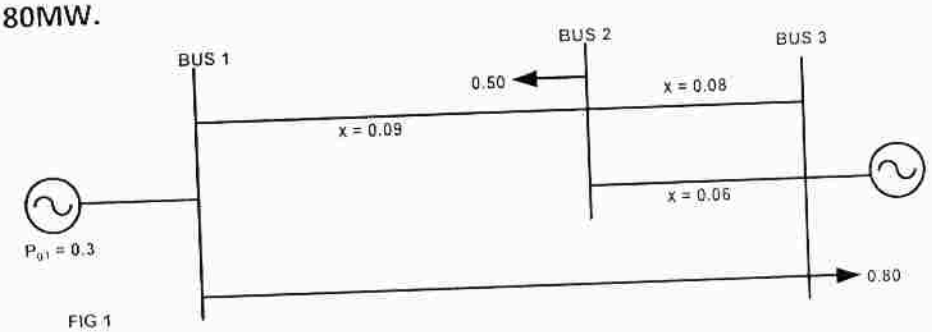

FIG 1

5 a. State 7 (seven) factors that affect power system stability.

b. Beginning from the first principles, derive the swing equation for power system stability studies.

c. Beginning from the swing equation derived in 5B above, justify the use of the Equal Area Criterion for stability analysis of power systems.

6 a. With the aid of suitable diagrams, describe and explain, stating any assumptions made, how a generator tied to an infinite busbar and running on synchronous speed regains its synchronous speed after being suddenly loaded

b. Show that if a 3-phase fault occurs at any point for a double-circuit transmission, the critical clearing angle is given by: $\delta_c = \text{Cos}^{-1}\{[P_s/P_{max}(\delta_m - \delta_0) - r_1 \text{Cos}\delta_0 + r_2 \text{Cos}\delta_m]/(r_2 - r_1)\}$