# B. Power Engineering Final Examination, 2008

1st Semester–(Supplementary)

## POWER PLANT INSTRUMENTATION AND CONTROL

Time : 3 hours                                                     Full marks : 100

### Answer any *five* questions.

1a    A system is defined by $G(s) = 5e^{-0.01s}/(2s + 1)$. What kind of controller would you recommend for this? What are the controller parameters? Use Ziegler Nichols method to derive the controller parameters and State the formula used.

15

1b    Is it possible to tune this system using Ziegler Nichols closed loop method? Explain your answer.

5

2a.   Calculate the steady –state error for a unity feedback loop for an open loop plant defined by $G(s) = \omega^2/(s^2 + 2\xi\omega s + \omega^2)$ with a proportional only controller for a step input $u$. How does this change when a PI controller is used?

5+5

2b    Calculate the proportional band for a gain of 20

5

2c    Why is a differential only controller never used?    5

3a.   Ammonia is being produced in a chemical reactor according to the following reaction:

$N_2 + 3H_2 = 2NH_3$

Devise a control system to control production rate of Ammonia by controlling flow rates of Nitrogen and Hydrogen to the reactor and represent the same using a proper process control schematic

20

4a.   A 4-20 mA signal is used to transmit information related to measurement of water level in a tank with the process value varying between 0 to 400mm. What is the signal value if the process value is 100mm? Now. assume that this signal is converted to a 0 to 5V signal which is fed to a 12bit sign adjusted successive approximation A/D

*[Turn over*

converter driven by a 5MHz clock and capable of handling inputs in the range -5 to 5 Volts, calculate the corresponding ADC count and the conversion time

2+4+4

4c With the help of a neat schematic represent a 3 bit flash ADC

10

5. With the help of a neat schematic describe the working of a cross-linked combustion control system in a oil-fired boiler for decreasing load.

20

6a. Define Master Control Signal in a thermal power plant

4

6b With the help of a neat schematic explain the Turbine following boiler mode of operation. What are its advantages.

8

6c What are the advantages of sliding pressure operation of boilers. What are its special features.

4

7a With the help of a neat schematic explain the combustion control in a coal fired boiler. What kind of control is this? Why is a temperature control loop used here?

3+2+2

7b What are the problems in controlling multiple PA fans with a single controller? What happens is two controllers are used with a same reference input?

4+4

8 With the help of a neat schematic explain steam temperature control mechanism. Draw the corresponding cascade control loop with master and slave controllers and remote and local setpoints demarcated.

20