

QP Code : 15314

(3 Hours)

[ Total Marks : 80

- INSTRUCTIONS:
- (1) Question no 1 is compulsory.
  - (2) Attempt any three question out of the remaining five questions.
  - (3) Assume any suitable data wherever necessary

1. Briefly explain any five 20
  - (a) Sample space
  - (b) Joint probability density function
  - (c) Least square estimate
  - (d) Fractional Random walk
  - (e) Transition probability matrix
  - (f) Unbiased estimate
2. (a) What do you mean by covariance. Explain the significance of covariance in error propagation analysis of measurements using numerical example 10  
 (b) What do you mean by random process? Explain the representation of stochastic characteristics of a random process in terms of mean, autocorrelation and power spectrum. 10
3. (a) Differentiate between random walk and brownian motion. 10  
 (b) Differentiate between ensemble average and time average of a random process 10
4. (a) Explain how the fractional calculus can be used for modelling anomalous diffusion. 10  
 (b) Obtain 0.5<sup>th</sup> derivative of  $y = t^4$  using gamma functions. 10
5. Write short notes on 20
  - (a) Kalman filter
  - (b) Physical and geometrical interpretation of a fractional integral
6. (a) Suppose that student scores in a subject forms a Normal distribution with mean value of 100 and variance of 400. Find the percentage of students whose scores fall between 10
  - (a) 80 and 120
  - (b) 60 and 140
  - (c) 40 and 160
  - (d) 100 and 120
  - (e) over 160
7. (a) Explain how probability density function can describe the stochastic properties of a continuous random variable. Assume any suitable distribution. 10

QP Code : 15317

(3 Hours)

[ Total Marks :80

- N.B. : (1) Question No.1 is compulsory.  
(2) Answer any three questions from Question Nos. 2 to 6.  
(3) Assume suitable data if necessary.

1. Answer the following questions:-

- (a) List and draw topologies used in Foundation Fieldbus. 5
- (b) What do you mean by constraint ? Explain its types: 5
- (c) Explain is.SIF, SA and RRF with respect to safety Instrumented system. 5
- (d) Draw and explain communication protocol structure of SCADA. 5

2. (a) State True/False and hence justify. Decoupler is a feedforward element. 10  
(b) Discuss single input single output constraint controller with its demerits. 10

3. (a) Discuss optimisation of Heat Exchanger. 10  
(b) Discuss phases involved in safety Instrumented system. 10

4. (a) Select appropriate control loop configuration for the following input-output relationship 10

$$\bar{y}_{1(s)} = \frac{2}{s^2 + 5s + 1} \bar{m}_{1(s)} + \frac{1}{(0.1s + 1)} \bar{m}_{2(s)}$$

$$\bar{y}_{2(s)} = \frac{-3}{0.5s + 1} \bar{m}_{1(s)} + \frac{10}{(7s + 1)} \bar{m}_{2(s)}$$

- (b) Explain procedure of PLC sizing. 10

5. (a) Explain dead time compensation. 10  
(b) Discuss High power trunk concept in detail. 10

6. Write short notes:- 20

- (a) VFD
- (b) IMC control strategy.



## INTRO. to Non-Linear Control.

QP Code : 15320

(3 Hours)

[Total Marks: 80]

- N. B.:** (1) Question No. 1 is compulsory.  
 (2) Attempt any four questions from remaining six questions.  
 (3) Assume suitable data if necessary.  
 (4) Figures to the right indicate full marks.

1. Answer the following 20
  - (a) Derive the describing for ideal relay.
  - (b) What is limit cycle? What is the significance of limit cycles?
  - (c) Explain bifurcations with example
  - (d) Explain static nonlinearities with examples.
2. (a) Explain concept of back stepping in detail. 10  
 (b) What is singular point? What is the significance of singular points for nonlinear systems? Explain different singular points in nonlinear system. 10
3. (a) Explain Lyapunov stability analysis for an autonomous system. 10  
 (b) Discuss stability of the following nonlinear system. 10

$$\dot{x}_1 = x_1 - x_1 x_2$$

$$\dot{x}_2 = -x_1 + x_2$$

Select the Lyapunov function  $V(x) = x_1^2 + x_2^2$ .
4. (a) Linearize the following system at equilibrium 10

$$\dot{x}_1(t) = x_2(t) + x_1(t)x_2(t)$$

$$\dot{x}_2(t) = x_3(t) - x_1(t)x_3(t)$$

$$\dot{x}_3(t) = 6x_1(t) - 8x_1(t)x_2(t) - u(t)$$
  
 (b) Write a note on High gain observer. 10
5. (a) For the function  $f(x) = x^2 + |x|$ . Find whether  $f(x)$  is 10
  - i) continuously differentiable
  - ii) continuous
  - iii) locally Lipschitz
  - iv) Globally Lipschitz  
 (b) Explain MIMO system linearization by state feedback. 10
6. Write short notes on 20
  - (a) Direct Lyapunov method for stability analysis
  - (b) Lasalle Invariance principle
  - (c) Sliding mode control
  - (d) Phase plane method

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QP Code : 15327

(3 Hours)

[Total Marks : 80]

Note : 1. Question No. 1 is compulsory.

2. Attempt any **three** questions from remaining five questions.

3. Assume suitable data if necessary.

- Q.1 a) Explain why semiconductor detectors give better resolution than the scintillation detectors. 05
- b) Explain why liquid scintillators are preferred over solid scintillators for counting beta particles emitted from tritium. 05
- c) Explain why mechanical collimator is not required in PET imaging technique. 05
- d) Explain various methods of neutron detection. 05
- Q.2 a) Explain principle and working of sliding scale linearization technique. 10
- b) Explain different modes of multichannel analyzer with their applications. 10
- Q.3 a) Explain how coincidence detection technique helps to reduce effect of noise. Explain its use in liquid scintillation counting system with block diagram. 10
- b) Explain various counting interferences associated with liquid scintillation counting system. 10
- Q.4 a) Explain a data acquisition system for accelerator experiments with block diagram. 10
- b) Explain working of Charge to Digital convertor. 05
- c) Explain need and principle of working of a Trigger system in astrophysics experiments 05
- Q.5 a) Explain meaning of functional imaging, its advantages and implementation with block diagram 10
- b) Explain method of coordinate signal generation in gamma scintillation camera. 10
- Q.6 Write short notes on any two of the following - 20
- a) Performance parameters and uses of nuclear ADC.
- b) In core and out of core reactor instrumentation.
- c) Need and working of spectrum stabilization technique.

EE / INST & CONTROL / SEM-II (CBSCS) / Intelligent & Autonomous  
Control / MAY-16

Q.P. Code : 15344

(3 Hours)

[Total Marks : 80]

- i. Q. 1. Compulsory. Attempt any 4.
- ii. Attempt any three from the remaining.
- iii. Assume suitable data.

- Q.1 (a) Explain the term Controllability / Reachability in control system. 5  
(b) Discuss the various operations on Fuzzy sets along with their properties. 5  
(c) Explain the term non-determinism with one good example. 5  
(d) Explain the limitations of roulette-wheel selection method. 5  
(e) Explain the evolution of RCS in brief. 5
- Q.2 (a) Develop the PN/CPN for any one example. 14  
(b) Explain any one level of the autonomous controller functional architecture. 6
- Q.3 (a) Describe the signal functions in NN. 10  
(b) Show the adaptive structural analogy in AI planning system. 10
- Q.4 (a) Explain the main tasks at management and organization level of autonomous controller. 10  
(b) Discuss in detail the behavior generation block of RCS 4. 10
- Q.5 Develop the Fuzzy Logic based environment control for any one example of your choice. State the assumptions clearly. 20
- Q.6 (a) Discuss the selection mechanisms in GA. 10  
(b) Explain the functions of BG, VJ, WM and SP in RCS 4. 10