



**KINGS**

COLLEGE OF ENGINEERING



**DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING**  
**QUESTION BANK**

**SUBJECT CODE & NAME : EE1354-MODERN CONTROL SYSTEMS**

**YEAR / SEM : III / VI**

**UNIT – I**

**STATE SPACE ANALYSIS OF CONTINUOUS TIME SYSTEMS**

**PART – A**

1. What are the drawbacks in transfer function model analysis?
2. What is State and state variable?
3. What are the advantages of state space analysis?
4. What is a state vector ?
5. Write the state model of  $n^{\text{th}}$  order system?
6. The state model of a linear time invariant system is given by
7. What is State diagram?
8. Draw the block diagram representation of state Model ?
9. What are the advantages of state space modeling using physical variable?
10. What are phase variables?
11. Write the properties of state transition matrix.
12. Write the solution of homogeneous state equations.?
13. Write the solution of non- homogeneous state equations.?
14. What are eigen values and eigen vectors?
15. Write any two properties of eigenvalues.
16. What is similarity transformation?
17. Define controllability and observability.

18. What is pole placement by state feed back?
19. What is state observer?
20. What is the need for state observer?
21. Derive the transfer function of the following state model.
22. What are the possible state assignment for the following electrical system?
23. What is canonical form of state model?
24. What is meant by diagonalization?

**PART – B**

1. (i) Define controllability and observability .Explain both of them with the help of Kalman’s test. (8)  
  
(ii) Determine controllability and observability of the system described by
  
2. (a) Clearly explain the limitations of the classical control method. Define state, state variables and state space. (8)  
(b) Develop the state model of linear system and draw the block diagram of state model (8)
  
3. (a) State the duality between controllability and observability. (8)  
(b) A linear dynamical time invariant system represented by  $\dot{x} = Ax + Bu$
  
4. (a) Construct a state model for a system characterized by the differential equation  
  
(b) What are the advantages and disadvantages of state space analysis. (8)
  
5. (a) State and explain the observability theorem (8)  
(ii) The state model of a system is given by  $\dot{x} = Ax + Bu, Y = cx$

where  $A=$  (8)

6. (8)  
(ii) What are the requirements of a good physiological transducer and explain the operation of any two types of physiological transducers with relevant sketches? (8)
7. Draw the structure of a living cell of our body and explain in its constituents detail. (16)
8. (i) Explain the working of Piezoelectric transducer as arterial pressure sensor. (8)  
(ii) Explain how Piezo electric transducer produces Ultrasonic waves. (8)
8. Write short notes on:  
(i) Strain gauge type chest transducer (8)  
(ii) Transducer as respiration sensor (8)

## UNIT – II

### Z-TRANSFORM AND SAMPLED DATA SYSTEMS

#### PART – A

1. What is sampled data control system?
2. Explain the terms sampling and sampler.
3. What is meant by quantization?
4. State (Shannon's) sampling theorem
5. What is zero order hold ?
6. What is region of convergence?
7. Define Z-transform of unit step signal?
8. Write any two properties of discrete convolution.
9. What is pulse transfer function?

10. What are the methods available for the stability analysis of sampled data control systems.?
11. What is bilinear transformation?

**PART - B**

1. (i) solve the following difference equation

$$2y(k) - 2y(k-1) + y(k-2) = r(k)$$

$$y(k) = 0 \text{ for } k < 0 \text{ and}$$

$$r(k) = \{1; k = 0, 1, 2$$

$$\{0; k < 0 \quad (8)$$

- (ii) check if all the roots of the following characteristics equation lie within the circle.

$$Z^4 - 1.368Z^3 + 0.4Z^2 + 0.08Z + 0.002 = 0 \quad (8)$$

2. (i) Explain the concept of sampling process. (8)  
(ii) Draw the frequency response of Zero-order Hold (4)  
(iii) Explain any two theorems on Z-transform (6)
3. (i) Draw the buffer amplifier circuit and explain its working (8)  
(ii) Explain the working of a Chopper amplifier (8)
4. Explain the working of (i) EEG Recorder (ii) EMG System (16)
5. Describe in detail about the clinical significance, lead configuration, recording methods and waveforms of ECG. (16)
6. Describe in detail about the basic components of a biomedical system? (16)
7. What are the electrodes used in biomedical and explain the types of electrodes in detail with diagrams (16)
8. (i) Explain any four types of surface electrodes in detail (8)  
(ii) Describe in detail the needle-electrodes and its types (8)

**UNIT – III**

**STATE SPACE ANALYSIS OF CONTINUOUS TIME SYSTEMS**

**PART – A**

1. Write the properties of the state transition matrix of discrete time systems.
2. Define BSR Measurement.
3. How is the blood pressure measured in the indirect method.
4. Briefly mention the uses of gas analyzers.
5. What is called Respiratory rate?
6. What is called Cardiac Output?
7. Explain the principle of sphygmomanometer
  
8. What are the methods involved in direct blood pressure measurement?
9. What is pH Value of Arterial blood and Venous blood?
10. Define Apnoea.
11. What is the principle of working of Electromagnetic blood flow meter?
12. What is Spiro meter?
13. Define MVV, FVC, and FRC?
14. What are the different sounds made by the heart?

**PART – B**

1. Explain the concept of linear observer design and pole placement by state feedback on discrete time systems. (16)
2. Explain with relevant equations the working and measurement produce of Plethysmograph?. (16)
3. With suitable figures explain How pH ,Pco<sub>2</sub> ,and Po<sub>2</sub> are measured? (16)
4. i) Explain any one method of measuring blood pressure. (8)

- ii) Explain about ESR and GSR measurements (8)
- 5. Describe in detail a method to determine Total Lung capacity (16)
- 6. Draw a circuit diagram of a pH meter and explain its working details. (16)
- 7. i) Explain the Working principle of a electromagnetic type blood flow meter. (8)  
ii) Define Cardiac output. Discuss a technique to determine Cardiac output (8)
- 8. i) Explain the Principle of operation of an Ultrasonic blood flow meter (8)  
ii) Explain the origin of different heart sounds. (8)

## **UNIT – IV**

### **NONLINEAR SYSTEMS**

#### **PART – A**

1. What are linear and nonlinear systems? Give examples.
2. How nonlinearities are introduced in the systems?
3. What are the methods available for the analysis of nonlinear system?
4. What is the principle of X-ray machine? Give the characteristics of X- Ray radiation ?
5. What is the principle of Endoscopy?
6. Name the different types of bio-telemetry system.
7. Distinguish between Fluoroscopy and Radiography.
8. Mention the classifications of Artifact
9. What are the types of Thermography?

#### **PART – B**

1. Draw the block diagram of Computer tomography scanner and explain its operation with emphasis on image reconstruction. (16)

2. What is an Endoscope? List the types of commonly available endoscopes. with schematic diagram explain the working of endoscopic laser coagulator (16)
3. Explain the working of X ray Machine? (16)
4. (i) Explain the different elements involved in Biotelemetry circuits. (8)  
(ii) Explain about Patient Monitoring system (8)
5. Explain in detail about the basic principle of Thermography. With neat diagram explain the different parts of the Thermal Imaging system. (16)
6. (i) Write the principle of NMR? (4)  
(ii) Explain with block diagram the MRI (8)  
(iii) Applications of MRI (4)
7. Explain the concepts of Ultrasonography and mention its types. (16)

## **UNIT – V**

### **MIMO SYSTEMS**

#### **PART – A**

1. What is the use of Biphasic D.C. defibrillators?
2. What is the principle of bubble oxygenators.
3. Why do we use heart – lung machine?
4. What is the purpose of Audiometer?
5. What is a pacemaker? What are the different modes of operation of Cardiac pacemakers?
6. What are the differences between Hemodialysis and Peritoneal dialysis?
7. What are the requirements for a blood pump?
8. What is meant by dialysis?
9. What is a ventilator?
10. What are the drawbacks of a.c. defibrillators?

**PART – B**

1. (i) Give the difference between internal and external pacemaker (8)  
(ii) Give short note on Double square pulse defibrillator. (8)
2. Why do we require Heart-lung machine? Draw a block diagram of it and explain its working. (16)
3. Draw the block diagram of synchronized D.C. defibrillator and explain its working. (16)
4. List the different types of waveforms used for stimulation of Muscle and nerves? Draw the block diagram of a typical Electrotherapeutic stimulator and explain. (16)
5. Write short notes on:
  - i) Short wave diathermy
  - ii) Microwave diathermy. (16)
6. Discuss different types of defibrillators with a neat sketch. (16)
7. Explain the process of dialysis with diagrams. How does this technique play a useful role in medical field? Give a few examples and state the limitations of this technique. (16)
8. Draw a circuit diagram of a Peripheral nerve stimulator and explain it and also discuss the different types of stimulator waveforms. (16)
9. i) Explain the principle of working of Ventilators. (8)  
ii) Explain about audiometers in bio-medical instrumentation. (8)