BIRLA INSTITUTE OF TECHNOLOGY
MESRA – 835215, RANCHI, INDIA

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Name: ……………………………………………. Roll No.: …………………………………………..
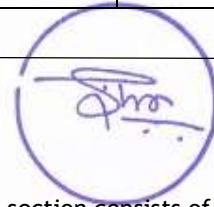
Branch: ……………………………………………. Signature of Invigilator: ……………………

Semester: VIth   Date: 28/04/2022 (MORNING)

Subject with Code: **EC445 INTRODUCTION TO SIGNAL PROCESSING**

Marks Obtained	Section A (30)	Section B (20)	Total Marks (50)

INSTRUCTION TO CANDIDATE

1. The booklet (question paper cum answer sheet) consists of two sections. First section consists of MCQs of 30 marks. Candidates may mark the correct answer in the space provided / may also write answers in the answer sheet provided. The Second section of question paper consists of subjective questions of 20 marks. The candidates may write the answers for these questions in the answer sheets provided with the question booklet.

2. The booklet will be distributed to the candidates before 05 minutes of the examination. **Candidates should write their roll no. in each page of the booklet.**

3. Place the Student ID card, Registration Slip and No Dues Clearance (if applicable) on your desk. All the entries on the cover page must be filled at the specified space.

4. Carrying or using of mobile phone / any electronic gadgets (except regular scientific calculator)/chits are strictly prohibited inside the examination hall as it comes under the category of unfair means.

5. No candidate should be allowed to enter the examination hall later than 10 minutes after the commencement of examination. Candidates are not allowed to go out of the examination hall/room during the first 30 minutes and last 10 minutes of the examination.

6. Write on both side of the leaf and use pens with same ink.

7. The medium of examination is English. Answer book written in language other than English is liable to be rejected.

8. All attached sheets such as graph papers, drawing sheets etc. should be properly folded to the size of the answer book and tagged with the answer book by the candidate at least 05 minutes before the end of examination.

9. The door of examination hall will be closed 10 minutes before the end of examination. Do not leave the examination hall until the invigilators instruct you to do so.

10. Always maintain the highest level of integrity. Remember you are a BITian.

11. Candidates need to **submit the question paper cum answer sheets before leaving the examination hall**.

BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS:
B.Tech   SEMESTER : VI

BRANCH: ECE (Open
          Elective)   SESSION : SP/22

SUBJECT: EC445 Introduction to Signal Processing

TIME:
2:00 Hrs   FULL MARKS: 50

PART A

Multiple Choice Questions
(There is no Negative Marking)

1. The even part and the odd part of the signal $x(n) = 3^n$ will be: [1]
   a. Even Part = ½ $[3^n + 3^{-n}]$ and Odd Part = ½ $[3^n - 3^{-n}]$
   b. Even Part = ½ $[3^n - 3^{-n}]$ and Odd Part = ½ $[3^n - 3^{-n}]$
   c. Even Part = ½ $[3^n + 3^{-n}]$ and Odd Part = ½ $[3^n + 3^{-n}]$
   d. Even Part = ½ $[3^n - 3^{-n}]$ and Odd Part = ½ $[3^n + 3^{-n}]$

2. For energy signals, the energy will be finite, and the average power will be,   [1]
   a. Infinite
   b. Finite
   c. Zero
   d. Cannot be defined

3. The sampling frequency of the analog signal, $x(t) = 4 \sin 150 \pi t + 2 \cos 50 \pi t$ should be, [1]
   a. Greater than 75 Hz
   b. Greater than 150 Hz
   c. Less than 150 Hz
   d. Greater than 50 Hz

4. In a signal $x(n)$, if 'n' is replaced by $n/3$, then it is called,   [1]
   a. Upsampling
   b. Folded version
   c. Downlsampling
   d. Shifter version

5. The zero input response (or) natural response is mainly due to,   [1]
   a. Initial stored energy in the system
   b. Initial conditions in the system
   c. Specific input signal
   d. Both a and b

6. The Z-transform is a,   [1]

a. Finite Series
b. Infinite Power Series
c. Geometric Series
d. Both (a) and (c)

7. An LTI system with impulse response, $h(n) = (-a)^n u(n)$ and $-a < -1$ will be, [1]
   a. Stable system
   b. Unstable system
   c. Anticausal system
   d. Neither stable nor causal

8. The ROC of the sequence $x(n) = u(-n)$ is, [1]
   a. $|z| > 1$
   b. $|z| < 1$
   c. No ROC
   d. $-1 < |z| < 1$

9. ROC of x(n) contains [1]
   a. Poles
   b. Zeros
   c. No poles
   d. No zeros

10. The system described by the input-output equation $y(n) = x^2(n)$ is [1]
    a. Linear
    b. Non-linear
    c. Sometimes linear and sometimes non-linear
    d. Cannot be determined

11. The system $y(n) = x(2n)$ is [1]
    a. Time invariant
    b. Time variant
    c. Unstable
    d. All the above

12. The poles of a Butterworth filter lie on a/an [1]
    a. Circle
    b. Parabola
    c. Ellipse
    d. Helix

13. The signal $u(n) + u(-n)$ is [1]
    a. Periodic
    b. Non-periodic
    c. Neither periodic nor non-periodic
    d. Either periodic or non-periodic sometimes

14. The system $y(n) = a\, x(n)$ is a [1]
    a. Static System
    b. Dynamic System with finite memory
    c. Dynamic System with infinite memory
    d. None of the above

15. $x_1(n)$ and $x_2(n)$ are periodic signals with periods N_1 and N_2 respectively. Under what conditions is the sum $x(n) = x_1(n) + x_2(n)$ will be periodic [2]
    a. $N_1/N_2 = q/p$
    b. $N_1/N_2 = p/q$
    c. $N_1 = N_2$
    d. The signal is never going to be periodic

16. The step response for the LTI system represented by the impulse response $h(n) = \delta(n) - \delta(n-1)$ will be [2]
    a. $a(n) - a(n-1)$ where a is a constant
    b. $u(n) - u(n-1)$ where $u(n)$ is the step signal
    c. 1
    d. $r(n) - r(n-1)$, where $r(n)$ is the ramp signal

17. Which of the following system is causal? [2]
    a. $h(n) = n(1/2)^n u(n+1)$
    b. $y(n) = x^2(n) - x(n+1)$
    c. $y(n) = x(-n) + x(2n-1)$
    d. $h(n) = n(1/2)^n u(n)$

18. The Fourier transform of the sequence $x(n) = \delta(n)$ will be [2]
    a. $a^n u(n)$
    b. 1
    c. 0
    d. $e^{-j\omega k}$

19. The Nyquist sampling frequency (rad/sec) for the signal $x(t) = 3 \cos 4t$ will be [2]
    a. 8 rad/sec
    b. 4 rad/sec
    c. 2 rad/sec
    d. 16 rad/sec

20. The inverse Z-transform of $3/(z-4)$, $|z| > 1$ is, [2]
    a. $3(4)^n u(n-1)$
    b. $3(4)^{n-1} u(n)$
    c. $3(4)^{n-1} u(n+1)$
    d. $3(4)^{n-1} u(n-1)$

21. The linear and circular convolution of the sequences $\{1,2\}$ with $\{2,1\}$ will be [2]
    a. Linear Convolution = $\{4,5,1\}$ & Circular Convolution = $\{4,5\}$
    b. Linear Convolution = $\{2,5,1\}$ & Circular Convolution = $\{2,5\}$
    c. Linear Convolution = $\{2,5,2\}$ & Circular Convolution = $\{4,5\}$
    d. Linear Convolution = $\{2,5,2\}$ & Circular Convolution = $\{2,5\}$

22. The fundamental period of the signal $x(n) = \sin(\pi n/4)$ is [2]
    a. 4 samples
    b. 8 samples
    c. 12 samples
    d. 2 samples

PART B

23. Determine the z-transform and the ROC of the discrete time signal $x(n) = 0.3^n u(n) + 0.8^n u(-n-1)$
[4]

24. Let Matrix $A = \begin{array}{ccc} 4 & 6 & 10 \\ 3 & 10 & 13 \\ -2 & -6 & 18 \end{array}$

    Find the Eigenvalue of matrix A
[4]

25. Compute 4-point DFT of a causal three sample sequence given by
    $x(n) = 1/3;$ $0 \le n \le 2$
           $= 0;$ elsewhere
[4]

26. Find the order and cut-off frequency of a Butterworth filter whose attenuation in passband is 2 dB, attenuation in the stopband is 10 dB, passband edge frequency is 20 radians/second and stopband edge frequency is 30 radians/sec.
[4]

27. Determine whether the signal $x(n) = (1/4)^n u(n)$ is an energy signal or power signal.
[4]