

SECOND SEMESTER (CBCSS—UG) DEGREE EXAMINATION  
APRIL 2021

## Instrumentation

## INS 2B 02—PRINCIPLES OF INSTRUMENTATION

Time : Two Hours and a Half

Maximum : 80 Marks

## Section A (Short Answer Type Questions)

*Answer at least ten questions.**Each question carries 3 marks.**All questions can be attended.**Overall Ceiling 30.*

1. Compare deflection and null type instruments ?
2. Define signal to noise ratio ?
3. What is the unit of luminous intensity ?
4. Differentiate interfering input and desired input ?
5. Write mathematical expression for power spectral density ?
6. Differentiate accuracy and precision ?
7. Give the classification of errors ?
8. Differentiate instrumental and systematic error ?
9. Give example for observational error ?
10. What is meant by impedance matching ?
11. Compare self generating and power operated type instruments ?
12. Differentiate intelligent and dumb instruments ?.
13. Derive the dimensions of pressure ?
14. List out the steps for calibration ?
15. Differentiate repeatability and reproducibility ?

(10 × 3 = 30 marks)

Turn over

**Section B (Paragraph Type Questions)**

*Answer at least five questions.*

*Each question carries 6 marks.*

*All questions can be attended.*

*Overall Ceiling 30.*

16. Define limiting errors ? And explain.
17. Mention how systematic error is reduced ?
18. Show that dimensions of product of voltage and current are dimensions of power ?
19. Explain the functions of signal conditioning system ?
20. Describe different types of errors occur in measurement system ?
21. Derive the dimensions of the following: Magnetic Flux, Permeability ?
22. Explain the corrections applied for modifying and interfering inputs ?
23. Explain the functional elements of a measurement system with an example ?

(5 × 6 = 30 marks)

**Section C**

*Answer any two questions.*

*Each question carries 10 marks.*

24. Compare contacting and non contacting type instruments with examples ?
25. Explain the various basis for classification of measuring instruments ?
26. Explain any *four* types of instruments.
27. Two capacitors are connected in parallel Determine the limiting error of the resultant capacitance in  $\mu\text{F}$  ? given  $C_1 = 150 + \text{or} - 2.4\mu\text{F}$ ,  $C_2 = 120 + \text{or} - 1.5\mu\text{F}$ .

(2 × 10 = 20 marks)

## SECOND SEMESTER (CUCBCSS-UG) DEGREE EXAMINATION, APRIL 2021

Instrumentation

INB 2B 02—APPLIED MATHEMATICS – II

(2018 Admissions)

Time : Three Hours

Maximum : 80 Marks

## Section A (Objective Type Questions)

Answer all questions.

1 mark each.

1.  $L(t^{1/2}) = \text{_____}$ .

2.  $L(t^2) = \text{_____}$ .

3.  $L^{-1}(1/s^2 + a^2) = \text{_____}$ .

4. Which is an even function ?

(a)  $x^2 - x$ .

(b)  $x^3 - 3$ .

(c)  $2x^2 \cos x$ .

(d)  $\sin(x)$ .

5. Coefficient of variation is :

(a)  $\sigma \bar{x}$ .

(b)  $\sqrt{\sigma / \bar{x}}$ .

(c)  $\sigma^2 / \bar{x}$ .

(d)  $\sigma / \bar{x}$ .

6. The half range Fourier series of an odd function in the interval  $(-\pi$  to  $\pi)$  is :

(a)  $a_n = 2/\pi \int_0^\pi f(x) \cos nx \, dx$  and  $b_n = 0$ .

(b)  $b_n = 2/\pi \int_0^\pi f(x) \sin nx \, dx$  and  $a_n = 0$ .

(c)  $a_n = 2/\pi \int_0^\pi f(x) \sin nx \, dx$  and  $b_n = 0$ .

(d)  $b_n = 2/\pi \int_0^\pi f(x) \cos nx \, dx$  and  $a_n = 0$ .

7. Choose the correct empirical relation :
- mean-mode = 3 (mean-median).
  - mean - median = 3 (mean-mode).
  - mean - mode = 1/3 (mean-median).
  - None of these.
8. If the sum to  $n$  terms tends to  $-\infty$ , then the series is said to be :
- Convergent.
  - Divergent.
  - Oscillatory.
  - None of these.
9. Number of combinations of  $n$  things into 2 groups of  $r$  and  $(n - r)$  things is :
- ${}^n C_{n-r}$ .
  - ${}^n C_2$ .
  - ${}^n C_{n-2}$ .
  - ${}^n C_r$ .
10. If A and B are mutually exclusive events,  $P(AB) = \underline{\hspace{2cm}}$ .

(10 × 1 = 10 marks)

**Section B (Short Answer Type Questions)**

*One or two sentences each.  
Answer any ten questions.  
2 marks each.*

- What is meant by absolute convergence of an infinite series ?
- Prove that  $L(1) = 1/s$ .
- Find the inverse Laplace transform of  $1/(s - a)$ .
- State the second shifting property of inverse Laplace transforms.
- What are the conditions for Fourier series expansion of a function ?
- Define Periodic function.
- Write the Euler's formulae for Fourier coefficients.
- Check the convergence or divergence of the following series using Cauchy's Root test :

$$\sum_0^{\infty} \left(1 - \frac{1}{n}\right)^{n^2}.$$

19. 100 tickets numbered from 1 to 100 are shuffled well and a ticket is drawn at random. What is the probability that the drawn ticket has number 5 or its multiple ?
20. What do you mean by mutually exclusive events ?
21. Define Geometric mean and Harmonic mean.
22. What is the probability of drawing an ace from a deck of cards ?

(10 × 2 = 20 marks)

### Section C (Paragraph Type Questions)

*Answer any six questions.  
5 marks each.*

23. Check the convergence of the given series using Ratio Test :

$$\frac{1}{10} + \frac{2!}{10^2} + \frac{3!}{10^3} + \frac{4!}{10^4} + \frac{5!}{10^5} + \dots\dots\dots$$

24. Show that  $L(t \sin at) = 2as / (s^2 + a^2)^2$  and  $L(t \cos at) = (s^2 - a^2) / (s^2 + a^2)^2$ .

25. Solve the equation using Laplace transform method :

$$(D^2 + n^2)x = a \sin(nt + \alpha), x = Dx = 0 \text{ at } t = 0.$$

26. Find a Fourier series to represent the function  $f(x) = e^{-x}$  in the interval  $0 < x < \pi$ .

27. Obtain a Fourier series for a function defined by :

$$f(x) = \begin{cases} x, & \text{for } 0 < x < \pi \\ -x, & \text{for } -\pi < x < 0. \end{cases}$$

28. The crushing strength of 8 cement concrete experimental block, in metric tonnes/cm<sup>2</sup> was 4.8, 4.2, 5.1, 3.8, 4.4, 4.7, 4.1 and 4.5. Find the mean crushing strength and standard deviation.
29. Explain the different measures of dispersion for a group of data.
30. Three cards are drawn from a pack of 52. Find the probability that they are of same colour.
31. A problem in mechanics is given to three students A, B and C whose chances of solving it are  $\frac{1}{2}$ ,  $\frac{1}{3}$  and  $\frac{1}{4}$  respectively. What is the probability that the problem will be solved ?

(6 × 5 = 30 marks)

## Section D (Essay Type Questions)

Answer any **two** questions.

10 marks each.

32. Find the inverse Laplace transforms of :

(a)  $(s^2 - 3s + 4)/(s^3)$ .

(b)  $(s + 3)/(s^2 - 4s + 13)$ .

(c)  $(2s^2 - 6s + 5)/(s^3 - 6s^2 + 11s - 6)$ .

33. Find the Fourier series expression of  $f(x) = x + x^2, -\pi < x < \pi$  and hence deduce that :

$$\pi^2/6 = 1 + 1/2^2 + 1/3^2 + 1/4^2 + \dots$$

34. (a) Find the probability that a leap year, selected at random will contain 53 Sundays.

(b) Explain the method of testing of convergence of an infinite series using comparison of ratio method.

35. Calculate the mean and standard deviation of the following frequency distribution :

Size of item	4.5–12.5	12.5–20.5	20.5–28.5	28.5–36.5	36.5–44.5
Frequency	4	24	21	18	5
	44.5–52.5	52.5–60.5	60.5–68.5	68.5–76.5	
	3	5	8	2	

(2 × 10 = 20 marks)

## SECOND SEMESTER (CUCBCSS—UG) DEGREE EXAMINATION, APRIL 2021

Instrumentation

ITN 2B 02—APPLIED MATHEMATICS—II

(2014 Admissions)

Time : Three Hours

Maximum : 80 Marks

## Section A

*Answer all questions.**Each question carries 1 mark.*

1. Give an example for a non-decreasing sequence.
2. What is the sum of the geometric series  $a + ar + ar^2 + \dots$  ( $|r| < 1$ ).
3. What is the Laplace transform of  $\sinh 3t$  ?
4. What is the inverse Laplace transform of  $\frac{1}{s^2 + 4}$  ?
5. Give an example for a periodic function.
6. State True or False :  $f(x) = x + x^2$  is an even function.
7. Define arithmetic mean of a frequency distribution.
8. What is the relation between standard deviation and variance of a frequency distribution ?
9. Define event of a random experiment.
10. What is the probability of drawing an ace from a well shuffled deck of 52 playing cards ?

(10 × 1 = 10 marks)

## Section B

*Answer any ten questions.**Each question carries 2 marks.*

11. Explain the idea of convergence and divergence of sequences.
12. State limit comparison test for convergence.
13. State Leibniz's theorem for the convergence of an alternating series.
14. Find the Laplace transform of  $f(t) = \sin 3t \cos 2t$ .

15. Find  $L^{-1}\left(\frac{s}{(s+1)^2(s+2)}\right)$ .

Turn over

16. Find the Laplace transform of  $f(t) = \begin{cases} e^{-2t}, & \text{if } 0 < t < 2 \\ 0 & \text{otherwise} \end{cases}$ .
17. Write Fourier cosine series formula of a function  $f(x)$  in the interval  $(0, l)$ .
18. Expand  $f(x) = x^2$  as a cosine series in  $0 < x < \pi$ .
19. Expand  $f(x) = e^x$  as a sine series in  $0 < x < 1$ .
20. In a moderately asymmetrical distribution, if mean is 24.6 and mode is 26.1, find the median.
21. Find the standard deviation of the given marks of 10 students : 20, 22, 27, 30, 40, 48, 45, 32, 31, 35.
22. Give any one definition for probability.

(10 × 2 = 20 marks)

### Section C

*Answer any six questions.  
Each question carries 5 marks.*

23. Discuss the convergence of  $\sum a_n$ , where  $a_n = \begin{cases} n/2^n, & n \text{ is odd} \\ 1/2, & n \text{ is even} \end{cases}$ .
24. State and prove the ratio test for convergence of series of non-negative terms.
25. Define dirac delta function. Also find its Laplace transform.
26. Find the inverse Laplace transform of  $\log \left( \frac{s^2}{s+1} \right)$ .
27. Find the Fourier series expansion of  $f(x) = x \sin x$  in the interval  $(0, 2\pi)$ .
28. Find the Fourier series expansion of  $f(x) = |x|$  in the interval  $-2 < x < 2$ .
29. Find the mode of the data :
- |           |   |       |       |       |       |       |       |       |       |       |
|-----------|---|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Class     | : | 11-15 | 16-20 | 21-25 | 26-30 | 31-35 | 36-40 | 41-45 | 46-50 | 51-55 |
| Frequency | : | 8     | 15    | 39    | 47    | 52    | 41    | 28    | 16    | 4     |
30. The first group of the sample has 100 items with mean 15 and SD 3. If the whole group has 250 items with mean 15.6 and  $SD = \sqrt{13.44}$ , find the SD of the second group.
31. A factory has three products lines I, II and III contributing 20%, 30% and 50% respectively, to its total output. The percentages of substandard items produced by lines I, II and III are, respectively 15, 10 and 2. If an item chosen at random from the total output is found to be substandard, what is the probability that the item is from line 1 ?

(6 × 5 = 30 marks)



## Section D

Answer any two questions.  
Each question carries 10 marks.

32. What do you mean by absolute convergence and conditional convergence of series? Prove that every absolutely convergent series is convergent. What about the converse? Justify your answer.
33. Using Laplace transform, solve  $y'' - 4y' + 4y = e^{2t}$ ,  $y(0) = 1, y'(0) = 1$ .
34. Obtain the Fourier series for the function  $f(x) = x^2$  in the interval  $(0, 3)$ . Deduce that

$$\frac{1}{1^2} + \frac{1}{2^2} + \frac{1}{3^2} + \dots = \frac{\pi^2}{6}.$$

35. Calculate the mean deviation about the median for the following data:

Class	:	3-4.9	5-6.9	7-8.9	9-10.9	11-12.9	13-14.9	15-16.9
Frequency	:	5	8	30	82	45	24	6

(2 × 10 = 20 marks)