B.sc. Part-I Honours Examination, 2020

Sub. - PHSA   Paper – I   FM – 100   Duration – 4 hrs.

Modalities

1. An examinee shall not attend her/his college in person to sit for the examination of a practical paper. Examinee shall

    (a)   write her/his answer with BLACK INK only.

    (b)   must attach a scanned copy of her/his registration certificate at the end of the answer script. She/he may attach a scenned copy of the admit card of current examinations, if available.

    (c)   scan the whole answer script in a single .pdf file. If it is instructed to use separate answer scripts for different modules/units, if any, examinee must do accordingly, but she/he shall create a single .pdf file for the answer script. There will be exactly one .pdf file for each examinee.

    (d)   upload her/his answer script through proper web portal to submit.

2. The full marks and duration of examination of a paper shall be in accord with those specified by the University of Calcutta.

3. For examinations of a practical paper, examinees need not submit their laboratory work book, neither they have to face any viva. Examinees shall have to answer the questions following the instructions given in the question paper. The question paper may demand as answer, any of the following

    (a) the theory of any experiment,
    (b) procedure (or any part) of any experiment,
    (c) graph plotting with supplied data of any experiment,
    (d) evaluation of any physical parameter concerned to any experiment,
    (e) any physical interpretation concerned to any experiment.

    Examinees shall use her/his own graph-papers to draw graphs(if any) in practical papers and attach them at proper positions of the answer script. Examinees shall draw circuits and graphs with BLACK INK only.

1.   Answer any *ten* questions   2x10=20

(a) Write down the definition of a vector according to transformation theory.

(b) Write down the Taylor's series for f(x-b) around b.

(c) Two cards are drawn from a full pack of 52 cards. Find the probability that one of them is a 'Heart' and the other is a 'Diamond'.

(d) Prove that the product of a matrix and its transpose is a symmetric matrix.

(e) Test $\sum_n n/2^n$ by Cauchy's ratio test.

(f) Write down the Fourier Inversion Theorem.

(g) State Fermat's principle.

(h) Explain Huygen's principle in wave theory of light.

(i) What are wave fronts ?

(j) State Thevenin theorem.

(k) What is break-down voltage of a Zener diode ?

(l) Briefly write the working principle of a photo-diode.

Unit-I : Answer any four questions.

2.   (a) A die is tossed and the number of points appearing on the uppermost face is observed. What is the probability of obtaining (i) an even number, (ii) an odd number, (iii) less than 3, (iv) a 'six' ?   4

(b) A random variable x has the following probability distribution :

x	4	5	6	8
Probability	0.1	0.3	0.4	0.2

Find the expectation value and standard deviation of x.   4

(c) What is meant by absolute convergence ?   2

3. (a) Write down physical interpretation of Gauss' divergence therem and Stokes' theorem. 2+2

(b) Prove that the transpose of the product of two square matrices equals the product of the transpose of the matrices taken in the reverse order. 3

(c) Write down the conditions for which a function can be expressed in terms of sinusoidal functions. 3

4. (a) Solve the following equation 4

$$\frac{\partial^2 f(x,t)}{\partial t^2} = b \frac{\partial^f(x,t)}{\partial x^2}$$

(b) Solve the following equation using Frobenius' method. 6

$$x^2 \frac{d^2 y}{dx^2} + x \frac{dy}{dx} + x^{2y} = 0$$

5. (a) Write down the generating function of Legendre polynomials. Hence prove that

$$\frac{dP_{n+1}(x)}{dx} + \frac{dP_{n-1}(x)}{dx} = (2x+1)\frac{dP_n(x)}{dx}$$

where $P_n(x)$ is Legendre polynomial. 1+4

(b) Write down the generating function of Hermite polynomials. Hence prove that

$$H_{n+1}(x) + 2nH_{n-1}(x) = 2xH_n(x)$$

where $H_n(x)$ is Hermite function. 1+4

6. (a) Expand the following function in Fourier series. 5

f(x) = - x in (-π,0)
      =   x in (0,π)

(b) Find the Fourier sine and cosine transform of 5

f(x) = 1   for 0≤x<1
     = 0   for x>1

Unit-II : Answer any four questions.

7. Construct the differential equation of a plane wave and and obtain its solution . 2+8

8.   (a) Establish the laws of reflection from Huygen's principle.   6

     (b) The wavelength of certain light in vaccum is 589 nm. Find its wavelength and velocity in a medium of refractive index 1.5.   4

9.   (a) Explain maximum power transfer theorem and superposition principle in current electricity.   5
     (b) Draw the output characteristics of P-N-P transistor in common emitter configuration.   5

10. Explain avalanche and zener break down. Explain the function of zener diode as a voltage regulator.   5+5

11. (a) What is absolute refractive index?   2
     (b) Use Huygen's principle to study the refraction of spherical waves through spherical refracting surface and establish the relation.
     $$\frac{n}{v} - \frac{1}{u} = \frac{n-1}{r}$$
     where the symbols have their usual meaning.   8