Write the following information in the first page of Answer Script before starting answer

ODD SEMESTER EXAMINATION: 2020-21

Exam ID Number______________________________

Course____________________________ Semester____________________________

Paper Code _________________Paper Title __________________________________

Type of Exam: ______________________________ (Regular/Back/Improvement)

Important Instruction for students:

1. Student should write objective and descriptive answer on plain white paper.
2. Give page number in each page starting from 1st page.
3. After completion of examination, Scan all pages, convert into a single PDF, rename the file with Class Roll No. **(2019MBA15)** and upload to the Google classroom as attachment.
4. Exam timing from 10am – 1pm (for morning shift).
5. Question Paper will be uploaded before 10 mins from the schedule time.
6. Additional 20 mins time will be given for scanning and uploading the single PDF file.
7. Student will be marked as ABSENT if failed to upload the PDF answer script due to any reason.

B.Sc. PHYSICS
FIRST SEMESTER
MATHEMATICAL PHYSICS-I
BSP-101

Duration : 3 hrs. **Full Marks : 70**

PART-A : Objective

Time : 20 min. **Marks : 20**

Choose the correct answer from the following: ***1X20=20***

1. The net amount of flux of vector field diverging or converging per unit volume is known as………………….

a. Curl of a vector field
b. Divergence of a vector field
c. Vector field
d. Gradient of a vector field

2. Choose the incorrect option related to the law of sines for plane triangles.

a. $a \times b = b \times c = c \times a$
b. $\frac{SinA}{a} = \frac{SinB}{b} = \frac{SinC}{c}$
c. $\frac{SinA}{b} = \frac{SinB}{c} = \frac{SinC}{a}$
d. $abSinC = bcSinA = caSinB$

3. ………………..of gradient is a Laplacian operator.

a. Divergence
b. Curl
c. Both divergence and curl
d. None of these

4. In terms of curvilinear coordinates, we have:

a. $(grad)_2 = \frac{\partial s}{\partial r}$
b. $(grad)_2 = \frac{\partial s}{\partial z}$
c. $(grad)_2 = \frac{1}{r}\frac{\partial s}{\partial \theta}$
d. $(grad)_2 = \frac{1}{r}\frac{\partial s}{\partial z}$

5. The gradient of a scalar field is a……………..

a. Vector function
b. Vector field
c. Scalar function
d. Scalar function

6. The …………….of two vectors results in two different ways, one is a number and the other is a vector.

a. Sum
b. Difference
c. Resultant
d. Product

7. If **A** and **B** are (3,4,5) and (6, 8,9) , then product of the vectors **AB** is..............

a. 3**i**+ 4**j**+ 9**k** **b.** 3**i**-4**j**+9**k**

c. -3**i**+4**j**+9**k** **d.** 3**i**+4**j**-9**k**

8. The value of ....triple product depends upon the cyclic order of vectors, but is independent of the position of the dot and cross.

a. Vector **b.** Scalar

c. Both scalar and vector **d.** None of these

9. Differential of an arc length is a ....differential form.

a. Quadratic **b.** Linear

c. Both linear and quadratic **d.** None of these

10. What is the wronskian determinant of x^2, x^3?

a. $2x^4$ **b.** x^4

c. $3x^4$ **d.** $4x^4$

11. The complementary function of the differential equation $(D^2+6D+9)y=5e^{3x}$ is:

a. $(C_1+C_2x)e^{-3x}$ **b.** $(C_1+C_2)e^{-3x}$

c. $(C_1+C_2x)e^{3x}$ **d.** $(C_1+C_2y)e^{3x}$

12. If m-1 and m+2 are factors of auxiliary equation of $y''+y'-2y=0$ then general solution is:

a. $Ae^{-x}+Be^{2x}$ **b.** $e^{-x}+e^{2x}$

c. $Ae^{x}+Be^{-2x}$ **d.** $e^{x}+e^{2x}$

13. Two differentiable function $Y_1(x)$ and $Y_2(x)$ are said to be linearly dependent if:

a. $W(Y_1, Y_2\ x)=0$ **b.** $W(Y_1, Y_2\ x)\neq 0$

c. $W(Y_1, Y_2\ x)=1$ **d.** $W(Y_1, Y_2\ x)\neq 0$

14. $\frac{1}{f(D)}x^m$ will be equal to:

a. $[F(D)]^{-1}x^m$ **b.** $F(D)x^m$

c. $mF(D)x^{m-1}$ **d.** $mx^{m-1}[F(D)]^{-1}$

15. When y = f(x) + c g(x) is the solution of an ordinary differential equation then:

a. f is called the particular integral (P.I.) and g is called the complementary function (C.F.)

b. f is called the complementary function (C.F.) and g is called the particular integral (P.I.)

c. f is called the complementary function (C.F.) and particular function (P.I.)

d. g is called the complementary function (C.F.) and particular function (P.I.)

16. The direction of $grad\phi$ is:

a. Tangential to level surfaces **b.** Normal to level surface

c. Inclined at 45^0 to level surface **d.** Arbitrary

17. The electric field due to a point charge Q is expressed $\vec{E} = \frac{Q\hat{r}}{4\pi\varepsilon_0 r^2}$, then the divergence of electric field due to that point charge is:

a. $\frac{3Q}{4\pi\varepsilon_0 r^2}$ **b.** $\frac{2Q}{4\pi\varepsilon_0 r}$

c. 0 **d.** $\frac{3Q}{4\pi\varepsilon_0 r}$

18. If a vector field $\vec{F} = x\hat{i} + 2y\hat{j} + 3z\hat{k}$, then $\nabla \times \nabla \times \vec{F}$ is:

a. $\hat{i}$ **b.** 0

c. $2\hat{j}$ **d.** $3\hat{k}$

19. If $\vec{R} = x\hat{i} + y\hat{j} + z\hat{k}$ and $\vec{A}$ is a constant vector, $curl(\vec{A} \times \vec{R})$ is equal to:

a. $\vec{R}$ **b.** $2\vec{R}$

c. $\vec{A}$ **d.** $2\vec{A}$

20. Stoke's theorem is the relationship between:

a. Surface and volume integral **b.** Line and surface integral

c. Line and volume integral **d.** None of these

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(PART-B : Descriptive)

Time : 2 hrs. 40 min. **Marks : 50**

[Answer question no.1 & any four (4) from the rest]

1. **a)** Find Curl of $\vec{f}$ if $\vec{f} = f_1\overline{T_u} + f_2\overline{T_v} + f_3\overline{T_w}$. 5+5=10

b) Solve $(D^2 + 4)Y = 3x\sin x$

2. **a)** Find the Laplacian operator in orthogonal curvilinear coordinats system. 8+2=10

b) Prove that $(\vec{a} \times \vec{b}).\{(\vec{b} \times \vec{c}) \times (\vec{c} \times \vec{a})\} = [\vec{a}.(\vec{b} \times \vec{c})]^2$

3. **a)** Express $x\hat{\imath} + 2y\,\hat{\jmath} + yz\hat{k}$ in spherical polar coordinates. 6+4=10

b) If $\vec{A} = 2\hat{\imath} + \hat{\jmath} + \hat{k}$ and $\vec{B} = \hat{\imath} - \hat{\jmath} + \widehat{2k}$. Find a vector perpendicular to $\vec{A}$ and $\vec{B}$.

4. **a)** Find the curl of a vector field $\vec{V}$ in terms of curvilinear coordinates. 6+2+2=10

b) Find the volume of a parallelepiped if $\vec{a} = -3\hat{\imath} + 7\hat{\jmath} + 5\hat{k}$;
$\vec{b} = -3\hat{\imath} + 7\hat{\jmath} - 3\hat{k}$ and
$\vec{c} = 7\hat{\imath} - 5\hat{\jmath} - 3\hat{k}$.

c) Find 'm' so that the vectors $2\hat{\imath} - 4\hat{\jmath} + 5\hat{k}$; $\hat{\imath} - m\hat{\jmath} + \hat{k}$ and $3\hat{\imath} + 2\hat{\jmath} - 5\hat{k}$.

5. **a)** Express $-z\hat{\imath} - 2\,\hat{\jmath} + y\hat{k}$ in cylindrical coordinates. 6+4=10

b) If $y_1 = e^{-x}\cos x,\ y_2 = e^{-x}\sin x$

i. Find Wronskian determinant

ii. Show by Wronskian test the solutions are independent.

6. Find the work done work done when a force $\vec{F} = (x^2 - y^2 + x)\hat{i} - (2xy + y)\hat{j}$ moves a particle from origin to (1,1) along a parabola $y^2 = x$ .If $\vec{F} = (2x^2 - 3z)\hat{i} - 2xy\hat{j} - 4x\hat{k}$ then evaluate $\iiint_v \nabla \times \vec{F}dV$, where V is the closed region bounded by the planes $x = 0, y = 0, z = 0$ and $2x + 2y + z = 4$. Using Stoke's theorem evaluate $\int_c [(2x - y)dx - yz^2dy - y^2zdz]$ where c is the circle $x^2 + y^2 = 1$, corresponding to the surface of sphere of unit radius. 3+4+3=10

7. 5+5=10

Solve **(i)** $(D^3+1)y=\cos^2(\frac{x}{2})+e^{-x}$

(ii) $\frac{d^3y}{dx^3}-7\frac{d^2y}{dx^2}+10\frac{dy}{dx}=e^{2x}\sin x$

8. 7+3=10

(i) Establish the relation $curl\,curl\,\vec{f}=\nabla div\,\vec{f}-\nabla^2\vec{f}$

(ii) Find the value of λ, for the differential equation

$(xy^2+\lambda x^2y)dx+(x+y)x^2dy=0$ is exact.

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