Rayat Shikshan Sanstha's

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Department of Physics

Question Bank

Paper **IX**- DSE-E1 **Mathematical Physics**

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Unit I- Chapter I- Partial Differential Equations

- **Multiple Choice Questions (Correct answer is shown in red color)**

1) Every partial differential equation involves atleast...... independent variables.

a)1	b) 2	c)3	d) 4

2) The order and degree of the differential equation $\frac{\partial^2 z}{\partial x^2} = k\frac{\partial z}{\partial y}$ is.............

a) 1,2	b) 1,1	c) 2,1	d) 2,2

3) The equation $\left(\frac{\partial z}{\partial x}\right)^2 + \left(\frac{\partial z}{\partial y}\right)^2 = 1$ is called ....equation.

a) Laplace	b) Non-linear	c) Linear	d) Heat

4) Which of the following is called Laplace equation?

a) $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = \frac{\partial u}{\partial t}$	b) $\frac{\partial^2 u}{\partial x^2} = C^2\frac{\partial u}{\partial t}$
c) $\frac{\partial^2 u}{\partial x^2} = \frac{\partial^2 u}{\partial y^2}$	d) $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$

5) The three dimensional Laplace equation is given by

a) $\frac{\partial^3 u}{\partial x^3} + \frac{\partial^3 u}{\partial y^3} + \frac{\partial^3 u}{\partial z^3} = 0$	b) $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} + \frac{\partial^2 u}{\partial z^2} = 0$
c) $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} + \frac{\partial u}{\partial z} += 0$	d) $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = \frac{\partial^2 u}{\partial t^2}$

6) To solve the equation $\frac{\partial^2 z}{\partial x^2} = k\frac{\partial z}{\partial y}$ by method of variables we assume the solution in the form

a) u(x, t) = X (x) Y (y)	b) u (x, t) = X (x) T (1)
c) u(x, t) = X (x) / T(t)	d) u (x, t)=kX (x) T(0)

7) The wave equation is of the form…..	
a) $\frac{\partial^2 u}{\partial x^2} = \frac{1}{C^2}\frac{\partial u}{\partial t}$	b) $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$
c) $\frac{\partial^2 u}{\partial x^2} = \frac{1}{C^2}\frac{\partial^2 u}{\partial t^2}$	d) $\frac{\partial^2 u}{\partial x^2} = k\frac{\partial u}{\partial y}$
8) Which of the following is not linear partial differential equation?	
a) $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} = 0$	b) $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$
c) $\left(\frac{\partial z}{\partial x}\right)^2 + \left(\frac{\partial z}{\partial y}\right)^2 = 0$	d) $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} + \frac{\partial^2 u}{\partial z^2} = 0$
9) The method of separation of variables converts the give differential equation into....... differential equation.	
a) partial	
b) partial ordinary	
c) ordinary	
d) None of these	
10) To solve the equation $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} + \frac{\partial^2 u}{\partial t^2} = 0$at =0 by method of separation variables, we assume the solution in the form u (x, y, t).	
a) X(x) Y(y) Z(z)	b) X(x) Y(y)
c) X(x) Y(y) T(1)	d) None of these

- **Short Answer Questions**

1.	Solve the equation of wave in the form$\frac{\partial^2 u}{\partial x^2} = \frac{1}{C^2}\frac{\partial^2 u}{\partial t^2}$ by method of separation of variables.
2.	Explain the method of separation of variables for solving equation $\frac{\partial^2 u}{\partial x^2} = \frac{\partial u}{\partial t}$
3.	Explain the method of separation of variables for solving the equation $\frac{\partial^2 u}{\partial x^2} = k\frac{\partial^2 u}{\partial y^2}$ $(k > 0)$

- **Long Answer Questions**

1.	Explain the method of solving two dimensional Laplace equation $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$ by method of separation of variables.
2.	Explain the method of separation of variables for solving three dimensional Laplace equation $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} + \frac{\partial^2 u}{\partial z^2} = 0$

Unit I- Chapter II- Frobenious Method and Special Functions

- **Multiple Choice Questions (Correct answer is shown in red color)**

1) If in the equation $\frac{d^2y}{dx^2} + H\,(x)\frac{dy}{dx} + B(x)y = 0$, the function P (x) and Q(x) are analytic at point x = x_o, then the point x_o is. ..... point.

a) ordinary	b) singular
c) both (a) and (b).	d) none of these

2) For the equation $x^2\frac{d^2y}{dx^2} + x\frac{dy}{dx} + y = 0$, the point of regular singularity is.........

a) x=∞	b) x=1
c) x = 0	d) none of these

3) For the equation $(1 - x^2)\frac{d^2y}{dx^2} + x\frac{dy}{dx} + 4y$, the point x = 0 ....point

a) ordinary	b) singular
c) both (a) and (b)	d) none of these

4) For the equation $2x^2\frac{d^2y}{dx^2} + x\frac{dy}{dx} + (x^2 - 4)y = 0$, the point removable singularity is.....

a) x=∞	b) x=0	c) x = 2	d) $x = \pm 1$

5) For the equation $x^2(x+1)^2\frac{d^2y}{dx^2} + (x^2 - 1)\frac{dy}{dx} + 2y = 0$, the point x = 0 is.... Point.

a) ordinary	b) singular	c) irregular singular	d) *both a & b*

6) For the equation $x^2(x+1)^2\frac{d^2y}{dx^2} + (x^2 - 1)\frac{dy}{dx} + 2y = 0$, the point irregular singularity is.....

a) x=0	b) x=1	c) x = -1	d) $x = \pm 1$

7) For the equation $x(x-1)^3\frac{d^2y}{dx^2}+2(x-1)y+3y=0$, the point regular singularity is…..			
a) x=0	b) x=1	c) both (a) and (b)	d) none of these
8) The equation $x^2\frac{d^2y}{dx^2}+ysinx=0$, the point x =0 is ….point.			
a) ordinary	b) regular singular		
c) irregular singular	d) none of these		
9) Legendre's differential equation has general solution in the form			
a) y = AP_n (x)			
b) y = BQ_n(x)			
c) y=A P_n(x)+BQ_n(x)			
d) none of these			
10) For the Legendre's polynomial P_n(x) which of the following is true….			
a) P_n(1)=0	b) P_n(-x) = Pn(x)	c) P_n(x)=1	d) P_n(-x)=(-1)P_n(x)
11) The Bessel's equation $x^2\frac{d^2y}{dx^2}+x\frac{dy}{dx}+(x^2-n^2)y=0$ has regular singularity at …….point.			
a) x=∞	b) x=0	c) x = 1	d) $x=n$
12) In Frobenious method of series solution to the Legendre's differential equation, the solution is given y= a P_n(x) + b Q_n(x). Here, functions P_n(x) and Q_n(x) are…….			
a) analytic	b) linearly dependent	c) linearly independent	d) none of these
13) If x = 0 is regular singularity of the differential equation, then its series solution is assumed in the form.....			
a) $y=\sum_{m=0}^{\infty}a_mx^m$	b) $y=\sum_{m=0}^{\infty}a_mx^{k+m}$		
c) $y=\sum_{m=0}^{\infty}a_mx^{k-m}$	d) *either* (*b*)*or* (*c*)		
• **Short Answer Questions**			
1.	Find the general solution of the equation $\frac{d^2y}{dx^2}+x\frac{dy}{dx}+3y=0$ by Frobenious method.		

2.	Define Legendre's Polynomials of first kind and derive first four polymials.
3.	In usual notations, prove that (i) $P_n(1)=1$(ii) $P_n(-x)=(-1)^n P_n(x)$.

- **Long Answer Questions**

1.	Define ordinary point, regular singularity and irregular singularity of the second order differential equation and them with help of examples.
2.	Find the general solution of the Legendre's differential equation by Frobenious method.
3.	Derive Lagrange's equations of motion from Hamilton's principle.
4.	Define Bessel's differential equation and solve it by using series solution method.
5.	Explain the Frobenious method for solving the equation, $a_o(x)\frac{d^2y}{dx^2}+a_1(x)\frac{dy}{dx}+a_2(x)y=0.$

Unit II- Chapter I *Some Special Integrals*

- **Multiple Choice Questions (Correct answer is shown in red color)**

1) The value of is			
a) $\sqrt{\pi}$	b) $\pi\sqrt{2}$	c) $\frac{\sqrt{\pi}}{2}$	d) $\frac{\pi}{\sqrt{2}}$
2) The value of $\Gamma\frac{1}{4}\cdot\Gamma\frac{3}{4}$			
a) $\frac{\sqrt{\pi}}{2}$	b) $\pi\sqrt{2}$	c) $\frac{\sqrt{\pi}}{2}$	d) $\frac{\pi}{2\sqrt{2}}$
3) $\int_0^1 (1-x)^{-1/2}dx=\ldots.$			
a) $\frac{16\sqrt{\pi}}{15}$	b) $\frac{8}{15}$	c) $\frac{16}{15}$	d) None
4) $\int_0^\infty \frac{x^6(1-x^8)}{(1+x)^{22}}dx = \ldots\ldots$			
a) 0	b) β (7,15)	c) β (6,22)	d) β (8,22)
5) The value of integral $\int_0^\infty e^{x^2}dx=\ldots.$			
a) π	b) $\frac{\sqrt{\pi}}{2}$	c) $\frac{\sqrt{\pi}}{2\sqrt{2}}$	d) 1

• **Short Answer Questions**	
1.	Prove that Beta function is symmetric and show that $\int_0^\infty \frac{dx}{1+x^4} = \frac{\pi}{2\sqrt{2}}$
2.	Definite error function, complementary error function and prove that $erf(x) + erf_c(x) = 1.$
3.	Define error function and show that it is odd function with relation $erf(0) + erf(\infty) = 1.$
• **Long Answer Questions**	
1.	Define Beta and Gamma functions and prove that $\beta(m, n) = \int_0^\infty \frac{x^{m-1}}{(1+x)^{m+n}} dx$
2.	Define Gamma function and prove that (i) $\int_0^\infty e^{-kx} x^{n-1} dx = \frac{\lceil n}{k^n}$ (ii) $\lceil n = (n-1)!$
3.	4. Define Beta function and prove that $\int_0^{\pi/2} \sin^p x \cos^q x dx = \frac{1}{2}\beta\left(\frac{p+1}{2}, \frac{q+1}{2}\right)$
4.	Derive the relation between beta and gamma functions in the form $\beta(m,n) = \frac{\lceil m \lceil n}{\lceil m+n}$
5.	Derive the duplication formula $2^{2m-1} \lceil m \lceil m + \frac{1}{2} = \sqrt{\pi} \lceil 2m.$

***Unit I- Chapter II-* Complex Analysis**			
• **Multiple Choice Questions (Correct answer is shown in red color)**			
1) The modulus of complex number $2(\sqrt{3}+i)$ is.....			
a) 2	b) 4	c) $2\sqrt{3}$	d) none
2) The argument of complex number $-1-\sqrt{3}$i is....			
a) $\frac{\pi}{3}$	b) $\frac{2\pi}{3}$	c) $\frac{4\pi}{3}$	d) $\frac{5\pi}{6}$
3) The exponential form of complex number 1-i is.....			
a) $\sqrt{2}e^{\frac{\pi i}{4}}$	b) $\sqrt{2}e^{\pi i}$	c) $\sqrt{2}e^{-\pi i}$	d) $\sqrt{2}e^{\frac{\pi i}{4}}$
4) The value of log (i) is......			
a) 1	b) $\frac{\pi}{2}$	c) $\frac{i\pi}{4}$	d) $\frac{i\pi}{2}$
5) If ω is complex cube root of unity, then $\omega^3 = \cdots$ ...			
a) 1	b) -1	c) i	d) 0
6) The square of i are given by.....			
a) $\pm(1+i)$	b) $\pm\frac{(1+i)}{\sqrt{2}}$	c) $\pm\frac{(1-i)}{\sqrt{2}}$	d)None
7) The value of $e^{i(\pi/2)}$is....			
a) 1	b) 1+i	c)i	d)-i
8) The value of $(1 + i + i^2)^{10}$ is.....			
a) 1	b) -1	c) 0	d) 1
9) One of the value of $\left(\sin\frac{\pi}{3}+icos\frac{\pi}{3}\right)^3$ is......			
a) i	b) -i	c) 0	d) 1
10) Cauchy Reimann Conditions for afunction f (z) = u+iv to be analytic are.....			

a) $\frac{\partial u}{\partial x} = \frac{\partial u}{\partial y}, \frac{\partial v}{\partial x} = \frac{\partial v}{\partial y}$		
b) $\frac{\partial u}{\partial x} = \frac{\partial v}{\partial y}, \frac{\partial u}{\partial y} = \frac{\partial v}{\partial x}$		
c) $\frac{\partial u}{\partial x} = \frac{\partial v}{\partial y}, \frac{\partial u}{\partial y} = \frac{-\partial v}{\partial x}$		
d) $\frac{\partial u}{\partial x} = \frac{\partial v}{\partial x}, \frac{\partial u}{\partial y} = \frac{\partial v}{\partial y}$		
• **Short Answer Questions**		
1.	Represent the complex numbers z_1. z_2 and z_1 / z_2 geometrically for any two complex z_1, and z_2.	
2.	Explain the method of finding square roots of complex number x+iy, hence, find the square root of 5-12i.	
3.	Prove that log z=log | z |+i argz, hence find the value of log (-1-i).	
4.	Explain the term 'generalised coordinates'. Why they are needed?	
5.	Write a note on 'Principle of virtual work'	
6.	Obtain D'Alembert's principle in generalized coordinates.	
7.	Write a note on 'Atwood's Machine'.	
8.	Derive an equation of motion for a bead sliding on a uniformly rotating wire.	
• **Long Answer Questions**		
1.	Using Euler's formula prove the De'Moivre's theorem.	
2.	Using De'Moivre's theorem, prove that if $x + \frac{1}{x} = 2\, cos\theta, then\ x^n + \frac{1}{x^n} = 2\, cos\theta$	
3.	State and prove the Cauchy-Riemann conditions for a function to be analytic.	