NO.1 INSITITUTE FOR IAS/IFoS EXAMINATIONS

IMS™
(INSTITUTE OF MATHEMATICAL SCIENCES)

MATHEMATICS CLASSROOM TEST 2021-22

Under the guidance *of* K. Venkanna

MATHEMATICS

PDE CLASS TEST

Date: 17 Jan.-2021   **Timing : 2:00 PM to 4:30 PM**

Time: 03:00 Hours   **Maximum Marks: 250**

INSTRUCTIONS

1. Write your details in the appropriate space provided on the right side.

2. Answer must be written in the medium specified in the admission Certificate issued to you, which must be stated clearly on the right side. No marks will be given for the answers written in a medium other than that specified in the Admission Certificate.

3. Candidates should attempt All Question.

4. The number of marks carried by each question is indicated at the end of the question. Assume suitable data if considered necessary and indicate the same clearly.

5. Symbols/notations carry their usual meanings, unless otherwise indicated.

6. All answers must be written in blue/black ink only. Sketch pen, pencil or ink of any other colour should not be used.

7. All rough work should be done in the space provided and scored out finally.

8. The candidate should respect the instructions given by the invigilator.

9. The question paper-cum-answer booklet must be returned in its entirety to the invigilator before leaving the examination hall. Do not remove any page from this booklet.

READ INSTRUCTIONS ON THE LEFT SIDE OF THIS PAGE CAREFULLY

Name

Mobile No.

Email.: (In Block Letter)

Test Centre

Medium

I have read all the instructions and shall abide by them

_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

Signature of the Candidate

I have verified the information filled by the candidate above

_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

Signature of the invigilator

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No.	PAGE NO.	MAX. MARKS	MARKS OBTAINED
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(8)		18	
(9)		17	
(10)		18	
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(12)		24	
(13)		18	
(14)		16	
(15)		15	

Total Marks

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P.T.O.

1. (i) Form a partial differential equation by eliminating the arbitrary function ϕ from $\phi(x + y + z, x^2 + y^2 - z^2) = 0$. What is the order of this partial differential equation ?

(ii) Find the surface whose tangent planes cut off an intercept of constant length k from the axis of z. **[6+10=16]**
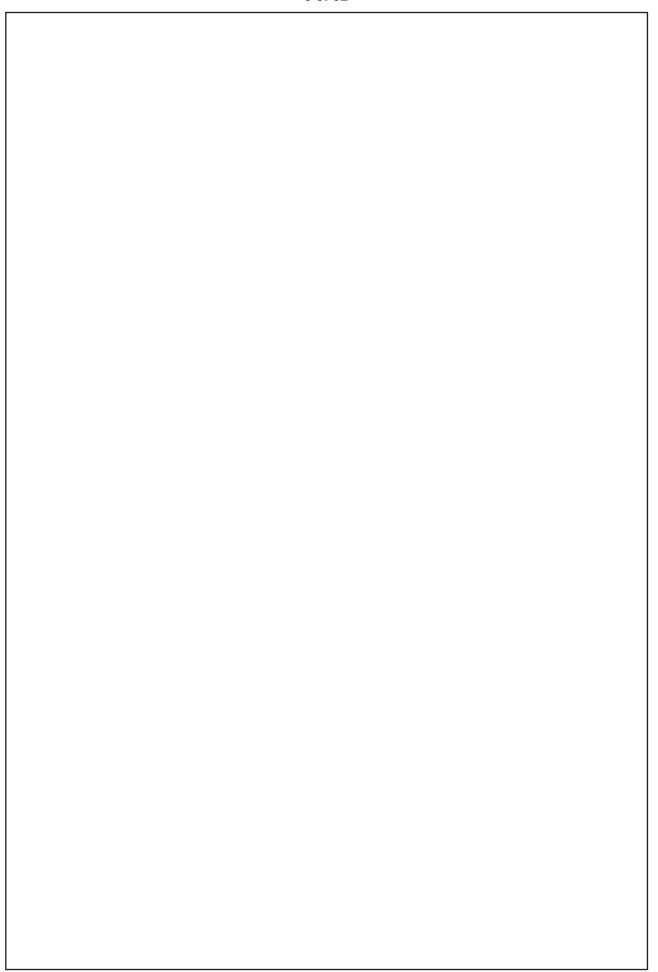
2. Solve the following differential equation :

$(D^3 - 4D^2 D' + 5DD'^2 - 2D'^3) z = e^{y + 2x} + (y + x)^{1/2}.$ **[10]**
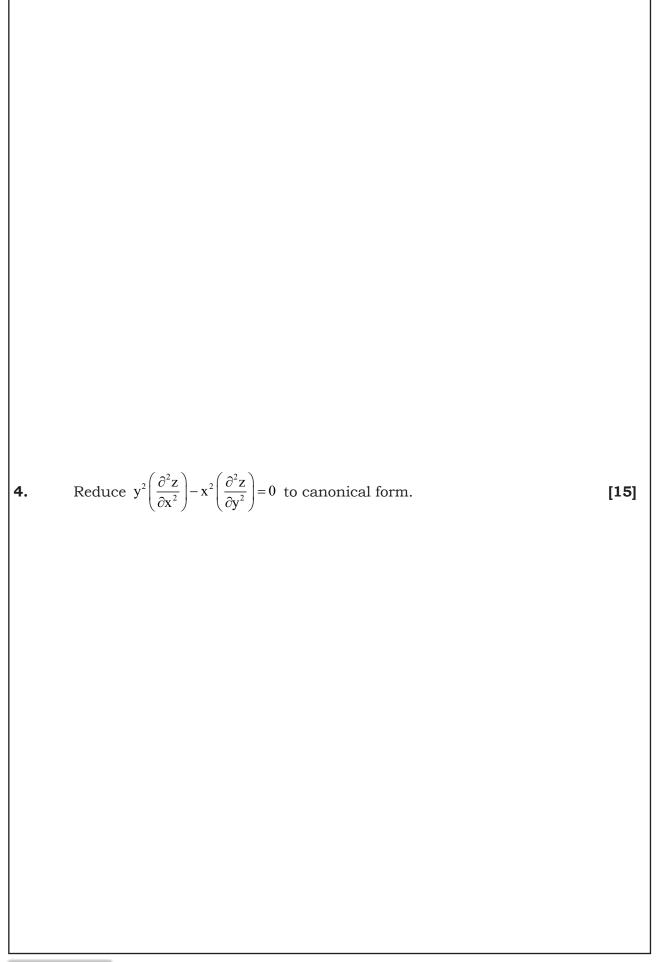
3.   (i) Find the complete integral of $(x + y)(p + q)^2 + (x - y)(p - q)^2 = 1$.   **[18]**

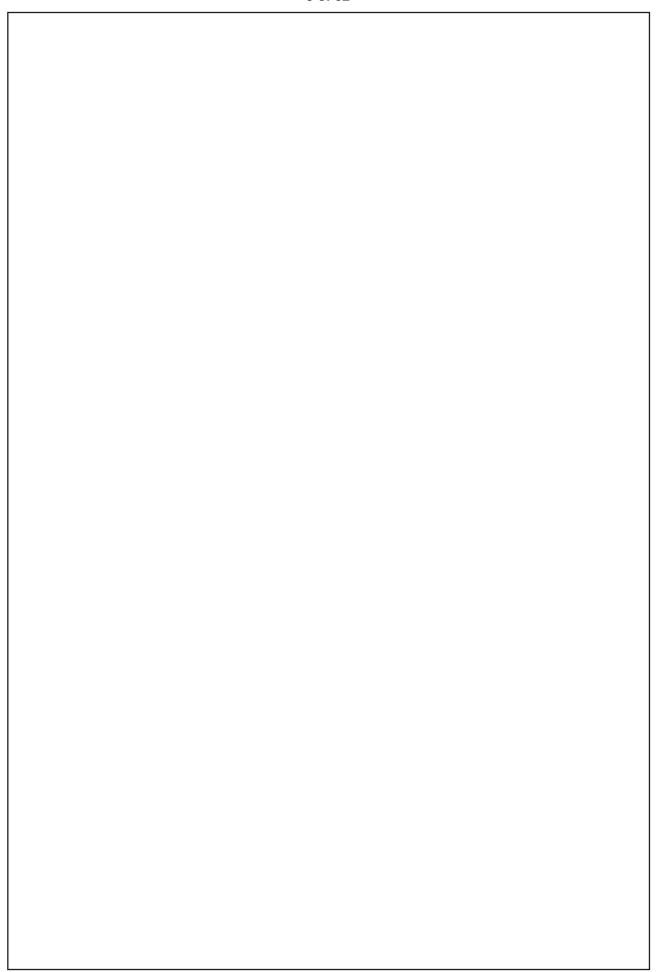   (ii) Solve $(D^2 - DD' - 2D'^2 + 2D + 2D')z = e^{2x+3y} + xy + \sin(2x + y)$.

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4. Reduce $y^2 \left(\dfrac{\partial^2 z}{\partial x^2} \right) - x^2 \left(\dfrac{\partial^2 z}{\partial y^2} \right) = 0$ to canonical form. **[15]**

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5. Solve $(D^2 + DD' - 6D'^2)z = x^2 \sin (x + y)$. **[13]**

6. Obtain temperature distribution y(x, t) in a uniform bar of unit length whose one end is kept at 10°C and the other end is insulated. Further it is given that
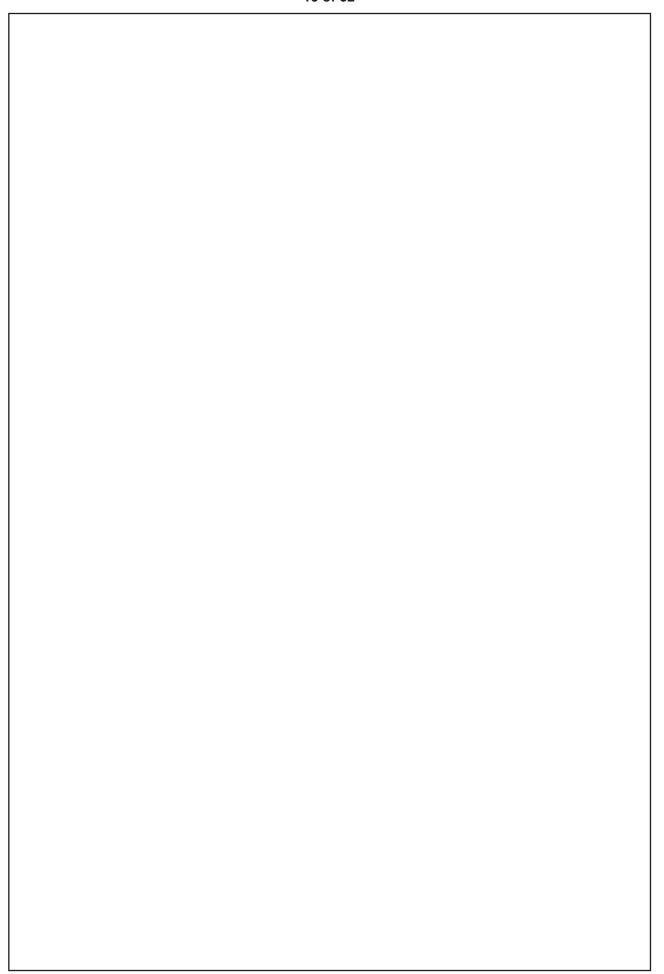
y(x,0) = 1 – x, 0 < x < 1. **[18]**

P.T.O.

7. A string is stretched and fastened to two points l apart, Motion is started by displacing the string into the form $y = m(lx - x^2)$ from which it is released at time $t = 0$. find the displacement of any point on the string at a distance x from one end at time t. **[16]**
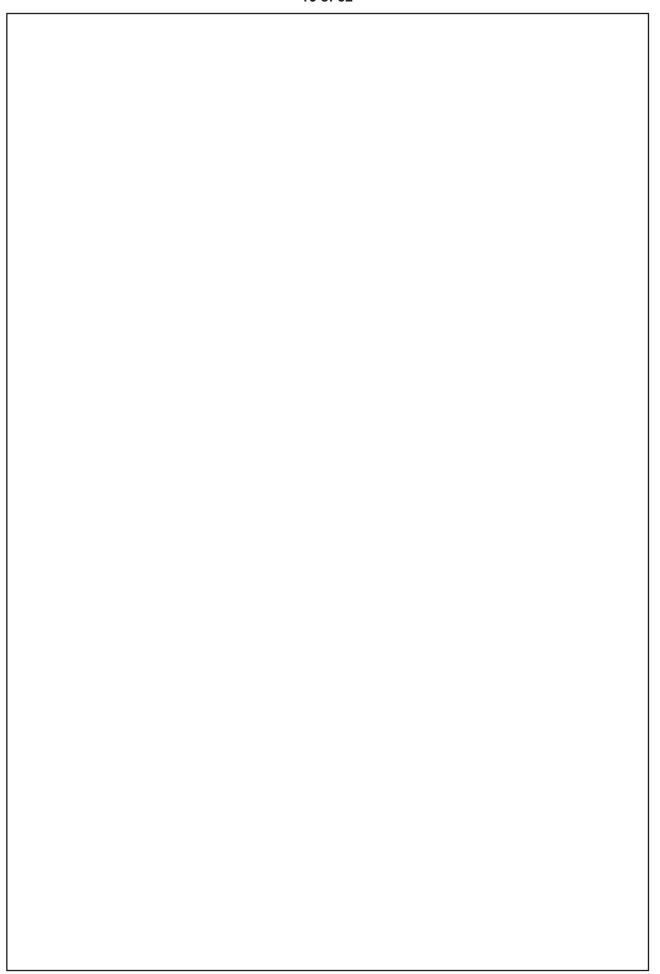
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8. (i) Solve $(x^2D^2 - xyDD' - 2y^2D'^2 + xD - 2yD')z = \log(y/x) - (1/2)$.

  (ii) Find the integral surface of the partial differential equation $(x - y)\, p + (y - x - z)\, q = z$ through the circle $z = 1$, $x^2 + y^2 = 1$. **[18]**

P.T.O.

9. A square plate is bounded by the lines x = 0, y = 0, x = 10 and y = 10. Its faces are insulated. The temperature along the upper horizontal edge is given by u(x, 10) = x (10 – x) while the other three faces are kept at 0°C. Find the steady state temperature in the plane. **[17]**
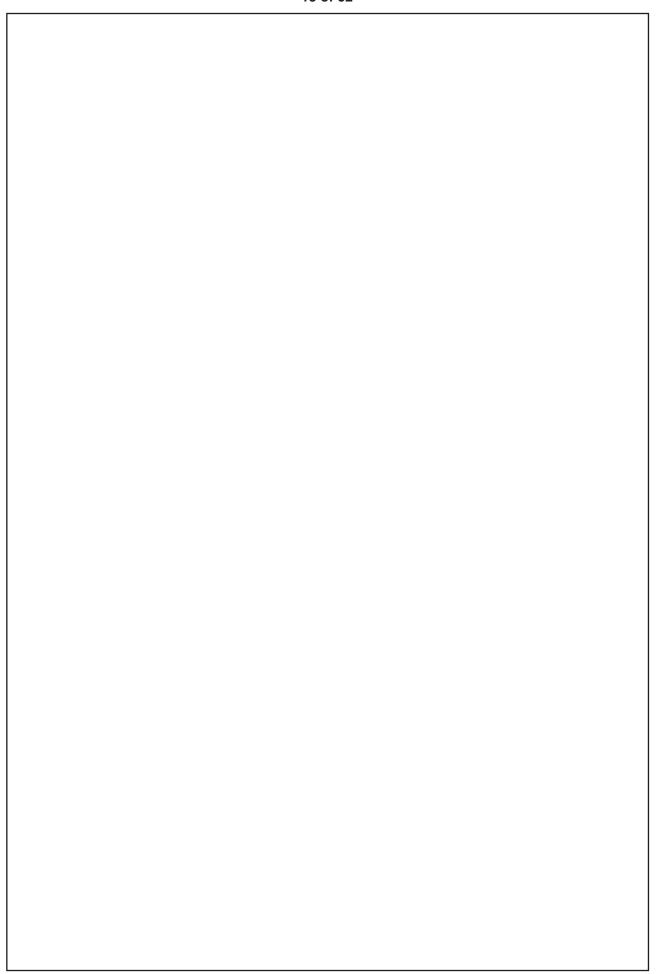
10. (i) Find a surface satisfying the equation $D^2z = 6x + 2$ and touching $z = x^3 + y^3$ along its section by the plane $x + y + 1 = 0$.

(ii) Form partial differential equation by eliminating arbitrary functions f and g from $z = f(x^2 - y) + g(x^2 + y)$.
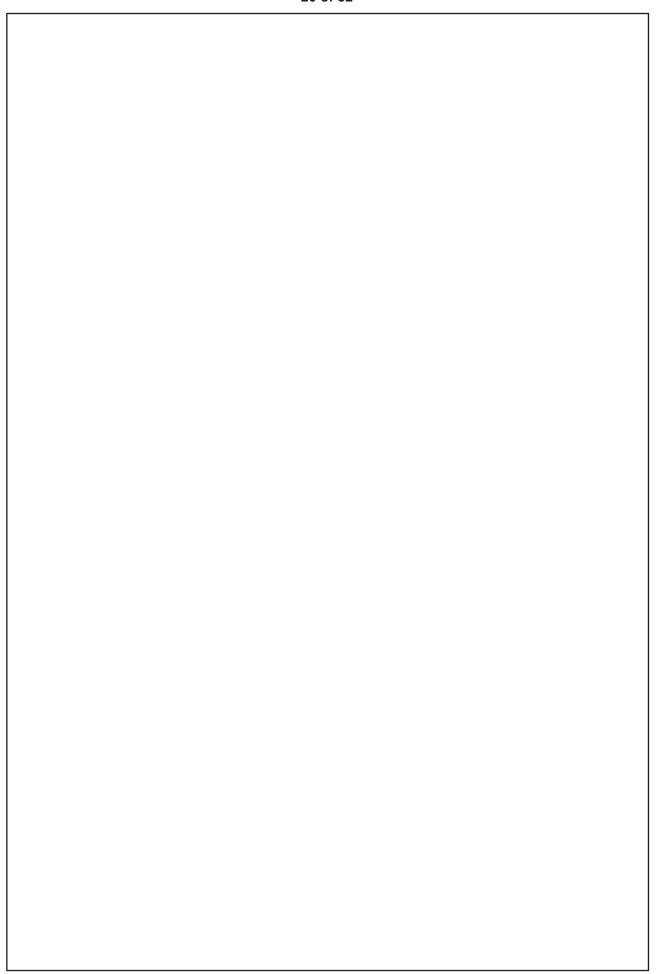
(iii) Solve $y^2p - xyq = x(z - 2y)$. **[8+5+5=18]**

11. Find the characteristic strips of the equation xp + yq – pq = 0 and then find the equation of the integral surface through the curve z = x/2, y = 0. **[18]**

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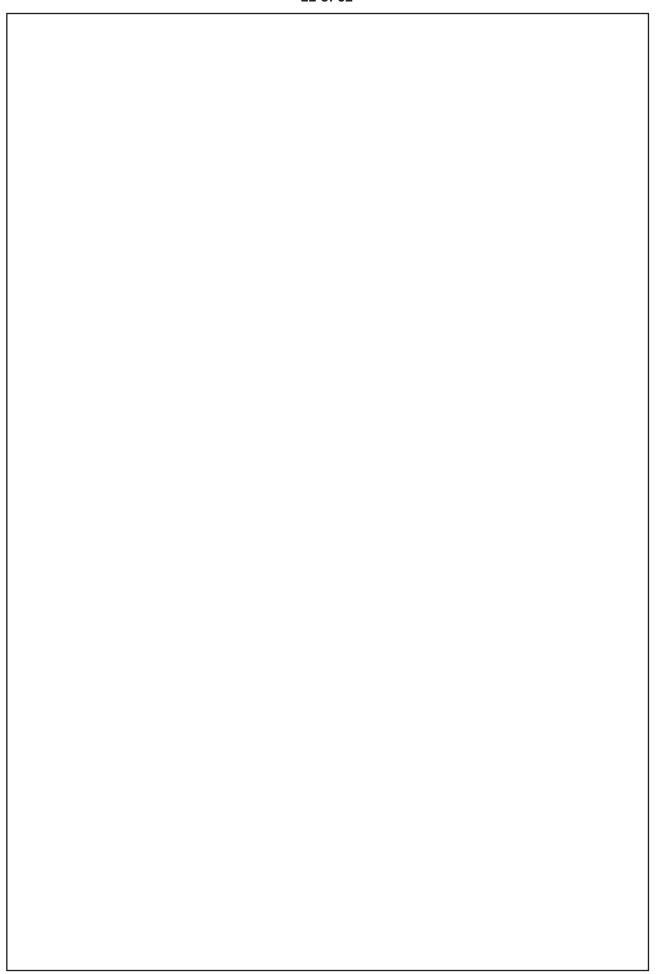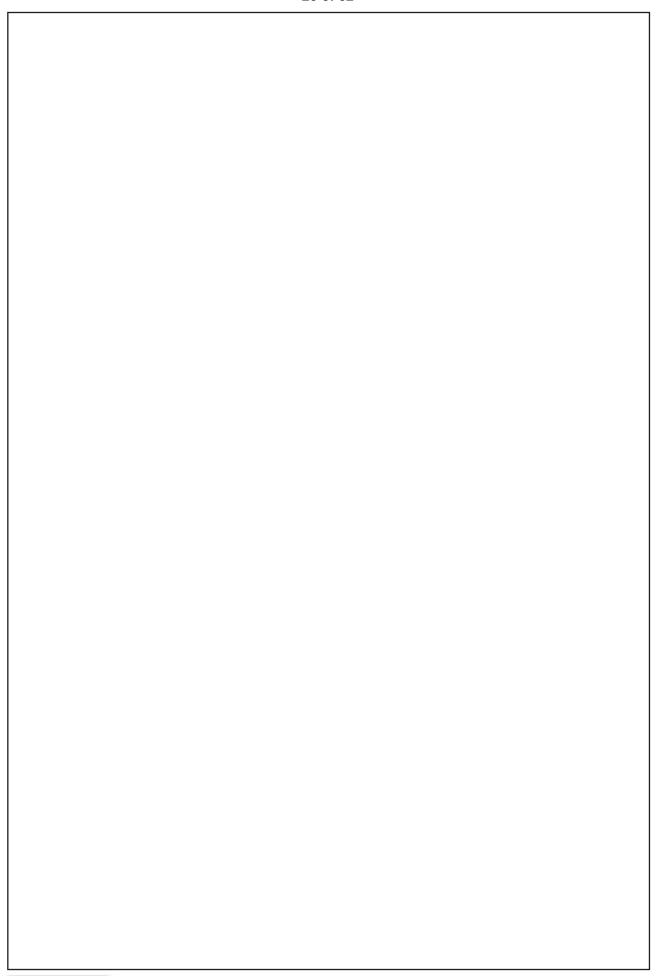www.ims4maths.com || Email: ims4maths@gmail.com

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12. (i) Find a partial differential equation by eliminating a, b, c from $x^2/a^2 + y^2/b^2 + z^2/c^2 = 1$.

(ii) Reduce the equation

$$y^2\left(\partial^2 z/\partial x^2\right) - 2xy\left(\partial^2 z/\partial x\, \partial y\right) + x^2\left(\partial^2 z/\partial y^2\right) = \left(y^2/x\right)\left(\partial z/\partial x\right) + \left(x^2/y\right)\left(\partial z/\partial y\right) \text{ to canonical}$$

form and hence solve it.

[8+16=24]

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13. (i) Form the differential equation by eliminating a and b from $z = (x^2 + a)(y^2 + b)$.

(ii) Form a partial differential equation by eliminating the function ϕ from $lx + my + nz = \phi(x^2 + y^2 + z^2)$.

(iii) Find the equation of the integral surface of the differential equation $2y(z - 3)p + (2x - z)q = y(2x - 3)$ which passes through the circle $z = 0$, $x^2 + y^2 = 2x$.

[5+5+8=18]

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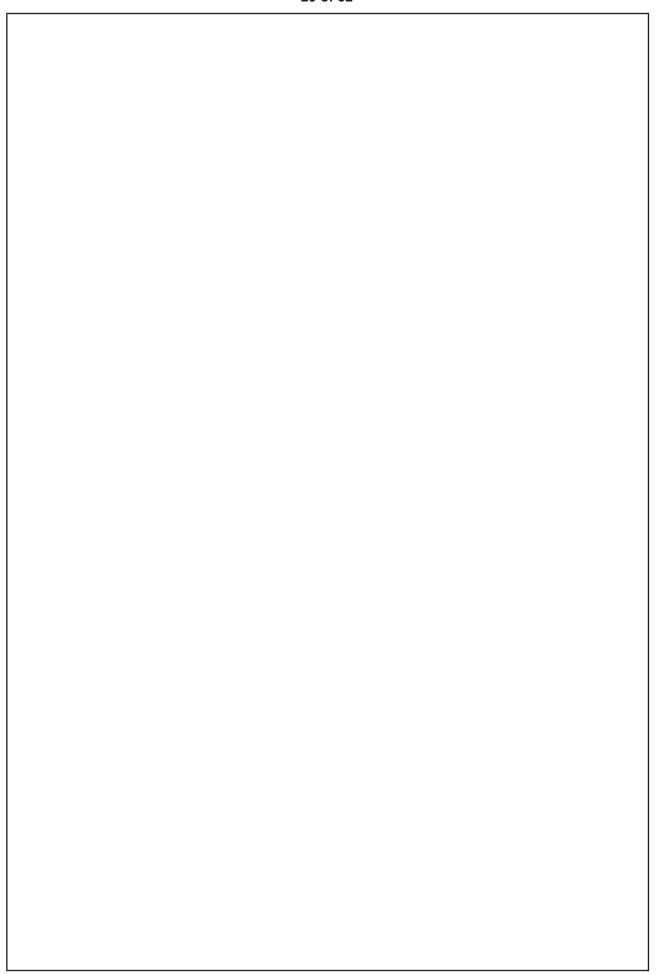**14.**   (i)   Solve $y^2(x - y)p + x^2(y - x)q = z(x^2 + y^2)$

       (ii) Solve $(\partial^2 z/\partial x^2) - (\partial^2 z/\partial y^2) + (\partial z/\partial x) + 3(\partial z/\partial y) - 2z = e^{x-y} - x^2 y$ **[6+10=16]**

P.T.O.

15. A string of length l is initially at rest in its equilibrium position and motion is started by giving each of its points a velocity v given by v = kx if $0 \leq x \leq l/2$ and v = k(l – x) if $l/2 \leq x \leq l$. Find the displacement function y(x, t). **[15]**

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