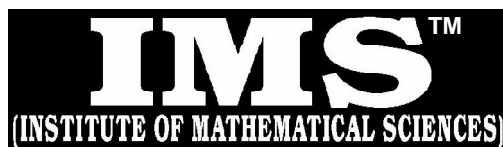


A CONSOLIDATED QUESTION PAPER-CUM-ANSWER BOOKLET



MAINS TEST SERIES-18

JUNE-2018 TO SEPT.-2018

Under the guidance of K. Venkanna

MATHEMATICS

PAPER - 2 : FULL SYLLABUS

TEST CODE: TEST-06: IAS(M)/22-JULY.-2018

Time: Three Hours

Maximum Marks: 250

INSTRUCTIONS

1. This question paper-cum-answer booklet has 50 pages and has **34 PART / SUBPART** questions. Please ensure that the copy of the question paper-cum-answer booklet you have received contains all the questions.
2. Write your Name, Roll Number, Name of the Test Centre and Medium in the appropriate space provided on the right side.
3. A consolidated Question Paper-cum-Answer Booklet, having space below each part/sub part of a question shall be provided to them for writing the answers. Candidates shall be required to attempt answer to the part/sub-part of a question strictly within the pre-defined space. Any attempt outside the pre-defined space shall not be evaluated. "
4. 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.
5. Candidates should attempt Question Nos. 1 and 5, which are compulsory, and any **THREE** of the remaining questions selecting at least **ONE** question from each Section.
6. 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.
7. Symbols/notations carry their usual meanings, unless otherwise indicated.
8. All questions carry equal marks.
9. All answers must be written in blue/black ink only. Sketch pen, pencil or ink of any other colour should not be used.
10. All rough work should be done in the space provided and scored out finally.
11. The candidate should respect the instructions given by the invigilator.
12. 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

Roll No.

Test Centre

Medium

Do not write your Roll Number or Name anywhere else in this Question Paper-cum-Answer Booklet.

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

IMPORTANT NOTE:

Whenever a question is being attempted, all its parts/ sub-parts must be attempted contiguously. This means that before moving on to the next question to be attempted, candidates must finish attempting all parts/ sub-parts of the previous question attempted. This is to be strictly followed. Pages left blank in the answer-book are to be clearly struck out in ink. Any answers that follow pages left blank may not be given credit.

**DO NOT WRITE ON
THIS SPACE**

INDEX TABLE

QUESTION	No.	PAGENO.	MAX.MARKS	MARKS OBTAINED
1	(a)			
	(b)			
	(c)			
	(d)			
	(e)			
2	(a)			
	(b)			
	(c)			
	(d)			
3	(a)			
	(b)			
	(c)			
	(d)			
4	(a)			
	(b)			
	(c)			
	(d)			
5	(a)			
	(b)			
	(c)			
	(d)			
	(e)			
6	(a)			
	(b)			
	(c)			
	(d)			
7	(a)			
	(b)			
	(c)			
	(d)			
8	(a)			
	(b)			
	(c)			
	(d)			
Total Marks				

**DO NOT WRITE ON
THIS SPACE**

SECTION – A

1. (a) Union of two subgroups is a subgroup iff one of them is contained in the other. **[10]**

1. (b) Let R be the ring of 3×3 matrices over reals. Show that $S = \left\{ \begin{bmatrix} x & x & x \\ x & x & x \\ x & x & x \end{bmatrix} \mid x \text{ real} \right\}$

is a subring of R and has unity different from unity of R .

[10]

1. (c) Prove that every infinite bounded subset of real numbers has a limit point. [10]

1. (d) Use Cauchy's theorem/Cauchy integral formulae evaluate

(i) $\int_C \frac{z-1}{(z+1)^2(z-2)} dz$ where $C : |z-i| = 2$ (ii) $\int_C \frac{\sin^6 z}{\left(z - \frac{\pi}{6}\right)^3} dz$ where C is the circle $|z| = 1$

[10]

1. (e) Write the dual of the following problem.

Min. $z = x_1 + x_2 + x_3$, subject to the constraints :

$x_1 - 3x_2 + 4x_3 = 5$, $x_1 - 2x_2 \leq 3$, $2x_2 - x_3 \geq 4$; $x_1, x_3 \geq 0$ and x_2 is unrestricted.

[10]

2. (a) Let H be a subgroup of a group G . Then $W = \bigcap_{g \in G} gHg^{-1}$ is a normal subgroup of G . [15]

2. (b) If $f(x + y) = f(x) + f(y)$ for all $x, y \in \mathbb{R}$ and f is continuous at a point of \mathbb{R} , prove that f is uniformly continuous on \mathbb{R} . **[15]**

2. (c) The integral function $f(z)$ satisfies everywhere the inequality $|f(z)| \leq A|z|^k$ where A and k are positive constants. Prove that $f(z)$ is a polynomial of degree not exceeding k . **[06]**

2. (d) Prove that

$$\int_0^{2\pi} \frac{\cos^2 3\theta}{1 - 2p \cos 2\theta + p^2} d\theta = \pi \frac{1 - p + p^2}{1 - p}, 0 < p < 1.$$

[14]

3. (a) (i) If in a ring R , with unity, $(xy)^2 = x^2 y^2$ for all $x, y \in R$ then show that R is commutative.
- (ii) Show that the ring R of real valued continuous functions on $[0, 1]$ has zero divisors.

[9 + 9 = 18]

3. (b) For the series $\sum_1^{\infty} f_n(x)$ where

$$f_n(x) = n^2 x e^{-n^2 x^2} - (n-1)^2 x e^{-(n-1)^2 x^2}, \quad x \in [0, 1]$$

show that $\sum_1^{\infty} \int_0^1 f_n(x) dx \neq \int_0^1 \left(\sum_1^{\infty} f_n(x) \right) dx$.

Is the series $\sum_1^{\infty} f_n(x)$ uniformly convergent on $[0, 1]$?

[15]

3. (c) Using the simplex method solve the LPP problem: Minimize $z = x_1 + x_2$, subject to $2x_1 + x_2 \geq 4$, $x_1 + 7x_2 \geq 7$, and $x_1, x_2 \geq 0$. **[17]**

4. (a) If R and S are two rings, then
 $\text{ch}(R \times S) = 0$ if $\text{ch } R = 0$ or $\text{ch } S = 0$
 $= k$ where $k = \text{l.c.m.}(\text{ch } R, \text{ch } S)$

[15]

4. (b) A function f is defined on $[0, 1]$ by $f(0) = 0$ and $f(x) = 0$, if x be irrational

$$= \frac{1}{q}, \text{ if } x = \frac{p}{q} \text{ where } p, q \text{ are positive integers prime to each other.}$$

Show that f is integrable on $[0, 1]$ and $\int_0^1 f = 0$.

[13]

4. (c) If $w = u + iv$ represents the complex potential for an electric field and

$$v = x^2 - y^2 + \frac{x}{x^2 + y^2}, \text{ determine the function } u. \quad [12]$$

4. (d) A methods Engineer wants to assign four new methods to three work centres. The assignment of the new methods will increase production and they are given below. If only one method can be assigned to a work centre, determine the optimum assignment :

		Increase in production(unit)		
Method		Work centres		
		A	B	C
	1	10	7	8
	2	8	9	7
	3	7	12	6
	4	10	10	8

[10]

SECTION – B

5. (a) Find the general integral of the partial differential equation $(2xy - 1) p + (z - 2x^2) q = 2(x - yz)$ and also the particular integral which passes through the line $x = 1, y = 0$. **[10]**

5. (b) Find complete integral of $(x^2 - y^2) pq - xy(p^2 - q^2) = 1$.

[10]

5. (c) Given that $f(0) = 1$, $f(1) = 3$, $f(3) = 55$, find the unique polynomial of degree 2 or less, which fits the given data. find the bound on the error. **[10]**

5. (d) (i) Implement $Y = \bar{A}B + A\bar{B}$ using NAND gates only
(ii) Find the hexadecimal equivalent of the decimal number $(587632)_{10}$. [10]

5. (e) Prove that the necessary and sufficient condition that vortex lines may be at right angles to the streamlines are $\mu, v, w = \mu \left(\frac{\partial \psi}{\partial x}, \frac{\partial \psi}{\partial y}, \frac{\partial \psi}{\partial z} \right)$, where μ and ϕ are functions of x, y, z, t . [10]

6. (a) Solve $(D^2 - DD' - 2D'^2) z = (2x^2 + xy - y^2) \sin xy - \cos xy$.

[10]

6. (b) Find a partial differential equation by eliminating a, b, c from $x^2/a^2 + y^2/b^2 + z^2/c^2 = 1$. **[07]**

6. (c) The equation $x^2 + ax + b = 0$ has two real roots α and β . Show that the iteration method

$$x_{k+1} = -(ax_k + b)/x_k$$

is convergent near $x = \alpha$ if $|\alpha| > |\beta|$ and that

$$x_{k+1} = -b/(x_k + a)$$

is convergent near $x = \alpha$ if $|\alpha| < |\beta|$.

Show also that the iteration method

$$x_{k+1} = -(x_k^2 + b)/a$$

is convergent near $x = \alpha$ is $2|\alpha| < |\alpha + \beta|$.

[15]

6. (d) Two equal rods AB and BC, each of length l smoothly joined at B are suspended from A and oscillate in a vertical plane through A. Show that the periods of normal oscillations are $\frac{2\pi}{n}$, where $n^2 = \left(3 \pm \frac{6}{\sqrt{7}}\right) \frac{g}{l}$. **[18]**

7. (a) Reduce the equation $yr + (x + y)s + xt = 0$ to canonical form and hence find its general solution. **[15]**

7. (b) Find the inverse of

$$A = \begin{bmatrix} 1 & 1 & 1 \\ 4 & 3 & -1 \\ 3 & 5 & 3 \end{bmatrix}$$

by Gauss-Jordan method.

[10]

7. (c) The velocity of a train which starts from rest is given in the following table. The time is in minutes and velocity is in km/hour.

t	2	4	6	8	10	12	14	16	18	20
v	16	28.8	40	46.4	51.2	32.0	17.6	8	3.2	0

Estimate approximately the total distance run in 30 minutes by using composite

simpson's $\frac{1}{3}$ rule.

[10]

7. (d) A sphere of radius a and mass M rolls down a rough plane inclined at an angle α to the horizontal.

If x be the distance of the point of contact of the sphere from a fixed point on the plane, find the acceleration by using Hamilton's equations. **[15]**

8. (a) The ends A and B of a rod 20 cm long have the temperature at 30° and 80° until steady state prevails. The temperatures of the ends are changed to 40° and 60° respectively. Find the temperature distribution in the rod at time t .

[18]

8. (b) Solve the initial value problem

$$u' = -2tu^2, u(0) = 1$$

with $h = 0.2$ on the interval $[0, 0.4]$. Use the fourth order classical Runge-Kutta method. compare with the exact solution. **[15]**

8. (c) Prove that liquid motion is possible when velocity at (x, y, z) is given by

$u = \frac{3x^2 - r^2}{r^5}, v = \frac{3xy}{r^5}, w = \frac{3xz}{r^5}$, where $r^2 = x^2 + y^2 + z^2$ and the stream lines are the intersection of the surfaces, $(x^2 + y^2 + z^2)^3 = c(y^2 + z^2)^2$, by the planes passing through Ox. Is this irrotational?

[17]

END OF THE EXAMINATION

ROUGH SPACE



OUR ACHIEVEMENTS IN IFoS (FROM 2008 TO 2017)

OUR RANKERS AMONG TOP 10 IN IFoS



PRATAP SINGH
AIR-01
IFoS-2015



PRATEEK JAIN
AIR-03
IFoS-2016



SIDHARTHA GUPTA
AIR-03
IFoS-2014



VARUN GUNTUPALLI
AIR-04
IFoS-2014



TESWANG GYALTSEN
AIR-04
IFoS-2010



DESHAL DAN
AIR-05
IFoS-2017



PARTH JAISWAL
AIR-05
IFoS-2014



HIMANSHU GUPTA
AIR-05
IFoS-2011



ASHISH REDDY MV
AIR-06
IFoS-2015



ANUPAM SHUKLA
AIR-07
IFoS-2012



HARSHVARDHAN
AIR-10
IFoS-2017



P.V.S. REDDY
AIR-22
IFoS-2017



PRAKHAR GUPTA
AIR-23
IFoS-2017



SUNNY K. SINGH
AIR-24
IFoS-2017



SITANSHU PANDEY
AIR-25
IFoS-2017



G. ROHITH
AIR-35
IFoS-2017



SUNIL SHRIVASTAVA
AIR-36
IFoS-2017



VASU DUGGAR
AIR-40
IFoS-2017



SACHIN GUPTA
AIR-45
IFoS-2017



ANKIT KUMAR
AIR-51
IFoS-2017



RISHAL GARG
AIR-58
IFoS-2017



RAHUL K. JADHAV
AIR-68
IFoS-2017



PRINCE KUMAR
AIR-80
IFoS-2017



DHARMVEER DAIRI
AIR-93
IFoS-2017



NAVDEEP AGGARWAL
AIR-21
IFoS-2016



PRAVEEN VERMA
AIR-22
IFoS-2016



SAURABH
AIR-23
IFoS-2016



DIPESH MALHOTRA
AIR-30
IFoS-2016



MANISH K. S.
AIR-31
IFoS-2016



ASHUTOSH SINGH
AIR-32
IFoS-2016



RAJAT KUMAR
AIR-35
IFoS-2016



PIYUSH B.
AIR-36
IFoS-2016



AYUSH JAIN
AIR-48
IFoS-2016



RAHUL SHINDE
AIR-57
IFoS-2016



RAHUL KUMAR
AIR-58
IFoS-2016



SANGEETA MAHALA
AIR-68
IFoS-2016



PUNIT SOMKAR
AIR-98
IFoS-2016



HIMANSHU P.
AIR-108
IFoS-2016



SIDHARTHA JAIN
AIR-13
IFoS-2015



AKSHAY GODARA
AIR-15
IFoS-2015



MANISHA RANA
AIR-19
IFoS-2015



RAJEEV RANJAN
AIR-29
IFoS-2015



VIJAY SHANKAR P.
AIR-30
IFoS-2015



MD. ADIL ASHRAF
AIR-48
IFoS-2015



MAHATM YADAV
AIR-62
IFoS-2015



KUNAL DUDAWAT
AIR-67
IFoS-2015



RAJ KUMAR
AIR-72
IFoS-2015



SUMIT KUMAR
AIR-74
IFoS-2015



NITHAN RAJ T
AIR-78
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AIR-87
IFoS-2015



KHAGESH PEGU
AIR-93
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ANIKET SINGH
AIR-101
IFoS-2015



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AIR-13
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JAI YADAV
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 SUNEEL S. AIR-250 (2017)	 NIKHIL BANSAL AIR-255 (2017)	 AVINASH C. S. AIR-391 (2017)	 PRABEEN CHANDRA AIR-512 (2017)	 DALIP KUMAR AIR-609 (2017)	 PRINCE KUMAR AIR-772 (2017)	 UTSAV KAUSHAL AIR-14 (2016)	 MANISH GURWANI AIR-18 (2016)	 AKSHAY GODARA AIR-40 (2016)	 SWAPNIL KHARE AIR-43 (2016)	 VIKALP BHARGAVA AIR-85 (2016)	 VARUN SINGLA AIR-114 (2016)	 MANI AGARWAL AIR-126 (2016)	 SHASHANK C. AIR-130 (2016)
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