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: PDE, NA, CP, MECHANICS AND FLUID DYNAMICS

TEST CODE: TEST-04: IAS(M)/01-JULY.-2018

Time: Three Hours Maximum Marks: 250

INSTRUCTIONS

- 1. This question paper-cum-answer booklet has <u>50</u> pages and has
 - 3 <u>2PART/SUBPART</u> questions. Please ensure that the copy of the question paper-cum-answer booklet you have received contains all the questions.
- 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/subpart 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.
- 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.
- 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.
- All questions carry equal marks.
- 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.
- 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.

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

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INDEX TABLE

| QUESTION | No. | PAGENO. | MAX.MARKS | MARKS OBTAINED |
|----------|-----|---------|-------------|----------------|
| 1 | (a) | | | |
| | (b) | | | |
| | (c) | | | |
| | (d) | | | |
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| 2 | (a) | | | |
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| 6 | (a) | | | |
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| 7 | (a) | | | |
| | (b) | | | |
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| 8 | (a) | | | |
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| 1. | (a) | Solve the following differential equation: | |
|----|-----|--|------|
| | | $(D^3 - 4D^2 D' + 5DD'^2 - 2D'^3) z = e^{y+2x} + (y+x)^{1/2}.$ | [10] |

| 1. | (b) | Find a complete integral of $px+qy=z(1+pq)^{1/2}$. | 10] |
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| 1. | (c) | Find the positive root of the equation $10 \int_{0}^{\infty} e^{-x^2} dt - 1 = 0$ correct up to 6 of | decimal |
|----|-----|--|----------|
| | | places by using Newton-Raphson method. Carry out computations of | only for |
| | | three iterations. | [10] |



| 1. | (d) | Construct a swi | itching ta | able i | for | each | of | the | switching | function | represented |
|----|-----|------------------|------------|--------|------|-------|----|-----|-----------|----------|-------------|
| | | by the following | g Boolean | expr | ress | sion. | | | | | |

- (i) x'yz + yz'
- (ii) x' (yz + y')

(iii) xz + yz' + x'y

[10]

| 1. | (e) | Find the M.I. of a right solid cone of mass M. height h and radius of whose base is a, about its axis. [10] |
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| 2. | (a) | 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 ? [08] |
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| 2. | (b) | Find the surface whose tangent planes cut off an intercept of constant k from the axis of z. | t length [12] |
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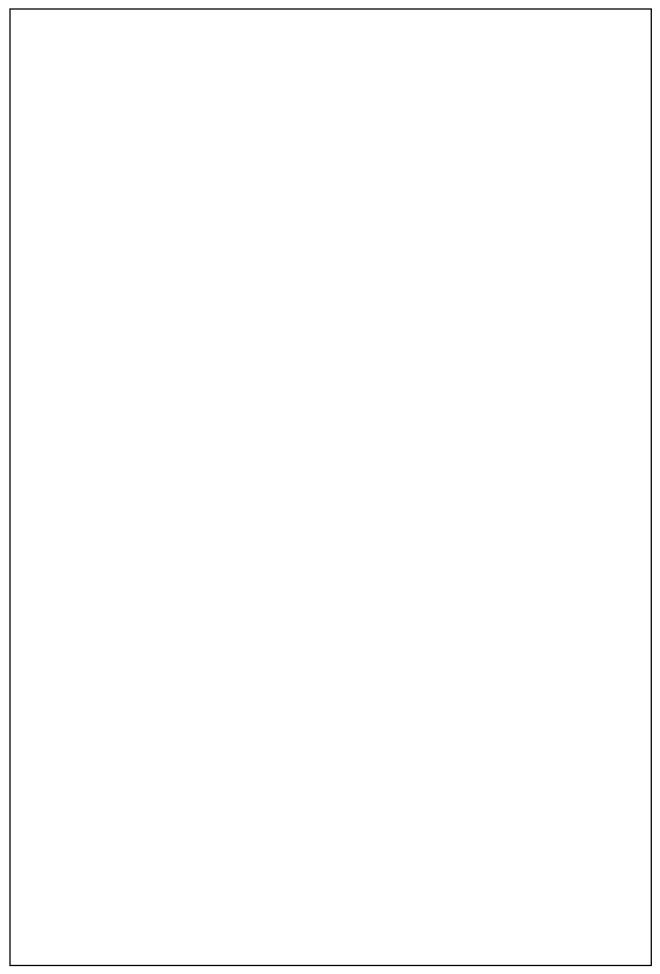
(c) A reservoir discharging water through sluices at a depth h below the water surface has a surface area A for various values of h as given below

| h(ft): | 10 | 11 | 12 | 13 | 14 |
|-----------|-----|------|------|------|------|
| A(sq.ft): | 950 | 1070 | 1200 | 1350 | 1530 |

If t denotes time in minutes, the rate of fall of the surface is given by dh/dt = $-48\sqrt{h} / A$.

Estimate the time taken for the water level to fall from 14 to 10 ft. above the sluices. [15]

| 2. | (d) | Use hamilton's space. | equations | to find | the | equations | of motion | n of a p | projectile [15] | in |
|----|-----|-----------------------|-----------|---------|-----|-----------|-----------|----------|-----------------|----|



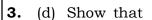
| 3. | (a) | Reduce the equation $x^2r - 2xys + y^2t - xp + 3yq = 8y/x$ to canonical for | m. |
|----|-----|---|------|
| | ` , | | [15] |
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| 3. | (b) | Using | Newton's | forward | interpolation | formula, | show | that |
|----|-----|-------|----------|---------|---------------|----------|------|------|
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$$\sum n^3 = \left\{ \frac{n(n+1)}{2} \right\}^2.$$

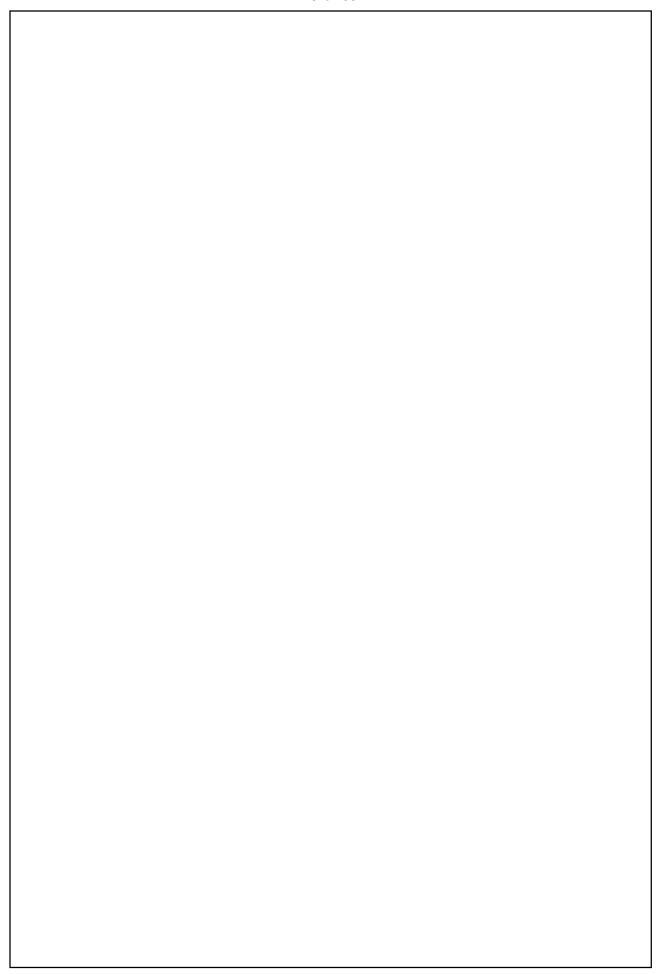
[10]

| 3. | (c) | Use only AND expression z = | gates to | construct a | logic circui | it for the | Boolean [10] |
|----|-----|-----------------------------|----------|-------------|--------------|------------|-----------------|

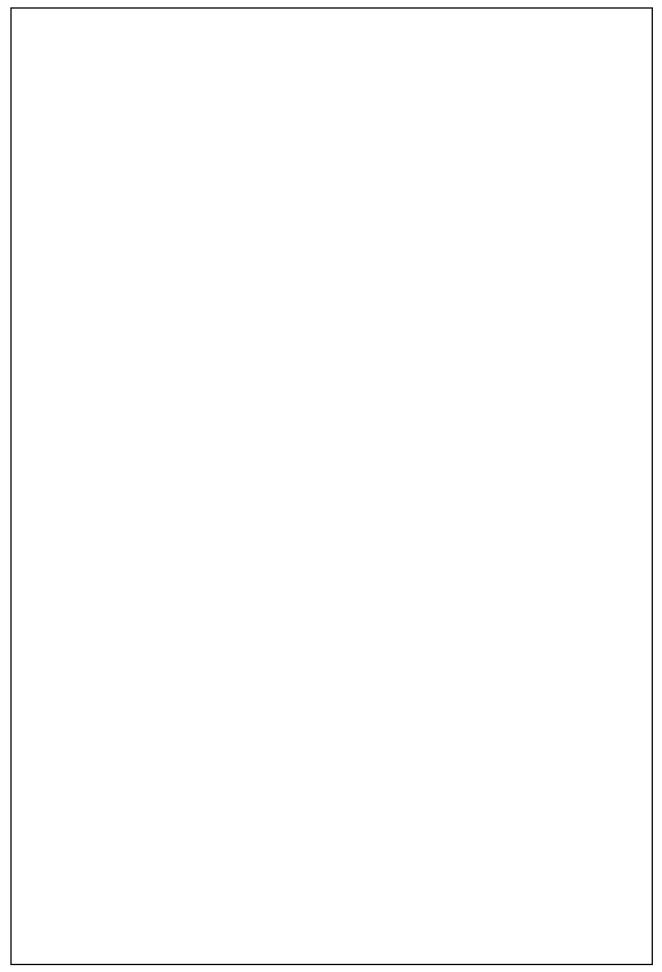


$$u = -\frac{2xyz}{(x^2 + y^2)^2}, v = \frac{(x^2 - y^2)z}{(x^2 + y^2)^2}, w = \frac{y}{x^2 + y^2}$$

are the velocity components of a possible liquid motion. Is this motion irrotational? [15]



| 4. | (a) | A string is stretched and fastened to two points <i>l</i> 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. [15] |
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| 4. (b) | Solve $20x + y - 2z =$ method. | 17; 3x + 20y - z | x = -18; $2x - 3y - 3$ | + 20z = 25 by G | auss seidal [15] |
|---------------|--------------------------------|------------------|--|-----------------|---------------------|



| 4. | (C) | along generators of a circular cylinder of radius a in an infinite | 5 |
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| | | Ç Ç | |
| | | that the vortices will move round the cylinder uniformly in time | $\frac{8\pi^2a^2}{(n-1)k}, \text{ and}$ |
| | | find the velocity at any point of the liquid. | [20] |



| | | | 26 of 50 | |
|----|-----|-------|--|------|
| | | | SECTION - B | |
| 5. | (a) | Solve | $(x^2D^2-xyDD'-2y^2D'^2+xD-2yD')z=log(y/x)-(1/2).$ | [10] |
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| 5. | (b) | Use Euler's method with step size $h = 0.15$ to compute the approximate of $y(0.6)$, correct up to five decimal places from the initial value problem | | | | | | |
| | | y' = x(y + x) - 2 y(0) = 2 | | | | | | |
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| 5. | (c) | (i) F | for any Bo | olean variabl | es x and v | r. show tha | t x + xv = x. | [10] |
|----|-----|-------|------------|---------------|------------|-------------|---------------|------|

(ii) Write the dual of each Boolean expression

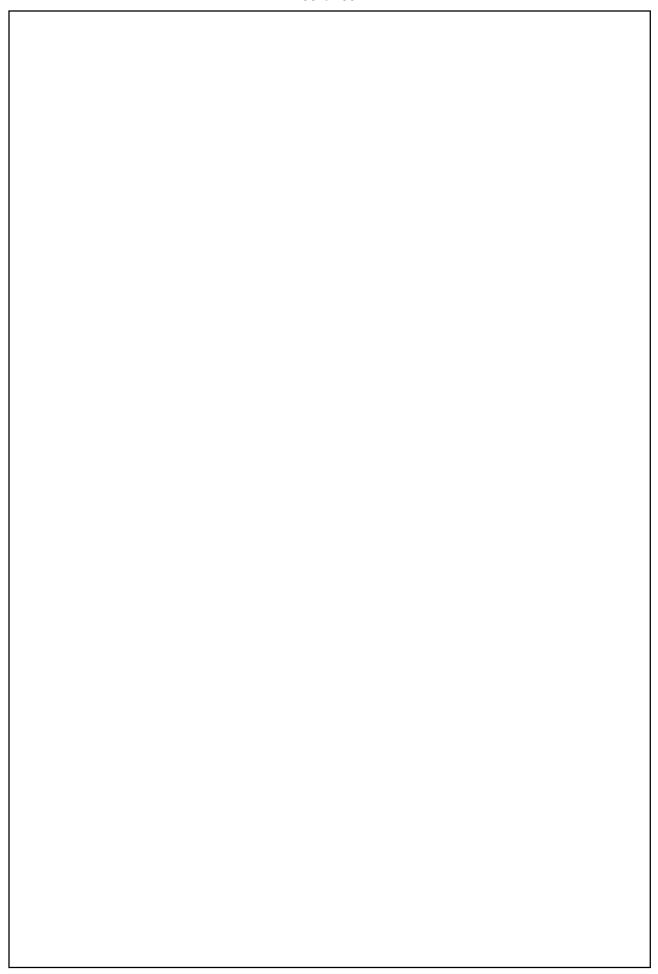
- (a) a(a'+b)=ab
- (b) (a+1)(a+0)=a,
- (c) (a+b)(b+c)=ac+b.

| 5. | (d) | Write the Hamiltonian pendulum. | function | and | equation | of motion | of the | compound [10] |
|----|-----|---------------------------------|----------|-----|----------|-----------|--------|---------------|

| 5. | (e) | Determine the streamlines and the path of the particles $u = x/(1 + t)$, $v = y/(1 + t)$, $w = z/(1 + t)$. | [10 | j |
|----|-----|---|-----|---|
| | | | | |

| 6. | (a) | Find the z) $q = z$ th | integral sur rough the o | rface of the circle z = 1, | partial difference $\mathbf{x}^2 + \mathbf{y}^2 = 1$ | ferential eq | uation (x – y |) p + (y - x - [10] |
|----|-----|---------------------------|-----------------------------|-------------------------------|--|--------------|---------------|------------------------|
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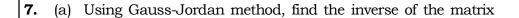
| 6. | (b) | Determine the characteristics of the equation $z=p^2-q^2$ and find the integral surface which passes through the parabola $4z+x^2=0$, $y=0$. [20] |
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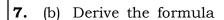
| | (-) | Died the stade state towns outers distribution in the state to the |
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| 6. | (c) | Find the steady state temperature distribution in a thin rectangular plate |
| | | bounded by the lines $x = 0$, $x = a$, $y = 0$, $y = b$. The edges $x = 0$, $x = a$. $y = 0$ are kept at temperature zero while the edge $y = b$ is kept at 100° C. [20] |
| | | kept at temperature zero wille the edge y - b is kept at 100°C. |
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$$\begin{bmatrix} 1 & 1 & 3 \\ 1 & 3 & -3 \\ -2 & -4 & -4 \end{bmatrix}$$

[08]



$$\int_{a}^{b} y dx = \frac{h}{3} \left[(y_0 + y_n) + 4(y_1 + y_3 + \dots + y_{n-1}) + 2(y_2 + y_4 + \dots + y_{n-2}) \right]$$

Is there any restriction on n? State that condition. What is the error bound

in the case of simpson's $\frac{1}{3}$ rule?

[16]



| (c) | Apply Runge-Kutta method of order 4 to find approximate value of y for $x = 0.2$, in steps of 0.1, if $dy/dx = x + y^2$, given that $y = 1$ where $x = 0$. [12] |
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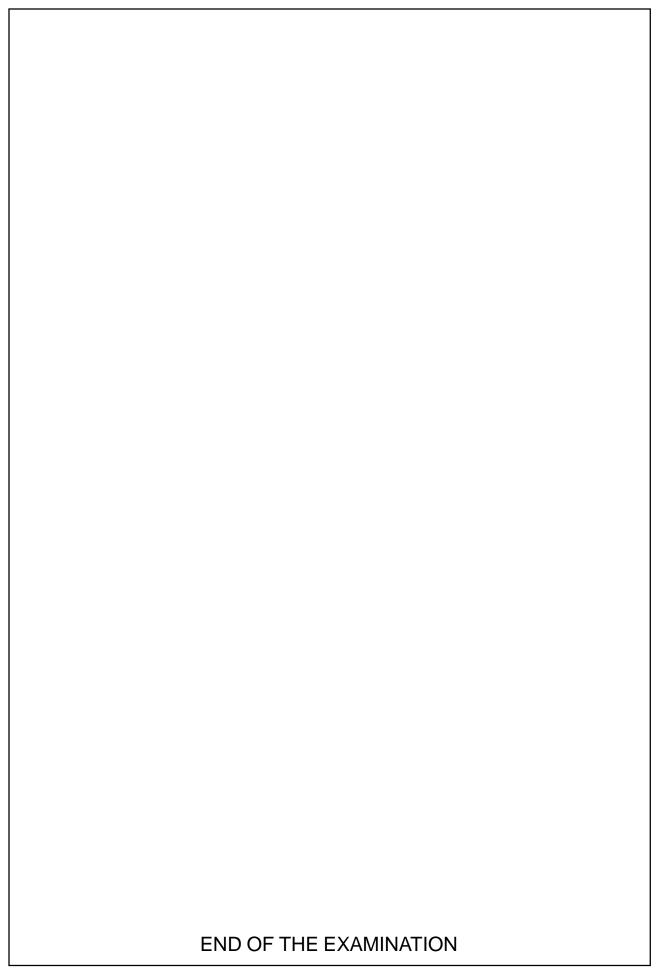
| 7. | (d) | Draw a | flow | chart | for | Lagrange's | interpolation | method. | [14] |
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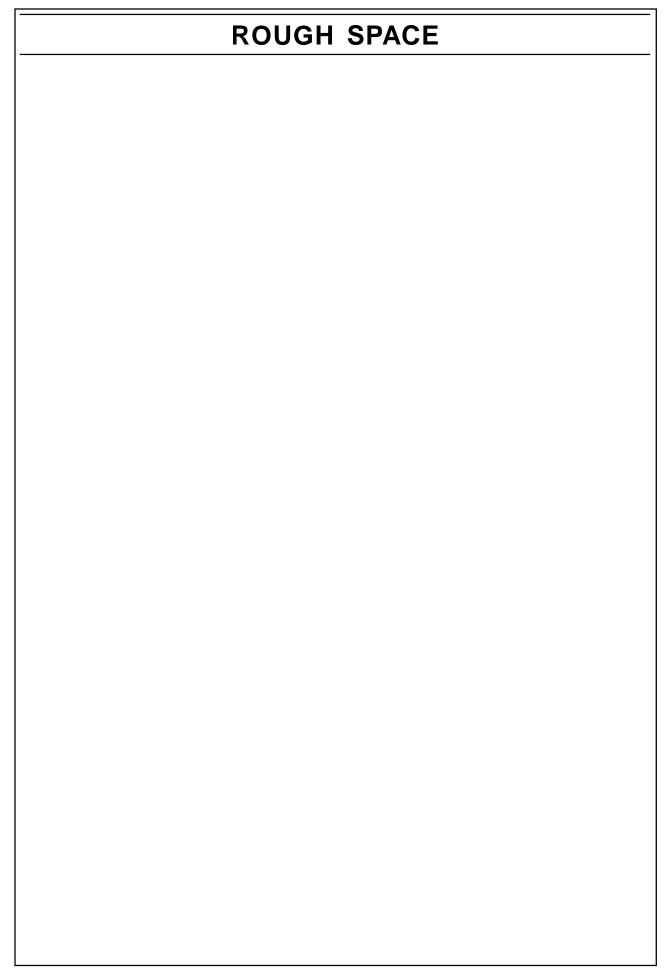
| 8. | (a) | A homogeneous sphere of radiusa, rotating with angular velocity ω about horizontal diameter is gently placed on a table whose coefficient of friction is μ . show that there will be slipping at the point of contact for a time $(2a\omega/7\mu g)$. and that then the sphere will roll with angular velocity $(2\omega/7)$. [16] |
|----|-----|---|



| 8. | (b) | A uniform straight rod of length 2a is freely movable about its centre and a |
|----|-----|--|
| | | particle of mass one-third that of the rod is attached by a light inextensible string of length a to one end of the rod; show that one period of principal oscillation is $(\sqrt{5} + l)$ p $\sqrt{(a/g)}$. [18] |
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| 8. | (c) | A source of fluid situated in space of two dimensions is of such strength that $2\pi\rho\mu$ represents the mass of fluid of density ρ emitted per unit of time. Show that the force necessary to hold a circular disc at rest in the plane of source is |
|----|-----|---|
| | | $2\pi\rho\mu^2 \ a^2/r \ (r^2 - a^2),$ |
| | | where a is the radius of the dise and r the distance of the source from its centre. In what direction is the disc urged by the pressure? [16] |
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OUR RANKERS AMONG TOP 10 IN IFoS



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AIR-03 IFoS-2014



AIR-04 IFoS-2014



TESWANG GYALTSON AIR-04 IFoS-2010



AIR-05 IFoS-2017



PARTH IAISWAL AIR-05



HIMANSHU GUPTA AIR-05



ASHISH REDDY MV **AIR-06**



ANUPAM SHUKLA AIR-07



HARSHVARDHAN AIR-10 IFoS-2017





SUNNY K. SINGH SITANSHU PANDEY AIR-25 IFoS-2017





VASU DOEGAR AIR-40 IFoS-2017



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AIR-29 IFoS-2013























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