PHE-05

ASSIGNMENT BOOKLET
Bachelor's Degree Programme (B.Sc.)

MATHEMATICAL METHODS IN PHYSICS-II

Valid from January 1, 2020 to December 31, 2020

It is compulsory to submit the Assignment before filling in the Term-End Examination Form.

Please Note

- **You can take electives (56 or 64 credits) from a minimum of TWO and a maximum of FOUR science disciplines, viz. Physics, Chemistry, Life Sciences and Mathematics.**
- **You can opt for elective courses worth a MINIMUM OF 8 CREDITS and a MAXIMUM OF 48 CREDITS from any of these four disciplines.**
- **At least 25% of the total credits that you register for in the elective courses from Life Sciences, Chemistry and Physics disciplines must be from the laboratory courses. For example, if you opt for a total of 64 credits of electives in these 3 disciplines, at least 16 credits out of those 64 credits should be from lab courses.**
- **You cannot appear in the Term-End Examination of any course without registering for the course. Otherwise, your result will not be declared and the responsibility will be yours.**

School of Sciences
Indira Gandhi National Open University
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2020

Dear Student,

We hope you are familiar with the system of evaluation to be followed for the Bachelor's Degree Programme. At this stage you may probably like to re-read the section on assignments in the Programme Guide for Elective Courses that we sent you after your enrolment. A weightage of 30 per cent, as you are aware, has been earmarked for continuous evaluation which would consist of **one tutor-marked assignment** for this course.

Instructions for Formatting Your Assignments

Before attempting the assignment please read the following instructions carefully.

1) On top of the first page of your TMA answer sheet, please write the details exactly in the following format:

ENROLMENT NO. : ……

NAME : ……

ADDRESS : ……

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COURSE CODE : ……..

COURSE TITLE : ……..…….

ASSIGNMENT NO. : ……..…

STUDY CENTRE : ……..……. DATE : ….……

PLEASE FOLLOW THE ABOVE FORMAT STRICTLY TO FACILITATE EVALUATION AND TO AVOID DELAY.

2) Use only foolscap size writing paper (but not of very thin variety) for writing your answers.

3) Leave 4 cm margin on the left, top and bottom of your answer sheet.

4) Your answers should be precise.

5) While solving problems, clearly indicate the question number along with the part being solved. Be precise. Write units at each step of your calculations as done in the text because marks will be deducted for such mistakes. Take care of significant digits in your work. Recheck your work before submitting it.

6) **This assignment will remain valid from January 1, 2020 to December 31, 2020**. However, you are advised to submit it within **12 weeks** of receiving this booklet to accomplish its purpose as a teaching-tool.

We strongly feel that you should retain a copy of your assignment response to avoid any unforeseen situation and append, if possible, a photocopy of this booklet with your response.

We wish you good luck.

Tutor Marked Assignment
MATHEMATICAL METHODS IN PHYSICS-II

Course Code: PHE-05
Assignment Code: PHE-05/TMA/2020
Max. Marks: 100

Note: Attempt all questions. Symbols have their usual meanings. The marks for each question are indicated against it.

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1. Solve the following ordinary differential equations:

   i) $(4x^3y^3+\frac{1}{x})dx+(3x^4y^2-\frac{1}{y})dy=0$

   ii) $3x\frac{dy}{dx}-y=\ln x+2;\quad$ for $x(1)=-3$

   iii) $\frac{d^2y}{dx^2}+2\frac{dy}{dx}+5y=5x^2+12$ (5+10+10)

2. The rate of change of temperature of an object is proportional to the difference between the temperature of the object and its environment. A glass of hot water at a temperature of 70ºC is kept in a room which is at a temperature of 30 ºC. If after 3 minutes the temperature of the water is 50 ºC, what will be its temperature after 5 minutes? (10)

3. A beam of length 10.0 m is supported at its ends and weighs 100 kg/m. The ODE governing the deflection y of the beam is:

   $$Cy''=100\left(\frac{x^2}{2}-5x\right)$$

   where C is a constant. Solve this equation to determine the deflection at x=6.0 m , given that

   $y=0$ at $x=0$ and $x=10.$ (10)

4. Use the Frobenius method to obtain the indicial equation and its roots for the following ODE:

   $$x^2y''+x\left(x-\frac{1}{2}\right)y'+\frac{1}{2}y=0$$ (10)

5. a) Show that

   $$u=Ce^{(1-n^2\pi^2)t}\sin(n\pi x)$$

   is a solution of the equation:

   $$\frac{\partial u}{\partial t}=\frac{\partial^2 u}{\partial x^2}+u$$ (5)

   b) Determine all the first and second order partial derivatives for the function:

   $$u\,(x,\,y)=y^3+\cos(x^2y)$$ (10)

6. Write down the equation

$$\partial^2 u / \partial t^2 = c^2 \, \nabla^2 u$$

in plane polar coordinates. By the method of separation of variables, reduce the PDE so obtained to a set of two ODEs. (10)

7. Obtain the Fourier series for the following function:

$$f(x) = \begin{cases} \dfrac{\pi}{2} + x & \text{for} \quad -\pi \le x \le 0 \\ \dfrac{\pi}{2} - x & \text{for} \quad 0 < x \le \pi \end{cases} \qquad (10)$$

8. Find the solution of the wave equation:

$$\frac{\partial^2 u}{\partial t^2} = c^2 \, \frac{\partial^2 u}{\partial x^2}$$

for a vibrating string of length l = 1 unit with its ends fixed. It is given that the initial velocity is zero and the initial deflection is

$$u(x,0) = 2\sin(5\pi x) + 3\sin(7\pi x) \qquad (10)$$

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