

**SCHEME OF EXAMINATION  
AND  
COURSE OF STUDY  
IN  
MATHEMATICS  
Ph.D.  
(W.e.f. 2021-22)**



**DEPARTMENT OF MATHEMATICS & STATISTICS  
GURUKULA KANGRI (Deemed to be University), HARIDWAR – 249404**

**September 2021**

Revised syllabus w.e.f. 2021-22

**Gurukul Kangari (Deemed to be University), Haridwar**

**Pre Ph.D. Course work**

**Mathematics**

There are three papers:

Paper-I: PMA-101 Research Methodology and Computer Applications

Paper-II: PMA-102 Research and Publication Ethics

Paper-III: PMA-103 Advances in Mathematics

S.No.	Paper Code	Paper Name	Credit	Periods per week			Evaluation Scheme			Subject Total	
							Sessional				ESE
				L	T	P	CT	TA	Total		
1	PMA-101	Research Methodology and Computer Applications	6	4	0	4	20	10	30	70	100
2	PMA-102	Research and Publication Ethics	2	1	2	0	20	10	30	70	100
3	PMA-103	Advances in Mathematics	6	5	2	0	20	10	30	70	100

L= Lecture    T=Tutorial    P=Practical

CT=Cumulative Test    TA=Teaching Assessment    ESE=End Semester Examination

**Note 1:** The marks of internal assessment of each paper will be split-up as under:

(A) Class test 20 Marks

(B) Assignments / Tutorials 05 Marks

(C) Attendance 05 Marks

**Note 2:** As per UGC recommendations, the teaching program shall be supplemented by tutorials and problem solving sessions for each theory paper. For this purpose, tutorials classes shall be held for each theory paper.

**RESEARCH METHODOLOGY AND COMPUTER APPLICATIONS**

MM : 100

Time : 3 hrs

L T P

4 04

Sessional : 30

ESE : 70

**NOTE:** The question paper shall consist of two sections (Sec.-A and Sec.-B ). Sec.-A shall contain 10 short answer type questions of six marks each and student shall be required to attempt any five questions. Sec.-B shall contain 8 descriptive type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

**Research Aptitude**

- Research: Meaning, Characteristics and types.
- Steps of research.
- Paper, Article, Workshop, Seminar, Conference and Symposium.
- Thesis writing: Its characteristics and format.

**Data Interpretation**

- Sources, Acquisition and interpretation of data.
- Quantitative and qualitative data.
- Graphical representation and mapping of data.

**Computer programming**

Advantages and Disadvantages of MATLAB. MATLAB Basics: Variable and array, Displaying output data, Scalar and array operation, Built-in functions, Graphs plotting, Loops: While loop, For loop; user defined functions, Input/ output Functions.

**Programs in MATLAB**

General programs and programs based on numerical methods like

- To find percentage of marks in an examination.
- To find trace, transpose and inverse of a square matrix.
- To find roots of a quadratic equation.
- To find the sum of first  $n$  terms of infinite series
$$x - \frac{x^3}{3!} + \frac{x^5}{5!} - \dots$$
- To find area and circumference of a circle using function.
- To find maximum of three numbers by means of user defined function.
- To plot the graph of a function  $f(x) = \frac{x^2 - 5x + 10}{x^2 - 2x - 3}$  for  $-10 \leq x \leq 10$ . Plot the function by dividing domain of  $x$  into three parts. Set the range of  $y$ -axis from -20 to 20.
- To solve a linear system of  $n$  equations in  $n$  unknowns.
- To find the root of a polynomial using built-in function.
- Root finding using Bisection and Newton-Raphson method.
- Numerical integration by Trapezoidal and Simpson's rule.
- Solution of ordinary differential equations using Euler and Runge-Kutta methods.

**Books Prescribed**

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|-----------------|---|
| 1. C R Kothari  | - Research Methodology, New Age International Pvt Ltd Publishers    |
| 2. Rudra Pratap | - Getting started with MATLAB, Oxford University Press.             |
| 3. Amos Gilat   | - MATLAB An Introduction with Applications, John Wiley & Sons, Inc. |
| 4. B.S. Grewal  | - Numerical Methods, Khanna Pub.                                    |

# PMA-102

## Research and Publication Ethics

Maximum Marks: 70

Time : 3 Hours

L T Credits

1 22

Sessional : 30 marks

ESE : 70 marks

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**PHILOSOPHY AND ETHICS:** Introduction to philosophy, definition, nature and scope, concept, branches; ethics, definition, moral philosophy, nature of moral judgements, and reactions.

**SCIENTIFIC CONDUCT:** Ethics with respect to science and research. Intellectual honesty and research integrity, scientific misconduct: falsification, fabrication and plagiarism (FFP); redundant publications, duplicate and overlapping publications, salami slicing; selective reporting and misrepresentation of data.

**PUBLICATION ETHICS:** Definition, introduction and importance. Best practices/ standards, setting initiatives and guidelines, COPE, WAME, etc.; Conflicts of interest, publication misconduct: Definition, concept, problems that lead to unethical behaviour and vice-versa, types; violation of publication ethics, authorship and contributorship; identification of publication misconduct, complaints and appeals, pediatric publishers and journals; use of plagiarism software like Turnitin, Urkund and other open source software tools.

**OPEN ACCESS PUBLISHING:** Open access publications and initiatives; SHEPRA/RoMEO online resource to check publisher copyright and self-archiving policies, software tool to identify pediatric publications developed by SPPU; Journal finder/journal suggestion tools viz., JANE, Elsevier journal finder, Springer journal suggester, etc.

**DATABASES AND RESEARCH METRICS:** Indexing databases, citation databases, Web of science, SCOPUS etc.; metrics- Impact factor of journal as per Journal Citation Report, SNIP, SJR, IPP, Cite Score; *h*-Index, *g*-index, *i10* index, altmetrics.

## References

Bird, A. (2006). *Philosophy of Science*. Routledge.

MacIntyre, Alasdair (1967) *A Short History of Ethics*. London.

P. Chaddah, (2018) *Ethics in Competitive Research: Do not get scooped; do not get plagiarized*, ISBN:978-9387480865

National Academy of Sciences, National Academy of Engineering and Institute of Medicine. (2009). *On Being a Scientist: A Guide to Responsible Conduct in Research: Third Edition*. National Academies Press.

Resnik, D. B. (2011). What is ethics in research & why is it important. *National Institute of Environmental Health Sciences*, 1–10. Retrieved from <https://www.niehs.nih.gov/research/resources/bioethics/whatis/index.cfm>

Beall, J. (2012). Predatory publishers are corrupting open access. *Nature*, 489(7415), 179–179. <https://doi.org/10.1038/489179a>

Indian National Science Academy (INSA), *Ethics in Science Education, Research and Governance* (2019), ISBN:978-81-939482-1-7. [http://www.insaindia.res.in/pdf/Ethics\\_Book.pdf](http://www.insaindia.res.in/pdf/Ethics_Book.pdf)

# PMA-103

## Advances in Mathematics

MM : 100

Time : 3 hrs

L T P

5 2 0

Sessional : 30

ESE : 70

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**Graph Theory:** Matching, Covering, Connectivity, Planar graphs: Kuratowski's theorem, Algebraic planarity criteria, Coloring, Matrix representation of graphs, Graph labeling:  $\alpha$ - labeling,  $\beta$ - labeling.

**Fuzzy Sets and Applications:** Basic concepts of Fuzzy sets and Fuzzy logic: Motivation, Fuzzy sets and their representations, Membership functions and their designing, Types of Fuzzy sets, Operations on fuzzy sets, Convex fuzzy sets, Alpha level cuts, Geometric representations of Fuzzy sets, Linguistic variables Possibility measure and distribution, Fuzzy numbers, Arithmetic operations on fuzzy numbers.

**Mathematical Modeling:** The Modeling Process: The real world systems and the mathematical world, Mathematical models and their nature, Construction of mathematical models, The iterative nature of model, Construction, Characteristics of mathematical models. Mathematical models in Pharmacokinetics: Compartment, n-Compartment system, Special cases of single and double compartment system.

**Wavelet Transform:** Definition of wavelets and examples, Continuous wavelet transforms and examples, Basic properties of wavelet transforms, Parseval's formula for wavelet transform, Inversion theorem for wavelet transform. The Discrete wavelet transforms and examples, Orthonormal wavelets and its examples, Approximation of square integrable functions using wavelet bases.

**Numerical Methods:** Finite Difference Methods for elliptic, parabolic and hyperbolic problems. Stability, Consistency and Convergence of finite difference schemes.

### Books Prescribed:

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|--------------------------|--|
| 1. L. Debnath            | - Wavelet Transforms and Their Applications, Birkhauser, Boston,           |
| 2. C. K. Chui            | - An Introduction to Wavelets, Academic Press, New York.                   |
| 3. Nar Singh Deo         | - Graph Theory, PHI.   |
| 4. G. J. Klier & B. Yuan | - Fuzzy Sets and Fuzzy Logic, Prentice Hall of India.                      |
| 5. H.J. Zimmerman        | - Fuzzy Set Theory and Its Applications, Kluwer Academic Publishers.       |
| 6. J.N. Kapur            | - Mathematical Modelling, New Age International                            |
| 7. J.N. Kapur            | - Mathematical models in Biology and Medicine, East-West Press.            |
| 8. S.S. Sastry           | - Introductory Methods of Numerical Analysis, Prentice Hall of India.      |
| 9. Jain & Iyengar        | - Numerical methods of Scientific and Engineering Computation, NewAge Pub. |