



# National Centre for Mathematics

[www.ncmath.org](http://www.ncmath.org)

(A joint centre of TIFR and IIT Bombay)

## Advanced Training in Mathematics Schools

[www.atmschools.org](http://www.atmschools.org)

(Supported by National Board for Higher Mathematics)



### Online Workshop on

“Algebra & Multivariate Calculus for Science and Engineering Teachers”  
at School of Mathematical & Physical Sciences Dr. Harisingh Gour Vishwavidyalaya  
(8th January to 14th February 2021)  
(INSA - NCM joint programme)



The proposed Teachers Enrichment Workshop (TEW) aims at highlighting the applications of algebra and multivariate calculus, two subjects that are basic to mathematics and science. The workshop would demonstrate to the participants how linear algebra and multivariate calculus are related and could be useful objects for mathematicians, engineers and physicists. The workshop would equip university, college teachers and engineering teachers with enough examples so that the process of mathematics teaching and learning could be made more meaningful and joyful. In addition, speakers would highlight the importance to study linear algebra and multivariate calculus.

### Organizers:

Dr. Punam Gupta (Local Organizer)  
Department of Mathematics & Statistics,  
Dr. Harisingh Gour Vishwavidyalaya  
Sagar - 470 003, M.P.

E-mail: [pgupta@dhsgsu.edu.in](mailto:pgupta@dhsgsu.edu.in) :: Phone: +91 9907452035

Dr. Sanjay Kumar Singh  
Department of Mathematics  
Indian Institute of Science Education & Research,  
Bhopal-462 066, M.P.

Email: [sanjayks@iiserb.ac.in](mailto:sanjayks@iiserb.ac.in) :: Phone: +91 7389491139

Email address to which soft copies of the applications can be sent: [tewdhsgsu2019@gmail.com](mailto:tewdhsgsu2019@gmail.com)

Postal address to which hard copies of the applications can be sent:

**Dr. Punam Gupta, Assistant Professor, Room No. 5, Department of Mathematics & Statistics  
Dr. Harisingh Gour Vishwavidyalaya, Sagar-470 003, M.P.**

**Last date for submission of the online registrations by the applicants: 30 December, 2020**

### Syllabus:

Vector spaces and their basic properties, Linear Transformations and Matrices, Change of Basis, Quotient Spaces, Rank and Nullity theorem.

Determinants, Eigenvalues and Eigenvectors, Cayley Hamilton Theorem, Decomposition theorems, Diagonalisation, Some application.

Modules, Modules versus Vector Spaces, Free Modules, Matrices over PIDs, Smith Normal Form, Finitely Generated Modules over PIDs and their structure, Rational and Jordan Canonical Forms.

**Speaker: Prof. C.S. Dalawat, Harish Chandra Research Institute, Prayagraj**

Symmetries of equilateral triangle and square; translations, rotations and reflections in the Euclidean Plane.

Group, subgroup, cyclic group, examples, Group homomorphism and normal subgroup, kernel and image of a homomorphism, quotient group, isomorphism theorems, Permutations of a finite set, permutation group  $S_n$ , Group action, class equation, Sylow's Theorems and applications. Example of Matrix group over real and complex numbers.

Group of symmetries of geometric objects in Euclidean spaces, dihedral group as the group of symmetries of a regular polygon, isometries of the Euclidean space, symmetries, platonic solids and their dual, symmetries of a tetrahedron, symmetries of a cube and octahedron, symmetries of icosahedron and dodecahedron, finite subgroups of  $SO(2)$  and  $SO(3)$ .

**Speaker: Dr. Sanjay Kumar Singh, Indian Institute of Science Education and Research (IISER) Bhopal.**

Basics of metric spaces, norms induced by inner products, Cauchy Schwarz inequality, equivalence of norms on finite dimensional vector spaces.

Limits and continuity, Derivative as a linear map, examples from first principle, chain rule, directional derivative and partial derivative, examples.

Sufficient condition for existence of total derivative, equality of mixed partial derivatives, Taylor's theorem up to second order and applications to maxima and minima, method of Lagrange multipliers, Mean value and Implicit function theorem.

**Speaker: Dr. Siddhartha Sarkar, Indian Institute of Science Education and Research (IISER) Bhopal.**

### Tutors / Course Associates :

Dr. Punam Gupta, Assistant Professor,  
Dr. Triloki Nath, Assistant Professor,  
Dr. R.K. Pandey, Assistant Professor,

Dr. Harisingh Gour Vishwavidyalaya.  
Dr. Harisingh Gour Vishwavidyalaya.  
Dr. Harisingh Gour Vishwavidyalaya.