PMRF-ISSS Teaching Programme

Prime Minister Research Fellowship students' teaching requirement

facilitated by the Institute of Smart Structures and Systems

Module PMRF-ISSS103/II/2024
Group Theory in Condensed Matter Physics

## Name of the PMRF student

Robin Bajaj

Required background of the students taught

B.Sc in Physics/Chemistry/Mathematics
B.Tech
M.Sc Physics
PhD in Physics
Condensed Matter Physics

Details of the content of the module

Lecture-1. Definition of group, examples, rearrangement theorem, cosets
Lecture-2. Conjugation and class, factor groups,
Lecture-3. Representation theory, definitions, matrices, irreducible and reducible representations, unitarity of representation
Lecture-4. Schur's lemma 1 and 2, Representation and vector spaces
Lecture-5. Wonderful orthogonality theorems 1 and 2
Lecture-6. Character of representation, characters and class, definitions, WOT for characters
Lecture-7. Setting up character tables, symmetry relations and point group classifications
Lecture-8. Symmetry operations and basis functions,, Projection operators
Lecture-9. The effect of projection operators on a arbitrary function,
Lecture-10. Linear combinations of atomic orbitals for three equivalent atoms at the corners of equilateral triangle
Lecture-11. Application of group theory to quantum mechanics, direct product of groups
Lecture-12. Selection rules
Lecture-13. Rotational energy levels, Rigid rotator, Wigner-Eckart theorem
Lecture-14. Application to periodic lattices, space group symmetry operations, translation spacegroup
Lecture-15. Symmetry of k vectors, group of k vectors, star of k
Lecture-16. Application of symmetry to lattice vibrations
Lecture-17. Energy band models based on symmetries, degenerate and Non-degenerate k.p perturbation theory
Lecture-18. Spin orbit interaction in solids, double groups
Lecture-19. Application of double groups to energy bands with spin
Lecture-20. Other symmetries: Time reversal symmetry
Lecture-21. Permutation groups, classes and irreps, basis functions
Lecture-22. Symmetry properties of tensors
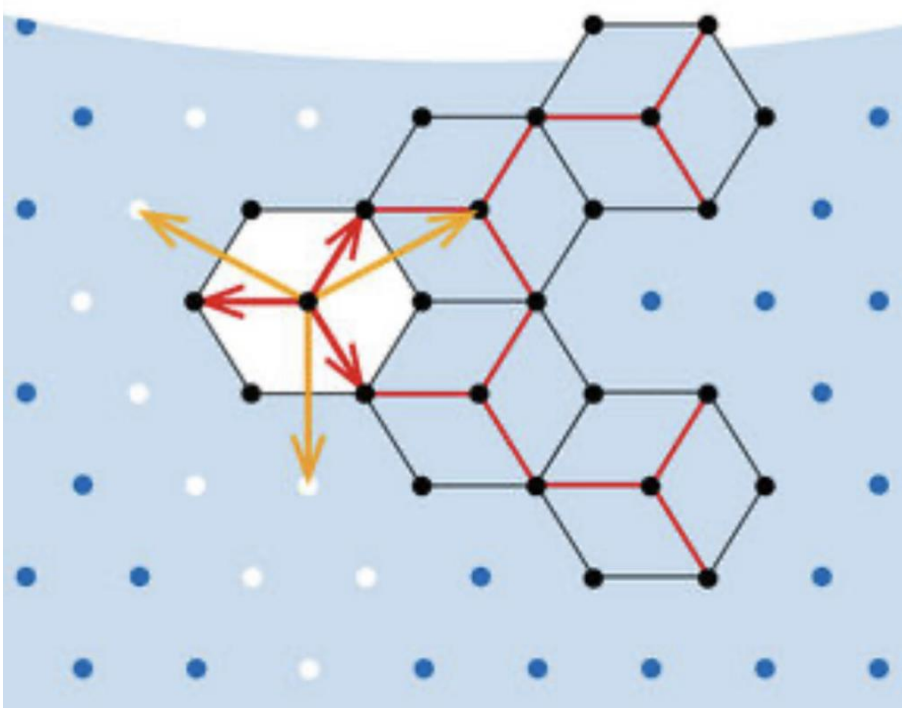
Schedule of the module

Tentative timings:
Start date: 3 August 2024 (Saturday)
End date: 28 December 2024 (Saturday)
Saturdays every week (11:00AM-12:30 PM)
Total Lectures: 22

Meeting link : Will be shared later

Contact email ID: robinbajaj46@gmail.com

Registration link:https://docs.google.com/forms/d/e/1FAIpQLSc_XQHjgoxFZwGWVcG58zPLlMnRypLmr7JIb-DL8cTLZ47HVA/viewform?usp=sf_link