PHY 663: Special topics in Mathematical Physics

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"One reason why mathematics enjoys special esteem, above all other sciences, is that its propositions are absolutely certain and indisputable, ... How can it be that mathematics, being after all a product of human thought which is independent of experience, is so admirably appropriate to the objects of reality. " — *Albert Einstein*

S. No.	Broad Title	Topics	No. of Lectures
	Strum-Liouville Theory	Hermitian operators, Ordinary-differential equations eigenvalue problem, Eigenvalues of special functions, variation methods.	5
	Partial differential equations	First order equations, Second order equations, Separation of variables, Laplace and Poisson's equation, Wave equations, Heat equation and diffusion PDE.	6
	Green's function	Green's function in one dimensional systems, two and three dimensional problems, scattering problems	5
	Special functions	Gamma function, Bessel Function, Legendre function, Hermite functions, Hypergeometric functions, and other functions.	8
	Group theory	Introduction to group theory, representation of groups, symmetry in physics, Discrete groups, Continuous groups, Lorentz groups, space groups	8
	Calculus of variation	Euler Equation, Other general variations, constrained maxima and minima, variation with constraints.	8
		Total number of lectures:	40

<u>Pre-requisites</u>: A background knowledge of differential equations, complex analysis and vector calculus.

<u>Recommended books:</u>

A) **Arfken, Weber and Harris**, *Mathematical methods for physicists*, 7th Edition, Academic press.

B) **S. Hassani**, *Mathematical Physics (A modern introduction to its foundations)*, Springer.

C) **S. D. Joglekar,** *Mathematical Physics Vol I & II,* **Universities Press.**

D) **Gelfand and Fomin,** *Calculus of variations,* ***Dover books on Mathematics***