Syllabi 1992-2005

	Instructor	RP	RP	RP	RP	RP	RP	RP	RP	RP	RP
	Terms per year	2.0	1.6	1.6	1.6	1.1	1.0	1.0	1.0	1.0	1.0
	Integration and Functions	1992	1993	1994	1995	2000	2001	2002	2003	2004	2005
*	Gaussian integrals	√	√	√	√	√			√	√	√
*	Gamma function [$\Gamma(x)$]	√	√	√	√	√	√	√	√	√	√
	Beta function [$B(p,q)$]	√	√	√	√			√	√	√	√
	Error functions [erf(x), erfc(x)]	√	√	√	√	√	√	√	√	√	√
	Zeta function [$\zeta(n)$]	√	√	√	√	√	√	√	√	√	√
	Exponential fns [$\gamma(n,x)$, $\Gamma(n,x)$, $E_n(x)$, $Ei(x)$]	√	√	√	√				√	√	√
	Fresnel functions [$C(x)$, $S(x)$]	√	√	√	√					√	√
	Sine integrals *et al.* [$li(x)$, $Ci(x)$, $si(x)$, $Si(x)$]		√	√	√						
	Elliptic integrals [$K(m)$, $E(m)$]	√	√	√	√				√	√	√
	Elliptic functions [$cn(x)$, $sn(x)$, *et al.*]	√		√					√		
	Volume of n-sphere	√	√	√	√						
	Invariant integration (symmetry)		√	√	√						
	Numerical quadrature	√	√	√	√	√					
	Monte-Carlo integration	√	√	√	√						
*	Steepest descents	√	√	√	√					√	√
	Infinite Series	1992	1993	1994	1995	2000	2001	2002	2003	2004	2005
	Convergence and uniform convergence	√	√	√	√	√	√	√	√	√	√
	Convergence tests	√	√	√	√	√					√
*	Summing infinite series	√	√	√	√	√	√	√	√	√	√
	Rational sums and polygamma functions	√		√			√	√	√	√	√
*	Power series and convergence		√	√	√	√	√	√	√	√	√
	Series expansion methods		√	√	√		√	√	√	√	√
	Bernouilli numbers [B_n]		√	√	√		√			√	√
	Euler-Maclaurin formula			√							
*	Asymptotic series		√	√	√	√	√	√	√	√	√
	Stirling's formula		√	√	√						√
	Infinite products										
	Ordinary Differential Equations	1992	1993	1994	1995	2000	2001	2002	2003	2004	2005
*	First-order (nonlinear) DEs	√	√	√	√	√	√	√	√	√	√
	Highest-order (nonlinear) DEs		√	√	√	√	√	√	√	√	√
*	Homogeneous linear DEs	√	√	√	√	√	√	√	√	√	√
*	Linear independence and Wronskians	√	√	√	√	√	√	√	√	√	√
	Second solutions	√	√	√	√	√	√	√	√	√	√
*	Inhomogeneous linear DEs (particular solns)	√	√	√	√	√	√	√	√	√	√
*	Series expansions (Frobenius method)	√	√	√	√	√	√	√	√	√	√
*	Legendre polynomials	√	√	√	√	√	√	√	√	√	√
	Bessel functions	√	√	√	√	√	√	√	√	√	√
	Singular solutions	√		√							
	Global analysis-1d flows			√					√	√	√
	Global analysis-2d flows			√					√	√	√
	Linear stability analysis								√	√	√
	Fixed points and Poincaré theorem								√	√	√
	Strange attractors and chaos								√	√	√
	Numerical methods	√	√	√	√	√			√	√	√

Orthogonal Fns & Eigenfunction Methods	1992	1993	1994	1995	2000	2001	2002	2003	2004	2005
* Hermitian operators	√	√	√	√	√	√	√	√	√	√
* Sturm-Liouville theorem	√	√	√	√	√	√	√	√	√	√
* Delta functions	√	√	√	√	√	√	√	√	√	√
* Closure	√	√	√	√	√	√	√	√	√	√
Orthogonalization	√	√	√	√	√	√	√	√	√	√
* Orthogonal series	√	√	√	√	√	√	√	√	√	√
Operators with continuous spectra				√						
Hankel transforms				√						

Legendre Functions	1992	1993	1994	1995	2000	2001	2002	2003	2004	2005
* Legendre *polynomials* $[P_n(x)]$	√	√	√	√	√	√	√	√	√	√
Rodrigues' formula		√	√	√	√	√	√	√	√	√
Generating function	√	√	√	√			√	√	√	√
Recurrence relations	√	√	√	√		√	√	√	√	√
Integral representations	√	√	√							
Orthogonality and Legendre Series	√	√	√	√	√	√	√	√	√	√
Legendre *functions* of order ν $[P_\nu(\cos\theta)]$		√	√	√						√
Legendre functions of the 2nd kind $[Q_n(x)]$	√	√	√	√		√		√	√	√
Other orthogonal poly's (Hermite, *etc*)		√	√	√	√	√	√	√		√

Spherical Harmonics (Y_l^m)	1992	1993	1994	1995	2000	2001	2002	2003	2004	2005
Associated Legendre functions $[P_l^m]$	√	√	√	√	√	√	√	√	√	√
* Spherical harmonics $[Y_l^m(\theta,\phi)]$	√	√	√	√	√	√	√	√	√	√
Laplace series	√	√	√	√	√	√	√	√	√	√
Completeness and 3d delta functions	√	√	√	√						
Angular momentum	√	√	√	√						
Addition theorem	√	√	√	√						
Two-center integrals		√	√	√						
Multipole expansion		√	√	√						
Vector spherical harmonics			√							

Cylindrical Bessel Functions (J, N, H, I, K)	1992	1993	1994	1995	2000	2001	2002	2003	2004	2005
Overview of all Bessel functions	√	√	√	√	√	√	√	√	√	√
Large and small x behavior	√	√	√	√	√			√	√	√
Series solutions [J]	√	√	√	√	√	√	√	√	√	√
Second solutions [N]	√	√	√	√	√			√	√	√
Generating functions	√	√	√	√						
Recurrence relations	√	√	√	√					√	√
Hankel functions [H]	√	√	√	√						
Integral representations	√	√	√	√						
Modified Bessel functions [I, K]	√	√	√	√	√	√	√	√	√	√
Integrals and diffraction	√	√	√	√						
Asymptotic forms	√	√	√	√					√	√
Orthogonality and Bessel series	√	√	√	√	√	√	√	√	√	√
Drumhead	√	√	√	√	√	√	√	√	√	√

Spherical Bessel Functions (j, n, etc)	1992	1993	1994	1995	2000	2001	2002	2003	2004	2005
Raleigh formula	√	√	√	√						
Orthogonality	√	√	√	√						
Helmholtz resonator	√	√	√	√						
Scattering theory	√	√	√	√						

Green's functions	1992	1993	1994	1995	2000	2001	2002	2003	2004	2005
* Green's functions method for linear DEs				√	√	√	√	√	√	√
Green's theorem and symmetry				√	√		√		√	
General approach (magic rule)				√	√	√	√	√	√	
* Eigenfunction expansion of Green's fns (1D)				√	√	√	√	√	√	√
3D Green's fns (fundamental & Poisson eq.)		√		√	√	√	√		√	
Method of Images		√		√	√	√	√		√	
Reduction to 1D Green's fn				√	√		√		√	
Eigenfunction expansion of Green's fns (3D)				√	√				√	
Spherical Green's functions	√	√	√	√						
Cylindrical Green's functions	√	√	√	√						

Vector Calculus	1992	1993	1994	1995	2000	2001	2002	2003	2004	2005
Line, Surface, and Volume Integrals	√									
Gauss' and Stokes' theorem	√									
Vector calculus identities and theorems	√	√		√						
Potential theory		√	√	√						
Uniqueness and Helmholtz' theorem		√	√	√						

Coordinates	1992	1993	1994	1995	2000	2001	2002	2003	2004	2005
* Cylindrical and spherical polar coordinates	√	√	√	√	√	√	√	√	√	√
* Coordinate transformations	√	√	√	√	√	√	√	√	√	√
General orthogonal coordinates	√	√	√	√	√	√	√	√	√	√
* Jacobian, volume element	√	√	√	√		√	√	√	√	√
Base vectors and unit vectors	√	√	√	√		√		√	√	√
Metric tensor	√	√	√	√		√			√	√
Scale factors	√	√	√	√	√	√	√	√	√	√
Coordinate curves and surfaces	√	√	√	√	√	√		√	√	√
Vector components	√	√	√	√	√	√	√	√	√	√
* Vector differential op's (grad, div, curl, ∇^2)	√	√	√	√	√	√	√	√	√	√

Tensors	1992	1993	1994	1995	2000	2001	2002	2003	2004	2005
* Transformation laws	√	√	√	√						
* Cartesian tensors	√	√	√	√						
* Isotropic tensors (δ_{ij}, ε_{ijk})	√	√	√	√						
Pseudotensors	√	√	√	√						
Non-Cartesian tensors	√	√	√	√						
General tensors	√	√	√	√						
Tensor operations	√	√	√	√						
Symmetry	√	√	√	√						
Tensor differential operations	√									

Non-orthogonal Coordinates	1992	1993	1994	1995	2000	2001	2002	2003	2004	2005
Contravariant and covariant representations	√			√		√				
Reciprocal vectors		√	√	√						
Metric tensor	√			√						
Vector differential operators (grad, div, curl, ∇^2)	√			√						
Covariant derivatives and Christoffel $[\Gamma^k_{ij}]$	√			√						

	Partial Differential Equations	1992	1993	1994	1995	2000	2001	2002	2003	2004	2005
*	Laplace/Poission, heat, wave eqn	√	√	√	√	√	√	√	√	√	√
	Classification and boundary conditions	√	√	√	√	√	√	√	√	√	√
*	Separation of variables	√	√	√	√	√	√	√	√	√	√
*	Solutions of Laplace & Helmholtz's equation	√	√	√	√	√	√	√	√	√	√
*	Rectangular Laplace problems	√	√	√	√	√	√	√	√	√	√
	Cylindrical Laplace problems (Bessel)	√	√	√	√	√	√	√	√	√	√
*	Spherical Laplace problems (Sph Harmonics)	√	√	√	√	√	√	√	√	√	√

	Fourier Series and Transforms	1992	1993	1994	1995	2000	2001	2002	2003	2004	2005
*	Fourier series	√	√	√	√	√			√	√	√
*	Non-periodic Fourier series	√	√	√	√	√	√	√	√	√	√
	Convergence of Fourier series and Gibbs	√	√	√	√	√		√			√
*	Orthogonal series	√	√	√	√	√	√	√	√	√	√
*	Fourier Transforms	√	√	√	√	√	√	√	√	√	√
	Limit of Fourier series	√	√	√	√				√	√	√
	Convergence of Fourier transforms	√	√	√	√	√					√
	Fourier transforms of derivatives, ODEs	√	√	√	√	√		√	√	√	√
	Sine and cosine transforms	√	√	√	√	√	√	√	√	√	√
	Fourier integral	√	√	√	√	√	√	√	√	√	√
*	Power spectra	√	√	√	√	√	√	√	√	√	√
*	Parseval's identity	√	√	√	√	√	√	√	√	√	√
*	Convolution theorem	√	√	√	√	√	√	√	√	√	√
	Transfer functions	√	√	√	√	√	√	√		√	√
	Correlation and Wiener-Khinchin theorem	√	√	√	√	√	√	√	√	√	√
	Discrete Fourier transform	√	√	√	√		√				
*	Numerical methods and FFT	√	√	√	√	√	√	√	√	√	√

	Laplace Transforms	1992	1993	1994	1995	2000	2001	2002	2003	2004	2005
	Derivation from Fourier	√	√	√	√	√					√
*	Definition and properties	√	√	√	√	√	√	√	√	√	√
	Inverse Laplace transformation	√	√	√	√	√	√	√	√	√	√
	ODEs	√	√	√	√	√	√	√	√	√	√
	PDEs	√	√	√	√	√	√	√	√	√	√
	Periodic functions	√	√	√	√						
	Other integral transforms	√	√	√	√		√		√	√	√

Integral Equations	1992	1993	1994	1995	2000	2001	2002	2003	2004	2005
Fredholm and Volterra equations										
DEs as an integral equations										
Separable kernels										
Neumann series										
Hilbert-Schmidt theory										

Group Theory	1992	1993	1994	1995	2000	2001	2002	2003	2004	2005
Finite group										
Irreducible represention										
Characters										
Lie groups										
SO(2), SO(3), SU(2)										
Lorentz group										

Functions of a Complex Variable	1992	1993	1994	1995	2000	2001	2002	2003	2004	2005
* Analytic functions and Cauchy-Riemann eqns	√	√	√	√	√	√	√	√	√	√
* Elementary functions	√	√	√	√	√	√	√	√	√	√
* Conformal mapping						√	√	√	√	√
* Cauchy's theorem and integral formula	√	√	√	√	√	√	√	√	√	√
Analytic continuation	√	√	√	√	√					
* Taylor and Laurent series	√	√	√	√	√	√	√	√	√	√
* Poles, zeroes, and branch points	√	√	√	√	√	√	√	√	√	√
* Residue theorem	√	√	√	√	√	√	√	√	√	√
* Contour integration	√	√	√	√	√	√	√	√	√	√
* Principal part integrals	√	√	√	√	√	√	√	√	√	√
* Conformal mapping	√	√	√	√					√	√
Dispersion relations and Kramers-Kronig	√									

Probability Theory	1992	1993	1994	1995	2000	2001	2002	2003	2004	2005
* Permutations and combinations			√	√		√	√	√	√	√
* Probability distributions	√	√	√	√	√	√	√	√	√	√
* Joint distributions	√	√	√	√	√	√	√	√	√	√
* Binomial distribution			√	√	√	√	√	√	√	√
* Random walks	√	√	√	√	√	√	√	√	√	√
* Poisson distribution	√	√	√	√	√	√	√	√	√	√
Random events and Poisson processes	√	√	√	√	√	√	√	√	√	√
Waiting times	√	√	√	√	√	√	√	√	√	√
* Gaussian distributions	√	√	√	√	√	√	√	√	√	√
Cauchy/Lorentzian distributions	√	√	√	√	√	√	√	√		
Gamma and beta distributions	√	√	√	√	√	√	√	√	√	√
* Transformed probability distribution	√	√	√	√	√	√	√	√	√	√
* Moment generation/characteristic functions	√	√	√	√	√	√	√	√	√	√
* Central limit theorem	√	√	√	√		√	√	√	√	√

Mathematical Statistics	1992	1993	1994	1995	2000	2001	2002	2003	2004	2005
Estimation of parameters										
Confidence intervals										
χ^2 distributions	√	√	√	√	√	√				
Significance testing				√						
Regression and correlation										

Determinants and Matrices — none —

Calculus of Variations — none —

Topology — none —

Differential Geometry — none —

Differential Forms — none —

Graphs and Networks — none —