

KEY REVIEW CHECKPOINTS FOR MTH 6151

GENERAL THEORY

- What is the order of a PDE
- The definition of linear and nonlinear PDEs
- The definition of homogeneous and inhomogeneous PDEs
- Principle of superpositions

FIRST ORDER PDES

- What is a characteristic curve (line)
- What are the general solutions of a linear first order PDE
- The definition of boundary and initial conditions

CLASSIFICATION OF SECOND ORDER PDES

- What is the principal part of a 2nd order PDE
- How to change the principal part to a canonical form
- The definition of elliptic, parabolic and hyperbolic PDEs

WAVE EQUATIONS (HYPERBOLIC EQUATIONS)

- What is the general solution of a wave equation, and more generally linear hyperbolic equations
- What formula is used to solve initial value for wave equations on $\mathbb{R}$
- How to solve the Goursat problem on the real line
- The definition of domain of dependence and domain of influence and relation to D'Alembert formula
- What is the speed of propagation of wave equations
- How to solve the wave equations on the half line
- What is the energy of wave equations and what properties and applications does it have
- How to solve wave equations on intervals using separation of variables
- How does eigenvalue problems relate to solving wave equations on intervals
- What is Duhamel's principle and how to use it for inhomogeneous wave equations
- What is Fourier series and how is it related to initial value problems

LAPLACE EQUATIONS (ELLIPTIC EQUATIONS)

- What is the polar coordinate expression of Laplace operator
- What is the general solutions in polar coordinates for domain of disk, annulus, $\mathbb{R}^2$
- How to solve boundary value problems
- What is Poisson's formula
- What is mean value theorem for Laplace equations
- What is maximum principle, and what applications does it have

HEAT EQUATIONS (PARABOLIC EQUATIONS)

- How to solve heat equations on the intervals using separation of variables
- What can you say about asymptotic behaviours of heat equations, and how does it compare to that of wave equations
- What is the energy of heat equations on an interval and what applications does it have
- What does the condition of finite total heat mean
- What property does the finite total heat of heat equations have
- What is a heat kernel K and what properties does it have as $t \rightarrow \infty$ or $t \rightarrow 0^+$
- What are the functions Dirac Delta δ , Heavyside H and the antiderivative Q of heat kernel K
- How to solve heat equations on half line using reflections and extensions
- What is the maximum principle of heat equations
- How to show stability and uniqueness properties of heat equations using maximum principles