AMSI Online: Honours and Masters Subject Guide

Introduction to String Theory

Semester 2, 2026

Administration and contact details

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Subject details

Handbook entry URL	https://handbook.unimelb.edu.au/subjects/mast90069
Subject homepage URL	n/a
Honours student hand-out URL	n/a
Teaching period (start and end date):	27/07/2026 - 25/10/2026
Exam period (start and end date):	02/11/2026 - 20/11/2026
Contact hours per week:	3
ACE enrolment closure date:	?
Lecture day(s) and time(s):	?
Description of electronic access arrangements for students (for example, LMS)	Students can get access to the Canvas LMS as external users. They have to create an account via a non-unimelb email address.

Subject content

1. Subject content description

String theory is a physical theory that unifies the known fundamental forces of nature at the quantum level. Point particles are replaced by fundamental strings. This concept has far reaching consequences, including extra dimensions, "stringy" dualities, and intricate mathematical structures. This course will cover the basic concepts and is intended to provide the foundations for further (self-)study and research projects in string theory. The course aims to be mostly self-contained and should be suitable also for students who do not necessarily have a background in physics.

Course Overview

- The classical bosonic string: Polyakov action, symmetries, equations of motion and their solution
- The quantised bosonic string: quantisation, spectrum and unification of forces, conformal anomaly and extra dimensions, compactification on a circle and T-duality
- Introduction to conformal field theory: basic concepts and application to string theory

2. Week-by-week topic overview

This is an approximate outline

- Week 1: Revision of basic concepts such as index notation, Minkowski space, Euler-Lagrange formalism
- Week 2: Nambu-Goto action, Polyakov action, equations of motion
- Week 3: Symmetries of the Polyakov action, conformal gauge
- Week 4: Symmetry algebra, solutions of the classical equations of motion, comments on open strings
- Week 5: Elements of BRST quantisation
Week 6: BRST quantisation of the bosonic string: action, conformal gauge, and commutator algebra in the ghost section, Virasoro algebra
- Week 7: BRST charge, vacuum states, conformal anomaly
- Week 8: Extra dimensions, quantum state space, unification of forces
- Week 9: Circle compactification and T-duality, string worldsheet in conformal field theory (CFT), conformal tensor fields
- Week 10: Energy momentum tensor, operator product expansions, operator-state correspondence
- Week 11: CFT correlation functions, CFT of the bosonic string, CFT of the ghost sector, energy momentum tensor and state space
- Week 12: Wick theorem and vertex operators, (if time permits) scattering amplitudes

3. Assumed prerequisite knowledge and capabilities

At the University of Melbourne, the subject prerequisites are Complex Analysis and Vector Calculus.

Basic knowledge on some of the following concepts is beneficial but not strictly required: complex analysis (residue theorem), Fourier series, the wave equation, the harmonic oscillator, basic classical and/or quantum mechanics. No knowledge of advanced concepts of theoretical physics, such as general relativity or quantum field theory, is required.

4. Learning outcomes and objectives

Get familiar with basic concepts of bosonic string theory and conformal field theory methods applied in this context.
Develop knowledge and skills for further study and research on more advanced topics on string theory.

AQF specific Program Learning Outcomes and Learning Outcome Descriptors (if available):

AQF Program Learning Outcomes addressed in this subject	Associated AQF Learning Outcome Descriptors for this subject
Insert Program Learning Outcome here	Choose from list below
Knowledge	K1
Skills	S1, S2
Application of Knowledge and Skills	A2

Learning Outcome Descriptors at AQF Level 8
Knowledge
K1: coherent and advanced knowledge of the underlying principles and concepts in one or more disciplines
K2: knowledge of research principles and methods
Skills
S1: cognitive skills to review, analyse, consolidate and synthesise knowledge to identify and provide solutions to complex problem with intellectual independence
S2: cognitive and technical skills to demonstrate a broad understanding of a body of knowledge and theoretical concepts with advanced understanding in some areas
S3: cognitive skills to exercise critical thinking and judgement in developing new understanding
S4: technical skills to design and use in a research project
S5: communication skills to present clear and coherent exposition of knowledge and ideas to a variety of audiences
Application of Knowledge and Skills
A1: with initiative and judgement in professional practice and/or scholarship
A2: to adapt knowledge and skills in diverse contexts
A3: with responsibility and accountability for own learning and practice and in collaboration with others within broad parameters
A4: to plan and execute project work and/or a piece of research and scholarship with some independence

5. Learning resources

Lecture notes will be provided. The course is mostly based on the book "Basic Concepts of String Theory" by Blumenhagen, Lust, Theisen. We will cover chapters 2-5 and, if time permits, some aspects of later chapters.

6. Assessment breakdown

Exam	60
Assignment	40 (2 assignments, 20% each)
Class work	n/a

Assignment due dates	**Exam date (approximate)**
Click here to enter a date.	Click here to enter a date.
Click here to enter a date.	
Click here to enter a date.	
Click here to enter a date.	

Institution honours program details

Weight of subject in total honours assessment at host department	n/a
Thesis/subject split at host department	n/a
Honours grade ranges at host department	n/a
H1	Enter range %
H2a	Enter range %
H2b	Enter range %
H3	Enter range %

Institution masters program details

Weight of subject in total masters assessment at host department	170
Thesis/subject split at host department	n/a
Masters grade ranges at host department	
H1	80%-100%
H2a	75%-79%
H2b	70%-74%
H3	65%-69%