

**Entanglement - 20<sup>th</sup> Century Physics and Philosophy**  
**PHYS 205/PHIL 250**  
**Course Guide Spring 2007**

Main Hall: 404 (Tues/Thu: 2.30-4.20pm)

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"There is no such thing as philosophy-free science; there is only science whose philosophical baggage is taken on board without examination." (Daniel Dennett)

### **Course Description**

An introduction to some key physics breakthroughs of the 20<sup>th</sup> Century and their philosophical implications.

### **Course Requirements**

#### **Presentations**

You will give 2 class presentations. In each case, you will be in a small group and you will present a summary of an assigned reading to the class and then lead the class discussion for half of the class time. One presentation will be prior to the class test; the second will be in the final week of class.

#### **Class Participation**

This class will be conducted as a topic/book seminar and so your participation is important.

You should prepare for and participate in all classes. You will be awarded a grade for each class and an average will be taken at the end of term.

Full attendance is expected. If there are more than 2 unexcused absences (absences which have not been cleared by the health centre or the Dean of Student Academic Services) your final grade will be reduced by one third of a letter grade each extra time you are absent. If you have full attendance your class participation grade will be increased by one third of a letter grade.

You should make an effort to be on time for each class. One incident of lateness does not matter. However, frequent lateness or consistent punctuality will be taken into account

when your class participation grade is assessed. N.B. It is better to come late, even very late, than not at all.

### **Class test**

There will be one class test on Thursday the 10<sup>th</sup> of May during class time. This will test your knowledge and understanding of what we have discussed in class. If you attend and prepare for every class, you should find the test straightforward. Further details will be provided closer to the time.

### **Essay**

You have to write one final essay of approximately 2000 words (10% either way is a reasonable margin but essays much longer or shorter than this will be penalized). The essay should be handed in by 4pm on Friday the 1<sup>st</sup> of June. Late papers will not be accepted so you should not wait until the last moment.

A few questions will be assigned in the latter half of the class but you may also write an essay on a question of your own choice provided we agree to this at least 1 week in advance of the essay due date.

### **Grades**

Presentation 1	10%
Presentation 2	10%
Class test	25%
Final essay	30%
Class participation	25%

### **Björklunden**

We have booked a weekend at Björklunden for this class. It is preferred, although not required, that you attend this. Whilst there, we shall watch a film and have a discussion about it (this will count towards your participation grade). Anyone who is unable to attend should notify us at the earliest opportunity; you will be given a short replacement assignment. Attending Björklunden *or* doing this assignment is required. The film will be watched on the Saturday evening so, if you have additional work to do during this weekend, you will have time to yourself on Saturday morning/afternoon and on Sunday.

### **Reading**

You should get your own copies of the following 3 books:

1. Kosso, Peter, *Appearance and Reality* (Oxford University Press: 1998)
2. Lethem, Jonathan, *As she climbed across the table* (Vintage: 1998)
3. Von Baeyer, Hans Christian, *Taming the Atom* (Dover Publications: 1992)

Copies of all other readings will be provided/placed on reserve in the Mudd library.

The readings in the class schedule are the *required* readings but you should also feel free to consult other books and articles; further reading is something you may find especially helpful when preparing for your final essay.

## Class Schedule

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### Week 1

Tuesday 27<sup>th</sup> March

**Introduction to class**

Thursday 29<sup>th</sup> March

**Introduction cont...**

*Appearance and Reality* Ch.1, 2, pp.7-30

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### Week 2

Tuesday 3<sup>rd</sup> April

**Relativity**

*Appearance and Reality* Ch 3, 5, pp.31-70, 94-109

Additional Relativity readings

Student presentations

Thursday 5<sup>th</sup> April

**Probability/Information**

*Appearance and Reality* Ch 6.1, pp.110-116

*Information* chapters

Student presentations

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### Week 3

Tuesday 10<sup>th</sup> April

**Atoms**

*Taming the Atom* Ch. 1-3, pp.3-56

Thursday 12<sup>th</sup> April

**Wave particle duality**

*Appearance and Reality* 6.2, pp.116-126

tba

Student presentations

Student presentations

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### Week 4

Tuesday 17<sup>th</sup> April

**Young's double slit experiment**

*The Quantum Challenge*, Ch.1

Additional Ketterle article

Student presentations

Thursday 19<sup>th</sup> April

**Indistinguishability/The Vacuum**

*Taming the Atom* Ch. 4-8, pp.59-131

Student presentations

Student presentations

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**Week 5**Tuesday 24<sup>th</sup> April**Uncertainty principle***Taming the Atom* Ch. 9, pp.132-143*Appearance and Reality* Ch. 6.3, pp.126-133

Student presentations

Thursday 26<sup>th</sup> April**Spin and the EPR experiment***Appearance and Reality* Ch. 6.4, pp.133-139*The Quantum Challenge*, Ch.5

Student presentations

Weekend

**BJÖRKLUNDEN**

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**Week 6**Tuesday 1<sup>st</sup> May**Entanglement**

Readings tba

Student presentations

Thursday 3<sup>rd</sup> May

NO CLASS (Reading period)

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**Week 7**Tuesday 8<sup>th</sup> May**Bell's Theorem***Appearance and Reality* Ch. 6.5, 6.6 & 7.1, pp.139-157

Additional Mermin article

Thursday 10<sup>th</sup> May**CLASS TEST**

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**Week 8**Tuesday 15<sup>th</sup> May**Quantum Mechanics and Realism***Appearance and Reality* Ch. 7.2-7.6, pp.157-176*Taming the Atom* Ch. 10-12, pp.147-193Thursday 17<sup>th</sup> May**Einstein-Bohr Challenge***Appearance and Reality* Ch. 8, pp.177-186*Taming the Atom* Ch.13-14, pp.194-223

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**Week 9**Tuesday 22<sup>nd</sup> May**Schrödinger's cat**

Readings tba

Thursday 24<sup>th</sup> May

**Blind physicists and academic satire**  
*As she climbed across the table*  
Whole book

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**Week 10**

Tuesday 29<sup>th</sup> May

**Topics in contemporary quantum mechanics**  
Readings tba  
Student presentations

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Thursday 31<sup>st</sup> May

**Topics in contemporary quantum mechanics**  
Readings tba  
Student presentations

Friday 1<sup>st</sup> June

Final essay due – 4pm

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