ANU EXTENSION

PHYSICS – ANU

H COURSE

B S S S AUSTRALIAN CAPITAL TERRITORY	**H Course**

College: The Australian National University	
Course Title: Physics - ANU	Course Code
Classification: H	

Unit Title(s)	Value (1.0)	Length	Unit Codes
Mechanics	(1.0)	3 Q	
Mechanics 1	(0.5)	1.5 Q	
Mechanics 2	(0.5)	1.5 Q	
Electromagnetism	(1.0)	3 Q	
Electromagnetism 1	(0.5)	1.5 Q	
Electromagnetism 2	(0.5)	1.5 Q	

Dates of Course Recognition:	From	2016	To	2020

H Classification: The course and units named above are consistent with H course policy and are signed on behalf of the BSSS.	
Course Development Coordinator: / /	Panel Chair: / /

Course Name: Physics ANU

Course Classification: H

Course Developers

Name	Qualifications
Alan Lyall	BSc Hons (Physics) ANU, Grad Dip Ed UC
Himel Ghosh	BA Hons (Physics) Amherst, MA Astronomy Columbia NY, PhD Astronomy Ohio State, Grad Dip Ed UC
Guy Fripp	BSc (Physics) UC, Grad Dip Ed UC
Adele Morrison	BSc Hons (Physics) ANU, Grad Dip Ed UC
Terry Werner	BAppSc (Physics) UC, Grad Dip Ed CSU, Grad Dip Elec UC
Dr Craig Savage	PhD (Physics) Waikato
Dr Paul Francis	PhD (Physics) Cambridge, MA Cambridge

This group gratefully acknowledges the contributions of the developers of the earlier course Professor Aidan Byrne, Norm Burmester and Sandra Box. The developers of the previous course remain as the changes are mainly concerned with the accommodation of the implementation of the Australian Curriculum Physics Courses in ACT schools/colleges.

Course Length and Composition

The definition of a unit and hour requirements for a standard unit and course duration, as outlined in policies 3.2.9 Unit, 3.2.9.1 Unit Values and 3.2.8.3 Course Duration (2015 BSSS Policy and Procedures Manual), apply to H courses.

Name and Number of Units Submitted and the Length of the Units expressed as a Value

Unit Title	Unit Value
Mechanics	1.0
Mechanic 1	0.5
Mechanics 2	0.5
Electromagnetism	1.0
Electromagnetism 1	0.5
Electromagnetism 2	0.5

Available Course Patterns

Course	Minimum number of hours per course	Number of standard 1.0 value units to meet course requirements
Minor	110 hours	2 units of 55 hours

Implementation Guidelines

Arrangements for continuing students

No Students affected

Prerequisites or co-requisites home college course/s

Students must be enrolled in physics major at their home school/college concurrently with this course. Students must be granted entry to ANU Extension.

Contribution towards an ATAR

Students can count up to 2 H courses to a maximum weight of 1.2 (equivalent to 2 minors) out of the required 3.6 in the calculation of the ATAR.

A maximum of 4 standard units from H courses can contribute to the minimum requirements for a Year 12 Certificate and Tertiary Entrance Statement.

Reporting of H courses on the ACT Year 12 certificate

Home college and H courses are reported separately, each with its own course type.

A T classified major minor and H minor in the same subject are equivalent to a double major course type.

If the student has completed insufficient H units to form a course, the units may be included in the home college course in the same course area but do not contribute to the course score. *(Refer section 9 University Programs in 2015 Policies and Procedures Manual)*

Goals

This course is intended for students in Year 11 and 12 who have an interest and aptitude in Physics or who require the skills and/or background covered in this course for further study at tertiary level.

Goals are statements of intended student outcomes. This course should enable students to develop an:

- appreciation of the contribution Science has made to a contemporary society
- appreciation of how scientific knowledge can be used to address contemporary issues
- understanding that scientific knowledge has developed over time, is used in a variety of contexts; and influences, and is influenced by, social, economic, cultural and ethical considerations
- understanding of the theories and models used to describe, explain and make predictions about systems, structures and properties
- understanding that Science is experimental and has developed through independent and collaborative research, and has significant impacts on society and implications for decision making
- ability to communicate scientific understandings, findings, arguments and conclusions using appropriate resources, modes and genres
- ability to conduct a variety of field, research and laboratory investigations involving collection and critical analysis of qualitative and quantitative data, and interpretation of evidence
- ability to critically evaluate and debate scientific arguments and claims in order to solve problems and generate informed, considered and ethical conclusions.

Literacy in Science

Literacy is important in students' development of Science Inquiry Skills and their understanding of content presented through the Science Understanding and Science as a Human Endeavour strands. Students gather, interpret, synthesise and critically analyse information presented in a wide range of genres, modes and representations (including text, flow diagrams, symbols, graphs and tables). They evaluate information sources and compare and contrast ideas, information and opinions presented within and between texts. They communicate processes and ideas logically and fluently and structure evidence-based arguments, selecting genres and employing appropriate structures and features to communicate for specific purposes and audiences.

Numeracy in Science

Numeracy is key to students' ability to apply a wide range of Science Inquiry Skills, including making and recording observations; ordering, representing and analysing data; and interpreting trends and relationships. They employ numeracy skills to interpret complex spatial and graphic representations, and to appreciate the ways in which systems are structured, interact and change across spatial and temporal scales. They engage in analysis of data, including issues relating to reliability and probability, and they interpret and manipulate mathematical relationships to calculate and predict values.

Student Group

Students apply to ANU for entry to this course and suitable applicants are selected at the beginning of their Year 11 year through a selection process. This process may include some or all of; a selection test, evidence provided of past academic successes, school/college recommendation.

Students must be enrolled in a physics major at an ACT school/college.

A student who achieves a satisfactory standard in this course will be made an early offer of entry to the ANU. The offer will be for the BSc or BSc (Advanced) Hons or PhB course depending on the level of achievement. A pass in this physics course is not a guarantee of an early offer. Early offers are decided by the ANU Dean of Sciences. Students who are made early offers will also be awarded a six point credit towards an ANU undergraduate course.

Assessment

There will be 3 – 5 summative assessment items for a 1.0 point unit and 2 – 3 for a 0.5 point unit. Weighting of assessment tasks will be consistent with the recommendations (below).

Task Types	**Student Investigations**	**Tests**
The following examples are a guide only	Logbook Prac Report Scientific Poster Research Assignment Seminar / Oral / Electronic presentations Project Essay Models	Unit tests Practical skills test Quizzes
Weighting (most units)	40 – 60 %	40 – 60 %
Weighting (project based units)	60 – 100 %	0 – 40 %

Moderation

9.2.2 Moderation of H courses (2015 BSSS Policies and Procedures Manual)

Teachers of H courses will be required to present portfolios of student work for verification that units are taught and assessed as documented. The Moderation Officer should report any concerns to the Board.

A Year 11 review portfolio will be prepared in December, after the end of the first 1.0 point unit, for Moderation Day 1 the following year.

A Year 12 review portfolio will be prepared by Week 3, Term 4 following the completion of the Year 12 unit at the end of Term 3.

Review portfolios will present the work of two students at different grade levels.

Grades in H courses are not subject to moderation.

Bibliography

Recommended Text

Book

Tipler, P. A. and Mosca, G. *Physics for Scientists and Engineers.* W. H. Freeman and Company, New York.

This was accurate at the time of Publication

Mechanics Value 1.0

Specific Unit Goals

This unit should enable students to:

- demonstrate an understanding of principal concepts in mechanics
- demonstrate a knowledge of rotational motion
- use systematic problem solving strategies, including dimensional analysis, critical reflection and the use of diagrams
- be able to design experiments to investigate mechanical systems
- identify and estimate sources of uncertainty in experiments
- calculate the total uncertainty in a derived quantity from individual measured uncertainties
- keep a detailed scientific logbook
- use a computational package (such as Mathematica) to plot and analyse experimental data, and use numerical techniques to solve iteration problems for non-constant forces

Content

Note that the ANU course develops a calculus approach to physics and while some of the content may appear to overlap with college courses the approach taken is quite different. More difficult problems are solved and the topics are developed to a higher level of difficulty.

- Experimental methodology, including uncertainties
- Mathematical techniques, including:
    - Iteration techniques (eg Euler algorithm)
    - Vector calculations - (dot and cross products)
    - The use of calculus in mechanics (summation / integration, derivatives)

  Using examples from:
        - Forces, including friction and spring forces
        - Energy and work (calculus approach)
        - Conservation of momentum in collisions
- Mass motion (integral approach)
- Moment of Inertia
- Rotational kinematics
- Rolling with and without slipping
- Torque and angular momentum

Teaching and Learning Strategies

A range of strategies will be used some of which are:

- Students will use computer-based resources to model mechanical systems
- The use of small group activities including peer mentoring to develop problem solving skills for understanding concepts of mechanics
- Students will perform a number of experiments to investigate the behaviour of mechanical systems

For this introductory unit of work, care will be taken to develop the student's physics literacy to a satisfactory level.

Assessment

There will be 4 – 6 summative assessment items and weighting of assessment tasks will be consistent with the recommendations (below).

Task Types	**Student Investigations**	**Tests**
The following examples are a guide only	*Logbook* *Prac Report* *Scientific Poster* *Research Assignment* *Seminar / Oral / Electronic presentations* *Project* *Essay* *Models*	*Unit tests* *Practical skills test* *Quizzes*
Weighting (most units)	40 – 60 %	40 – 60 %
Weighting (project based units)	60 – 100 %	0 – 40 %

Specific Unit Resource

Recommended Text

Book

Tipler, P. A. and Mosca, G. *Physics for Scientists and Engineers.* W. H. Freeman and Company, New York.

This was accurate at the time of Publication

Mechanics 1 Value 0.5

Specific Unit Goals

This unit should enable students to:

- demonstrate an understanding of principal concepts in mechanics
- use problem solving skills, including dimensional analysis, critical reflection and the use of diagrams
- be able to design experiments to investigate mechanical systems
- identify and estimate sources of uncertainty in experiments
- calculate the total uncertainty in a derived quantity from individual measured uncertainties
- keep a detailed scientific logbook
- use a computational package (such as Mathematica) to plot and analyse experimental data, and use numerical techniques to solve iteration problems for non-constant forces

Content

Note that the ANU course develops a calculus approach to physics and while some of the content may appear to overlap with college courses the approach taken is quite different. More difficult problems are solved and the topics are developed to a higher level of difficulty.

- Forces, including friction and spring forces
- Vector calculations - (dot and cross products)
- Energy and work (calculus approach)
- Conservation of momentum in collisions
- Experimental methodology, including uncertainties
- Iteration techniques (eg Euler algorithm)

Teaching and Learning Strategies

A range of strategies will be used some of which are:

- Students will use computer-based resources to model mechanical systems
- The use of small group activities including peer mentoring to develop problem solving skills for understanding concepts of mechanics
- Students will perform a number of experiments to investigate the behaviour of mechanical systems

For this introductory unit of work, care will be taken to develop the student's physics literacy to a satisfactory level.

Assessment

There will be 2 – 3 summative assessment items and the weighting of assessment tasks will be consistent with the recommendations (below).

Task Types	**Student Investigations**	**Tests**
The following examples are a guide only	*Logbook* *Prac Report* *Scientific Poster* *Research Assignment* *Seminar / Oral / Electronic presentations* *Project* *Essay* *Models*	*Unit tests* *Practical skills test* *Quizzes*
Weighting (most units)	40 – 60 %	40 – 60 %
Weighting (project based units)	60 – 100 %	0 – 40 %

Specific Unit Resource

Recommended Text

Books

Tipler, P. A. and Mosca, G. *Physics for Scientists and Engineers.* W. H. Freeman and Company, New York.

Mechanics 2 Value 0.5

Specific Unit Goals

This unit should enable students to:

- demonstrate an understanding of principal concepts in mechanics
- demonstrate a knowledge of rotational motion
- use problem solving skills, including dimensional analysis, critical reflection and the use of diagrams
- be able to design experiments to investigate mechanical systems
- identify and estimate sources of uncertainty in experiments
- calculate the total uncertainty in a derived quantity from individual measured uncertainties
- keep a detailed scientific logbook
- use a computational package (such as Mathematica) to plot and analyse experimental data

Content

Note that the ANU course develops a calculus approach to physics and while some of the content may appear to overlap with college courses the approach taken is quite different. More difficult problems are solved and the topics are developed to a higher level of difficulty.

- Mass motion(integral approach)
- Moment of Inertia
- Rotational kinematics
- Rolling with and without slipping
- Torque and angular momentum
- Experimental methodology, including uncertainties

Teaching and Learning Strategies

A range of strategies will be used some of which are:

- Students will use computer-based resources to model mechanical systems
- The use of small group activities including peer mentoring to develop problem solving skills for understanding concepts of mechanics
- Students will perform a number of experiments to investigate the behaviour of mechanical systems

Assessment

There will be 2 – 3 summative assessment items and the weighting of assessment tasks will be consistent with the recommendations (below).

Task Types	**Student Investigations**	**Tests**
The following examples are a guide only	*Logbook* *Prac Report* *Scientific Poster* *Research Assignment* *Seminar / Oral / Electronic presentations* *Project* *Essay* *Models*	*Unit tests* *Practical skills test* *Quizzes*
Weighting (most units)	40 – 60 %	40 – 60 %
Weighting (project based units)	60 – 100 %	0 – 40 %

Specific Unit Resource

Recommended Text

Book

Tipler, P. A. and Mosca, G. *Physics for Scientists and Engineers.* W. H. Freeman and Company, New York.

This was accurate at the time of Publication

Electromagnetism   Value 1.0

Specific Unit Goals

This unit should enable students to:

- calculate electric fields and potentials of simple charge distributions using Coulomb's Law (eg line, ring)
- calculate electric fields of symmetric charge distributions using Gauss's Law (eg sphere, cylinder, infinite plane)
- explain magnetic induction and Lenz's Law
- quantify the magnetic field produced by a current using the Biot-Savart Law and Ampere's Law (eg current loop, straight wire, solenoid)
- predict the behaviour of AC circuits containing capacitors and inductors
- experimentally analyse AC circuits
- identify and estimate sources of uncertainty in experiments
- calculate the total uncertainty in a derived quantity from individual measured uncertainties
- keep a detailed scientific logbook
- use a computational package (such as Mathematica) to plot and analyse experimental data, and use numerical techniques to solve differential equation problems
- use experimental equipment to analyse electrical circuits

Content

Note that the ANU course develops a calculus approach to physics. While part of the content may appear to overlap with college courses the approach taken in overlapping areas is that of Advanced Physics 1101 at the ANU ie. more difficult problems are solved and the topics are developed to a higher level of difficulty.

- Kirchhoff's Rules
- Electric fields of continuous charge distributions
- Gauss's Law
- Electric potential in three dimensions
- Capacitance and RC circuits
- Biot-Savart and Ampere's laws
- Magnetic induction and Lenz's law
- Inductance and RL circuits
- Oscillatory motion and resonance
- Advanced techniques in measurement and data analysis

Where content is duplicated in the Home College the material will be replaced by an equivalent amount from a similar, but unrelated area. For example "Kirchoff's Rules" may be supplemented by "Thevenin's Theorem"

Teaching and Learning Strategies

A range of strategies will be used some of which are:

- Students will use computer-based resources to model physical systems
- Students will be introduced to the concepts of vector calculus to illustrate behaviour in continuous systems
- The use of small group activities including peer mentoring to develop problem solving skills for understanding concepts of electric and magnetic fields
- Students will perform a number of experiments to investigate the behaviour of DC and AC circuits, involving resistance, capacitance and inductance.

Assessment

There will be 4 – 6 summative assessment items and weighting of assessment tasks will be consistent with the recommendations (below).

Task Types	**Student Investigations**	**Tests**
The following examples are a guide only	*Logbook* *Prac Report* *Scientific Poster* *Research Assignment* *Seminar / Oral / Electronic presentations* *Project* *Essay* *Models*	*Unit tests* *Practical skills test* *Quizzes*
Weighting (most units)	40 – 60 %	40 – 60 %
Weighting (project based units)	60 – 100 %	0 – 40 %

Specific Unit Resource

Recommended Text

Book

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This was accurate at the time of Publication

Electromagnetism 1 Value 0.5

Specific Unit Goals

This unit should enable students to:

- analyse circuits using Kirchoff's Rules
- calculate electric fields and potentials of simple charge distributions using Coulomb's Law (eg line, ring, disc of charge)
- calculate electric fields of symmetric charge distributions using Gauss's Law (eg sphere, cylinder, infinite plane)
- identify and estimate sources of uncertainty in experiments
- calculate the total uncertainty in a derived quantity from individual measured uncertainties
- keep a detailed scientific logbook
- use a computational package (such as Mathematica) to plot and analyse experimental data, and use numerical techniques to solve differential equation problems
- use experimental equipment to analyse electrical circuits

Content

Note that the ANU course develops a calculus approach to physics. While part of the content may appear to overlap with college courses the approach taken in overlapping areas is that of Advanced Physics 1101 at the ANU i.e. more difficult problems are solved and the topics are developed to a higher level of difficulty.

- Analysis of circuits using Kirchhoff's Rules
- Electric fields of continuous charge distributions
- Gauss's Law
- Electric potential
- Capacitance and RC circuits
- Advanced techniques in measurement and data analysis

Where content is duplicated in the Home College the material will be replaced by an equivalent amount from a similar, but unrelated area. For example "Kirchoff's Rules" may be supplemented by "Thevenin's Theorem"

Teaching and Learning Strategies

A range of strategies will be used some of which are:

- Students will use computer-based resources to model physical systems
- Students will be introduced to the concepts of vector calculus to illustrate behaviour in continuous systems
- The use of small group activities including peer mentoring to develop problem solving skills for understanding concepts of electric fields

- Students will perform a number of experiments to investigate the behaviour of DC circuits, involving resistance and capacitance.

Assessment

There will be 2 – 3 summative assessment items and the weighting of assessment tasks will be consistent with the recommendations (below).

Task Types	**Student Investigations**	**Tests**
The following examples are a guide only	*Logbook* *Prac Report* *Scientific Poster* *Research Assignment* *Seminar / Oral / Electronic presentations* *Project* *Essay* *Models*	*Unit tests* *Practical skills test* *Quizzes*
Weighting (most units)	40 – 60 %	40 – 60 %
Weighting (project based units)	60 – 100 %	0 – 40 %

Specific Unit Resource

Recommended Text

Book

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This was accurate at the time of Publication

Electromagnetism 2 Value 0.5

Specific Unit Goals

This unit should enable students to:

- quantify the magnetic field produced by a current using the Biot-Savart Law and Ampere's Law (eg current loop, straight wire, solenoid)
- analyse RLC circuits and predict the behaviour of simple circuits containing capacitors and inductors
- analyse AC circuits
- identify and estimate sources of uncertainty in experiments
- calculate the total uncertainty in a derived quantity from individual measured uncertainties
- keep a detailed scientific logbook
- use a computational package (such as Mathematica) to plot and analyse experimental data, and use numerical techniques to solve differential equation problems
- use experimental equipment to analyse electrical circuits

Content

Note that the ANU course develops a calculus approach to physics. While part of the content may appear to overlap with college courses the approach taken in overlapping areas is that of Advanced Physics 1101 at the ANU i.e. more difficult problems are solved and the topics are developed to a higher level of difficulty.

- Magnetic fields of simple charge distributions (Biot-Savart and Ampere's laws)
- Magnetism
- Magnetic induction and Lenz's law
- Inductance and RL circuits
- RLC circuits
- AC circuits
- Oscillatory motion and resonance
- Advanced techniques in measurement and data analysis

Where content is duplicated in the Home College the material will be replaced by an equivalent amount from a similar, but unrelated area. For example, the treatment of electromagnetism (using calculus, unlike the home college course) may be supplemented by Maxwell's Equations using vector calculus.

Teaching and Learning Strategies

A range of strategies will be used some of which are:

- Students will use computer-based resources to model physical systems

- Students will be introduced to the concepts of vector calculus to illustrate behaviour in continuous systems
- The use of small group activities including peer mentoring to develop problem solving skills for understanding concepts of electric and magnetic fields
- Students will perform a number of experiments to investigate the behaviour of DC and AC circuits, involving resistance, capacitance and inductance.

Assessment

There will be 2 – 3 summative assessment items and the weighting of assessment tasks will be consistent with the recommendations (below).

Task Types	**Student Investigations**	**Tests**
The following examples are a guide only	*Logbook* *Prac Report* *Scientific Poster* *Research Assignment* *Seminar / Oral / Electronic presentations* *Project* *Essay* *Models*	*Unit tests* *Practical skills test* *Quizzes*
Weighting (most units)	40 – 60 %	40 – 60 %
Weighting (project based units)	60 – 100 %	0 – 40 %

Specific Unit Resource

Recommended Text

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