Swansea University
Prifysgol Abertawe

FACULTY OF SCIENCE AND ENGINEERING

POSTGRADUATE STUDENT HANDBOOK

YEAR 4 (FHEQ LEVEL 7)

MSC ENVIRONMENTAL DRONE REMOTE SENSING

SUBJECT SPECIFIC
PART TWO OF TWO
MODULE AND COURSE STRUCTURE
2023-24

DISCLAIMER

The Faculty of Science and Engineering has made all reasonable efforts to ensure that the information contained within this publication is accurate and up-to-date when published but can accept no responsibility for any errors or omissions.

The Faculty of Science and Engineering reserves the right to revise, alter or discontinue degree programmes or modules and to amend regulations and procedures at any time, but every effort will be made to notify interested parties.

It should be noted that not every module listed in this handbook may be available every year, and changes may be made to the details of the modules. You are advised to contact the Faculty of Science and Engineering directly if you require further information.

The 23-24 academic year begins on 25 September 2023

Full term dates can be found here

DATES OF 23-24 TERMS

25 September 2023 – 15 December 2023

8 January 2024 – 22 March 2024

15 April 2024 – 07 June 2024

SEMESTER 1

25 September 2023 – 29 January 2024

SEMESTER 2

29 January 2024 – 07 June 2024

SUMMER

10 June 2024 – 20 September 2024

IMPORTANT

Swansea University and the Faculty of Science of Engineering takes any form of **academic misconduct** very seriously. In order to maintain academic integrity and ensure that the quality of an Award from Swansea University is not diminished, it is important to ensure that all students are judged on their ability. No student should have an unfair advantage over another as a result of academic misconduct - whether this is in the form of **Plagiarism**, **Collusion** or **Commissioning**.

It is important that you are aware of the **guidelines** governing Academic Misconduct within the University/Faculty of Science and Engineering and the possible implications. The Faculty of Science and Engineering will not take intent into consideration and in relation to an allegation of academic misconduct - there can be no defence that the offence was committed unintentionally or accidentally.

Please ensure that you read the University webpages covering the topic – procedural guidance here and further information here. You should also read the Faculty Part One handbook fully, in particular the pages that concern Academic Misconduct/Academic Integrity.

Welcome to the Faculty of Science and Engineering!

Whether you are a new or a returning student, we could not be happier to be on this journey with you.

At Swansea University and in the Faculty of Science and Engineering, we believe in working in partnership with students. We work hard to break down barriers and value the contribution of everyone.

Our goal is an inclusive community where everyone is respected, and everyone's contributions are valued. Always feel free to talk to academic, technical and administrative staff, administrators - I'm sure you will find many friendly helping hands ready to assist you. And make the most of living and working alongside your fellow students.

During your time with us, please learn, create, collaborate, and most of all – enjoy yourself!

Professor David Smith
Pro-Vice-Chancellor and Executive Dean
Faculty of Science and Engineering

Faculty of Science and Engineering	
Pro-Vice-Chancellor and Executive Dean	Professor David Smith
Head of Operations	Mrs Ruth Bunting
Associate Dean – Student Learning and Experience (SLE)	Dr Laura Roberts
School of Biosciences, Geography and Physics	
Head of School	TBC
School Education Lead	Dr Wendy Harris and Dr Sarah Roberts
Head of Geography	Dr Kevin Rees
Geography Programme Director	Dr Joanne Maddern
Year Coordinators	Year 0 – Dr Kath Ficken Year 1 – Dr Kath Ficken Year 2 – Dr Nick Felstead Year 3 – Dr Keith Halfacree PGT – Dr Iain Robertson

STUDENT SUPPORT

The Faculty of Science and Engineering has two **Reception** areas - Engineering Central (Bay Campus) and Wallace 223c (Singleton Park Campus).

Standard Reception opening hours are Monday-Friday 8.30am-4pm.

The **Student Support Team** provides dedicated and professional support to all students in the Faculty of Science and Engineering. Should you require assistance, have any questions, be unsure what to do or are experiencing difficulties with your studies or in your personal life, our team can offer direct help and advice, plus signpost you to further sources of support within the University. There are lots of ways to get information and contact the team:

Email: studentsupport-scienceengineering@swansea.ac.uk (Monday–Friday, 9am–5pm)

Call: +44 (0) 1792 295514 (Monday-Friday, 10am–12pm, 2–4pm).

Zoom: By appointment. Students can email, and if appropriate we will share a link to our Zoom calendar for students to select a date/time to meet.

The current student **webpages** also contain useful information and links to other resources:

https://myuni.swansea.ac.uk/fse/

READING LISTS

Reading lists for each module are available on the course Canvas page and are also accessible via http://ifindreading.swan.ac.uk/. We've removed reading lists from the 23-24 handbooks to ensure that you have access to the most up-to-date versions.
We do not expect you to purchase textbooks, unless it is a specified key text for the course.

THE DIFFERENCE BETWEEN COMPULSORY AND CORE MODULES

Compulsory modules must be **pursued** by a student.

Core modules must not only be **pursued**, but also **passed** before a student can proceed to the next level of study or qualify for an award. Failures in core modules must be redeemed.

Further information can be found under "Modular Terminology" on the following link - https://myuni.swansea.ac.uk/academic-life/academic-regulations/taught-guidance/essential-

info-taught-students/your-programme-explained/

MSc (FHEQ Level 7) 2023/24
Environmental Drone Remote Sensing
MSc Environmental Drone Remote Sensing

Compulsory Modules

Semester 1 Modules	Semester 2 Modules
GEGM03 **Drone Operation and Accreditation** **20 Credits** **Dr JAB Rosette/Prof PRJ North**	**GEGM09** **Environmental Drone Remote Sensing** **20 Credits** **Dr JAB Rosette/Prof PRJ North**
GEGM10 **Satellite Remote Sensing** **20 Credits** **Dr JAB Rosette**	
GEGM22 **Geographical Information Systems** **20 Credits** **Prof AJ Luckman/Dr RJ Fry/Dr Y Sun**	
GEGM06C **Environmental Drone Remote Sensing Dissertation** **60 Credits** **Prof PRJ North/Dr JAB Rosette**	
Total 180 Credits	

Optional Modules
Choose exactly 40 credits

BIOM22	Advanced Techniques in Biodiversity Assessment	Prof LJ Roberts/Dr PJ Neyland	TB2	20
BIOM32	Ecosystems: Ecology, Conservation & Resource Management	Prof CA Froyd/Dr WE Harris	TB2	20
GEGM04	Environmental Modelling	Prof PRJ North/Prof B Kulessa	TB1	20
GEGM21	Climate Change - Past, Present and Future	Dr J Hiemstra/Dr PG Albert	TB2	20

BIOM22 Advanced Techniques in Biodiversity Assessment

Credits: 20 Session: 2023/24 January-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Prof LJ Roberts, Dr PJ Neyland

Format: 24 hours workshops
15 hours fieldwork

Delivery Method: Delivery will be blended and include lectures, workshops, online learning, briefing sessions and regular field work.

Module Aims: This module aims to introduce advanced professional techniques in biodiversity assessment and management.

Students will learn how to use, interpret and evaluate appropriate metrics and methodologies to assess the impacts of new developments on biodiversity such as Ecological Impact Assessment (EcIA), UK Habitat Classification, Biodiversity Net Gain (BNG) and Environment Net Gain (ENG). Student will also learn the evaluation of ecological and broader environmental features as part of an economic valuation of the environment e.g. for ecosystem services assessment, natural capital valuation and/or environmental net gain.

This module provides students with highly employable skills within the environmental and conservation sector, aligning with the CIEEM's Competency Framework. While undertaking the module student will gain the experiences and develop a portfolio to allow them to apply for Qualifying Membership with the CIEEM.

Module Content: The syllabus and locations are indicative and subject to change based on weather and staff availability

Week 1
Workshop 1: Module Overview, Biodiversity Legislation, Assessment 1
Workshop 2: Theory of Biodiversity Assessment, Ecological Impact Assessment, Assessment 2

Week 2
Workshop 3: EcIA Scoping, Introduction to UK Habitat Classification
Fieldwork: Margam Park EcIA UK Habs survey

Week 3
Workshop 4: Habitat Mapping and Introduction to Biodiversity Net Gain
Fieldwork: Margam Park EcIA for Biodiversity Net Gain Survey

Week 4
Workshop 5: Introduction to Environment Net Gain
Fieldwork: Margam Park EcIA for Environment Net Gain Survey

Week 5
Assessment workshop

Intended Learning Outcomes: Students will be able to:
1. Undertake, interpret and critically evaluate methods of biological assessment including Preliminary Ecological Appraisals, Biodiversity Net Gain and Environment Net Gain using UK Habitat Classification;
2. Critically appraise techniques for assessing ecological and broader environmental features as part of an economic valuation of the environment e.g. for ecosystem services assessment, natural capital valuation and/or environmental net gain.
3. Synthesise ecological information and analyse biological data to create professional reports and work effectivity as an individual or as part of a team to collect data
4. Demonstrate and evidence professional competencies in environmental conservation and management

Assessment:	Coursework 1 (37%) Coursework 2 (38%) Coursework 3 (25%)

Assessment Description: Coursework 1: EcIA Part 1: UKHabs and Impact Assessment
Coursework 2: EcIA Part 3: Biodiversity Net Gain, Environmental Net Gain and Evaluation
Coursework 3: Application for Qualifying Membership of the CIEEM

Moderation approach to main assessment: Moderation by sampling of the cohort

Assessment Feedback: Written feedback directly on coursework. Discussion and questions will additionally be used. Feedback sessions and workshops.

Failure Redemption: August resit of failed continuous assessment components

Reading List: JNCC, Handbook for Phase 1 habitat survey - a technique for environmental audit. Sunderland, What works in conservation.
Chouinard, Omer, editor.; Jorgensen, Bethany, 1986- editor.; Tett, Paul, editor.; Vanderlinden, Jean-Paul, editor.; Vasseur, Liette, 1963- editor.; Baztan, Juan, editor.; Wright, Wendy Watson, writer of foreword., Coastal zones : solutions for the 21st century, Elsevier, 2015.ISBN: 9780128027486
Glasson, John, 1946-, Introduction to environmental impact assessment, ROUTLEDGE, 2019.ISBN: 0429894619

Additional Notes: This module provides students with highly employable skills within the environmental and conservation sector, aligning with the CIEEM's Competency Framework. While undertaking the module student will gain the experiences and develop a portfolio to allow them to apply for Qualifying Membership with the CIEEM.

The module is available to exchange or visiting students.

BIOM32 Ecosystems: Ecology, Conservation & Resource Management

Credits: 20 Session: 2023/24 January-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Prof CA Froyd, Dr WE Harris

Format: 19 hours of lectures / workshops
21 hours of field visits.
Contact Hours will be delivered through a blend of live activities online and on-campus, and may include, for example, lectures, seminars, practical sessions and Academic Mentoring sessions.

Delivery Method: All Programmes will employ a blended approach to delivery using the Canvas Digital Learning Platform for live and self-directed online activity, with live and self-directed on-campus activities each week. Students may also have the opportunity to engage with online versions of sessions delivered on-campus

Combination of lectures/workshops and field site visits.

Module Aims: In this module, the students will learn to identify and understand the diversity and contrasting characteristics of terrestrial ecosystems with an emphasis on the origin and effects of various human-induced environmental impacts.

Module Content: In this module the students will learn to identify and understand the diversity and contrasting characteristics of terrestrial ecosystems with an emphasis on the origin and effects of various human-induced environmental impacts.

Due to the mode of teaching the syllabus outlined below is indicative of the material provided and is subject to modification.

*Terrestrial systems;
*Ecological monitoring for conservation;
*Biodiversity and biogeography;
*Long-term ecology;
*Conservation planning and resource management

Field visits will focus on woodland communities and include lowland and upland deciduous woodlands and upland coniferous woodlands in the locality

Intended Learning Outcomes: Upon completion of this module students will be able to acquire advanced, specialised knowledge on:

*Applied Conservation biology and Management;
*Implications of anthropogenically driven habitat changes and its possible relation to climate change.

Assessment: Examination (50%)
Coursework 1 (10%)
Coursework 2 (20%)
Coursework 3 (20%)

Assessment Description: A 2 hour written examination and 3 assignments consisting of a 3000 word field course report, a 1,500 word briefing paper, and a group workshop discussion presentation.

EX1: 50%
CW1: 10%
CW2: 20%
CW3: 20%

Moderation approach to main assessment: Moderation by sampling of the cohort

Assessment Feedback: Written feedback given on submitted work and annotated examination scripts

Failure Redemption: Resit examination (capped at 50%).

Reading List: Hartel, Tibor, Kirby, K. J., editor.; Watkins, C., editor., Europe's changing woods and forests : from wildwood to managed landscapes, CABI, 2015.ISBN: 1789243971
Kirby, K. J, Watkins, C, Europe's changing woods and forests : from wildwood to managed landscapes / edited by Keith J. Kirby and Charles Watkins., CABI, 2015.ISBN: 1780643373
J. S. Rodwell editor.; C. D. Pigott contributor., British plant communities. Volume 1, Woodlands and scrub / J. S. Rodwell, editor ; C. D. Pigott [and nine others], contributor ; for the Nature Conservancy Council., Cambridge : Cambridge University Press, 1991.ISBN: 1107099560
Rodwell, J. S, Pigott, C.D, British plant communities. Vol.1, Woodlands and scrub ; J. S. Rodwell (editor) ; C.D.Pigott ... [et al.] for the Nature Conservancy Council., Cambridge University Press, 1991.
Whittaker, Robert JFernandez-Palacios, Jose Maria, Island biogeography ecology, evolution, and conservation / Robert J. Whittaker, and Jose Maria Fernandez-Palacios., Oxford University Press, 2007.ISBN: 0198566123
Richard J. Hobbs, R. J Hobbs (Richard J.); Eric Higgs 1958-; Carol M Hall, Novel ecosystems intervening in the new ecological world order / edited by Richard J Hobbs, Eric S. Higgs, and Carol M. Hall., Wiley-Blackwell, 2013.ISBN: 1118354184
David A. Perry 1938-, Ram Oren 1952-; Stephen C. Hart 1961-, Forest ecosystems / David A. Perry, Ram Oren, Stephen C. Hart., Johns Hopkins University Press, 2008.ISBN: 9780801888403
Roberts, Neil, Holocene : an environmental history / Neil Roberts., Wiley Blackwell, 2014.ISBN: 1405155213
Oliver Rackham author, Woodlands / Oliver Rackham., London : William Collins, 2015.ISBN: 9780008156916
Richard H. W. Bradshaw, Martin T Sykes, Ecosystem dynamics : from the past to the future / Richard H.W. Bradshaw, University of Liverpool, Martin T. Sykes, Lund University., Chichester, West Sussex, UK ; Hoboken, NJ, USA : Wiley Blackwell, 2014.ISBN: 9781119970774
Stace, Clive A., author., Thompson, Hilli, illustrator.; Stace, Margaret A., illustrator., New flora of the British Isles., C&M Floristics, 2019.ISBN: 9781527226302

Additional Notes: Delivery of both teaching and assessment will be blended including live and self-directed activities online and on-campus.

Not available to exchange or visiting students.

GEGM03 Drone Operation and Accreditation

Credits: 20 Session: 2023/24 September-January

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr JAB Rosette, Prof PRJ North

Format: Swansea University: 5 hours small group seminar on background knowledge and prerequisites required for CAA training, flight practice and CAA registration requirements.
Authorised training provider:
3 days CAA GVC theoretical training (21 hours)
1 day flight training (7 hours)
3 hour theory test
1 hour flight test

Delivery Method: On campus teaching, flight skills development and theoretical and practical flight assessment:

STAFF-LED TEACHING:
* Drone types: advantages and limitations; high resolution remote sensing; environmental applications

STUDENT-LED LEARNING FACILITATED BY STAFF:
* CAA drone categories and regulations; CAA online test to obtain Flyer ID
* DJI flight controller; software interface and Return to Home settings; emergency recovery
* Portfolio of flight and aircraft logs; legislation requirements (assessed)

EXPERIENTIAL LEARNING:
* Flight Practice (minimum 4 hours)
* Mock commercial flight assignment: operational procedures, flight planning, safety, NOTAMS & site checks (assessed)

EXTERNAL PROVIDER - TRAINING AND ASSESSMENT:
* GVC theoretical training: CAA regulations; aviation charts; safe operation, etc.
* Practical flight training
* Theory assessment
* Flight assessment

Module Aims: This Module teaches the flight skills, legislative and regulatory requirements for operating a drone in the UK. Students will gain an overview of the advantages and limitations of different types of drone; opportunities offered by high resolution user-captured remote sensing data; and environmental applications for drones.
Much of the teaching is practice-based and students will develop the knowledge, safety awareness and flight experience required to undertake assessment for the Civil Aviation Authority GVC (General Visual Line of Sight Certificate). Students will therefore graduate with the additional CAA GVC drone pilot accreditation, comprising theoretical training and written graded test, and flight training and assessment. This Module will be delivered in partnership with a CAA registered and authorised training provider. The externally-delivered syllabus comprises: Drone Airspace Operating Regulations; Airmanship and Aviation Safety; Air Law and Responsibilities; Meteorology; Navigation and Aviation Charts; Human Factors; Aircraft Knowledge; Operating Procedures.

Together with the CAA accreditation, an internal University assignment and an assessed portfolio will ultimately determine successful completion of this Module.

This Module is a prerequisite of GEGM09 Drone Remote Sensing and GEGM03C Environmental Drone Remote Sensing Dissertation.

Module Content:
INTRODUCTION:
This Module teaches the flight skills, legislative and regulatory requirements for operating a drone in the UK. Much of the teaching is practice-based and students will develop the knowledge, safety awareness and flight experience required to undertake assessment for the Civil Aviation Authority GVC (General Visual Line of Sight Certificate). Students will therefore graduate with the additional CAA GVC drone pilot accreditation, comprising theoretical training and written graded test, and flight training and assessment. This Module will be delivered in partnership with a CAA registered and authorised training provider.

INDICATIVE INTRODUCTORY LECTURE TOPICS:
- Types of drone, their advantages and limitations
- Obtaining the CAA Flyer ID and UK legislation and regulations
- Environmental applications for drones

INDICATIVE CAA GVC THEORY COURSE CONTENT:
- Drone Airspace Operating Regulations;
- Airmanship and Aviation Safety;
- Air Law and Responsibilities;
- Meteorology;
- Navigation and Aviation Charts;
- Human Factors;
- Aircraft Knowledge;
- Operating Procedures.

INDICATIVE CAA GVC DRONE FLIGHT COMPENTENCY:
- Manual flight control of several manoeuvres
- Distance retrieval in ATTI mode
- Return to Home and controller settings
- Airspace and ground-space control

Together with the CAA accreditation, an internal University assignment and an assessed portfolio will ultimately determine successful completion of this Module.

Successful completion of this Module is a prerequisite of GEGM09 Drone Remote Sensing and GEGM03C Environmental Drone Remote Sensing Dissertation.

The externally-led component of this Module is expected to be undertaken within a concentrated period of one week.

Intended Learning Outcomes: At the end of this Module, students should be able to:

* Describe and adhere to CAA regulations: drone legislation classes, weight & risk categories, operation procedures and legal requirements (e.g. CAA Flyer ID & Operator ID registration), privacy & GDPR considerations for data capture
* Describe safe drone operation procedures – satellite coverage, RTH, observer, public management, actions to be taken in the event of an emergency
* Interpret Aviation Charts, understand NOTAMS, flight restrictions and obtain permission to fly
* Characterise meteorology, drone operation weather limitations, pre-flight weather checks, on-site checks and go/no-go call
* Critically assess and evaluate academic literature, data and other sources of information
* Apply knowledge and understanding of environmental theories, paradigms, concepts and principles to problem solving in the real world systems.
* Develop safe drone remote pilot skills to obtain CAA pilot competency accreditation
* Maintain regulatory pilot and aircraft related logs required for CAA drone remote pilot status
* Implement pre-flight procedures to obtain site permissions, carry out weather & site checks, aviation chart site status and NOTAMS
* Implement safe in-flight procedures: ground/public management, air space management, manually-controlled drone flights and programmed remote sensing flight campaigns

Assessment:	Examination 1 (25%) Examination 2 (25%) Coursework 1 (25%) Coursework 2 (25%)

Assessment Description: Assessed components comprise the following:
E1 Graded theoretical multiple choice exam for CAA GVC (approximately 3 hours): 25% of mark
E2 Graded flight exam for CAA GVC (approximately 1 hour): 25% of mark
C1 Portfolio of regulatory flight and aircraft logs, pre-flight and during flight risk & safety assessments: 25% of mark
C2 Written assignment detailing procedures and mock commercial assignment with flight and safety planning (1000 words): 25% of mark

Moderation approach to main assessment: Universal Non-Blind Double Marking of the whole cohort

Assessment Feedback: Feedback on the CAA theory test will be provided in person (or online) to the group, through revisiting questions and discussing correct answers.

Individual feedback on the flight test is provided in person, immediately after the test.

Written feedback will be provided for the internally-assessed assignment and a portfolio of aircraft and flight logs.

Failure Redemption: Exams E1-E2 will be redeemed by retaking these in association with external partner.
Coursework C1-C2 will be redeemed by resubmission of coursework.

Additional Notes: The compulsory requirement for this Module will be waived with a current CAA PfCO or GVC.

cessary and any changes will be communicated to students, as soon as possible. Delivery of both teaching and assessment will be blended including live and self-directed activities online and on campus.

GEGM04 Environmental Modelling

Credits: 20 Session: 2023/24 September-January

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Prof PRJ North, Prof B Kulessa

Format: 36 Contact Hours will be delivered through live activities on-campus, and will include, lectures, seminars, and computer practical sessions.

Delivery Method: All Programmes will employ a blended approach to delivery using the Canvas Digital Learning Platform for live and self-directed online activity, with live and self-directed on-campus activities each week. Students may also have the opportunity to engage with online versions of sessions delivered on-campus

On Campus

Module Aims: An understanding of the environment is increasingly important in many areas, e.g. industry, agriculture, conservation, health, science, and planning. This module introduces computational modelling in a geographical context. It aims to develop thinking about environmental issues within a modelling framework, and to develop practical skills in developing and using computational models, and in computer data analysis and visualisation. Examples are focused on solving practical scientific problems in environmental dynamics and climate change, focussing on modelling the terrestrial carbon and hydrological cycles.

Module Content: This module introduces computational modelling in the context of environmental dynamics and climatic Change. It aims to develop thinking about environmental issues within a modelling framework, and to develop practical skills in developing and using computational models, and in computer data analysis and visualisation. Examples are focussed on solving practical scientific problems which involve modelling the terrestrial carbon and hydrological cycles.

Outline of lecture topics:

-Role of modelling in environmental dynamics and climate change.
-Land surface carbon and hydrological cycles
-Models of plant photosynthesis and respiration
-Climate modelling and GCMs
-Modelling vegetation dynamics and succession
-Hydrological modelling - ground water and evapotranspiration
-Modelling surface water flow
-Example applications in climate change science and environmental planning

Example practical sessions

-Computer data analysis and visualisation
-Modelling the terrestrial carbon cycle using Biome BGC
-Introduction to modelling groundwater flow

Intended Learning Outcomes: -A broad understanding of the purpose and scope of computational modelling in environmental dynamics and climate change
-A critical awareness of the range of modern applications to which environmental modelling contributes
-An understanding of the environmental processes related to the water cycle and to biogeochemical cycles
-An ability to independently develop and execute simple computational models
-The ability to solve problems and write reports based on application of existing environmental models

Assessment: Coursework 1 (25%)
Coursework 2 (25%)
Examination 1 (50%)

Assessment Description: Examination
Coursework 1 - Hydrological Modelling
Coursework 2 - Carbon Cycle

Moderation approach to main assessment: Moderation by sampling of the cohort

Assessment Feedback: Continual assessment feedback in writing on standard department feedback forms

Failure Redemption: resit examination or resubmit continual assessment whichever if applicable
Reading List: Schlesinger, William H., author., Bernhardt, Emily S., author., Biogeochemistry : an analysis of global change., Academic Press, 2020.ISBN: 9780128146095 Hornberger, George M., Elements of physical hydrology / George M. Hornberger ... [et al.]., Johns Hopkins University Press,, c1998..ISBN: 9780801858574 George M Hornberger, Elements of physical hydrology / George M. Hornberger [and others]., Johns Hopkins University Press, 2014.ISBN: 9781421413730 Fitts, Charles R. (Charles Richard), 1953-, Groundwater science, Academic Press, 2013.ISBN: 9780123847058
Additional Notes: Delivery of both teaching and assessment will be blended including live and self-directed activities online and on-campus. Available for visiting students.

GEGM06C Environmental Drone Remote Sensing Dissertation

Credits: 60 Session: 2023/24 January-September

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Prof PRJ North, Dr JAB Rosette

Format: c.10 hrs contact per student, plus c.5 hr presentation sessions, c.2 hr project planning selection meeting. (online and covid-19 permitting).

Delivery Method: On-campus provision is delivered through a combination of individual meetings, group meetings, presentations, laboratory / field training and supervision according to the chosen research topic. With the diverse nature of dissertations in mind, students may need to work off-site or in the field during part of their research period.

Change in delivery of module to on-line synchronous. Choice of Dissertation topic may be limited by covid-19 restrictions (i.e. restricted choice of topic/method, use of secondary data etc.).

Module Aims: This module offers the opportunity to undertake a major individual research project in the field of Environmental Drone Remote Sensing. Support is provided by a staff supervisor and through student-led discussions. There will also be an opportunity to give constructive feedback to other students undertaking related research projects, learning from their research problems and their subsequent solutions. Provisional research results will be communicated verbally (in July and August). The final results of the thesis will be presented as the scientific paper of a leading international journal in the same field of research.

Module Content: The dissertation provides an opportunity for students to develop and undertake an independent, substantial and original research project that complements and reports on a topic of interest on the Masters Program. Dissertation work is usually done from June to mid-September in the second and third periods of study. However, work can be started at any time and before this date, and students are encouraged to start their research early. An initial Dissertation meeting will be held in TB1 where the dissertation will be introduced and the date of submission. However, in recognition of the fact that many Masters level students have already identified areas of significant expertise, or would like to undertake projects that require extended monitoring or fieldwork, students may identify a research topic and approach and discuss it with a coordinator / potential module supervisors to develop their research ideas at any time in TB1 or TB2. In developing their ideas, students are asked to write a concise project proposal and conduct background literature reviews at this early stage of project development.

Once students have identified an appropriate research topic and research question, an academic supervisor will be appointed who will work with the student to further refine the thesis and approve the topic and scope of the study. They will also provide supervision through the research process. A meeting at the end of TB1 (about week 10) will provide an update and further guidance relevant to the development of a dissertation topic. Students are asked to further consider and refine their dissertation topics during the winter holidays. Students refine their dissertation ideas and develop their research throughout TB2. A meeting held at the beginning of the semester will provide an opportunity to answer students' questions about the module and monitor progress. At the end of the examination period, it is expected that students will have chosen an appropriate topic for their dissertations, and that these have been approved and ready to embark on the research (if they have not already done so).

Full-time students are expected to work full-time on their dissertations throughout the research period. Students are expected to be proactive in arranging meetings with their supervisors. Students are provided with a supervision record and a meeting guide for at least 10 hours of supervision provided to them during the research period. The record of supervision is available on Canvas and should be submitted as a mandatory part of the "Administrative Annex". Where a student's bursary conditions require that time is spent with an industrial partner, students will also need to monitor this contact, in addition to supervision at the University. During the research period, individual and group meetings are held to give students the opportunity to discuss any concerns, discuss progress etc. These sessions will include two mandatory presentations (July and August) in which the student will be required to present their research strategy, results and progress to date. Each presentation will be followed by a peer group discussion and questions. There will also be an opportunity to give constructive feedback to fellow students undertaking related research projects, learning from their research experiences. Written feedback will be provided to students following these mandatory meetings.

Intended Learning Outcomes: At the end of this module, the student should be able to:

Review the scientific literature, using databases where appropriate.

Investigate and be able to explain the implications of the relevant health and safety legislation.

Complete detailed research program.

Maintain research records during field, computer or laboratory work.

Integrate material from the literature with research results.

Work independently to produce a major research report.

Communicate research orally through formal and informal presentations and discussions.

Write a research paper of the appropriate length and format for submission to an appropriate journal.

Assessment: Other (100%)

Assessment Description: The dissertation format is a fully referenced scientific paper, supported by full supplementary data and documentary details. This supplementary data should be sufficient to enable markers to assess the interpretations presented in the scientific paper. All dissertations submitted for assessment must follow this structure. A dissertation should also include an "Administrative Appendix" which includes all risk / safety documentation, ethical considerations, licenses and supervision reports).

Moderation approach to main assessment: Universal Double Blind Marking of the whole cohort

Assessment Feedback: During the research period, feedback is mainly provided through the student's project supervisor. Supervisors may comment on a draft of the dissertation, which will be submitted to them within a reasonable time period (at least 3 weeks before submission). The review does not take the form of a formal assessment or proofreading, but acts as an opportunity to provide broad feedback and identify the main areas of concern or areas for further development during the remaining time. Group and individual meetings are held throughout the year to offer students the opportunity to discuss concerns and progress etc. These sessions will consist of two mandatory presentations (c. July and August) where students will be required to present their research strategies, results and progress to date. Each presentation will be followed by a peer group discussion and questions. There will also be an opportunity to give constructive feedback to fellow students undertaking related research projects, learning from their research experiences. Written feedback will be provided to students following these mandatory meetings. Written feedback will be made available to students when their dissertations are marked.

Failure Redemption: Ability to resubmit the dissertation within 3 months. This re-submission carries 100% of the marks.

Additional Notes: Available to students enrolled on the MSc in Environmental Drone Remote Sensing only.
Candidates for the MSc degree are completed on submission of a dissertation and approved by examiners. Dissertations may only be submitted for examination following the successful completion of Part One. To succeed, dissertations must have a mark of 50% or higher. The dissertation has a relative value of 0.5 (ie Part 1 equivalent value) when calculating the final MSc degree classification. A full-time thesis is normally conducted from June to mid-September in the second and third periods of study. However, in recognition of the fact that many Masters level students have significant areas of interest / expertise, or would like to undertake projects that require monitoring or extended fieldwork, dissertation work may begin at any time before this date (subject to approval of the subject by their supervisors) and students are encouraged to begin their research early. As a personal choice, or in some cases as a result of bursary conditions, students may wish / need to undertake a research project in partnership with industry. All subjects and details of a partnership must be approved by the module coordinator and academic supervisor before the student begins the research. Please note that supervisors have many duties as well as offering guidance and support to students writing their dissertations, including research and fieldwork abroad. You should therefore assume that your supervisor in Swansea cannot be contacted throughout the entire research period.

TRAETHAWD DRWY YR IAETH CYMRAEG - DISSERTATION THROUGH THE WELSH LANGUAGE
Gwahoddir myfyrwyr Cymraeg i gyflwyno eu traethawd hir yn y Gymraeg. Fodd bynnag, nid oes gorfodaeth arnynt i
wneud hynny os yw'n well ganddynt ysgrifennu yn Saesneg. Rhaid i fyfyrwyr sy'n bwriadu cyflwyno eu traethawd hir
yn y Gymraeg hysbysu cydlynydd y modiwl, a chofrestru eu diddordeb gyda Swyddfa Gweinyddu Dysgu'r Coleg
erbyn y dyddiad olaf a nodir gan y Brifysgol.
Fel arfer, cynhelir sesiynau goruchwylio / tiwtorialau / seminarau yn Saesneg, gan adlewyrchu gallu ieithyddol
presennol staff yr Adran Daearyddiaeth. Ymdrechir i sicrhau bod y traethawd hir yn cael ei farcio gan siaradwr
Cymraeg sydd â'r arbenigedd perthnasol. Fodd bynnag, os na fydd hynny'n bosibl, efallai y bydd angen cyfieithu'r
traethawd hir. Dylai ymgeiswyr fod yn ymwybodol y gall hyn arwain at beth oedi yn y broses asesu.
Mae'r un meini prawf fformatio a chosbau'n ddilys ar gyfer traethawd hir yn y Gymraeg neu'r Saesneg. Dylai'r
ddogfen ysgrifenedig fod o'r safon a'r ansawdd a ddisgwylir ar lefel gradd uwch. Efallai y bydd o gymorth i fyfyrwyr
sy'n ysgrifennu yn y Gymraeg i gynnwys geirfa o'r termau allweddol yn y flaenddalen/ mewn atodiad i'r ddogfen a
gyflwynir.
(Translation: Welsh-speaking students are invited to submit their thesis through the medium of Welsh, although they
are not obliged to do so if they would prefer to write in English. Students planning to submit their dissertation in
Welsh are required to notify their module co-ordinator and to register their interest with the Teaching and Administration Office by the specified University deadline.
Supervisions/Tutorials/Seminars will normally be held in English reflecting the current linguistic competences within
the Department of Geography. Effort will be made for the dissertation to be marked by a Welsh speaker with
relevant expertise, however, where this is not possible, the dissertation may require translation. Candidates should
be aware that this may result in a slight delay to the assessment process.
For dissertations submitted through the medium of Welsh, the same formatting criteria and penalties apply as for
the English language submissions. The written document should be of a quality and to a standard that is expected

for a higher degree. Students writing in Welsh may also find it helpful to incorporate a glossary of key-terms as a
cover page/Appendix within the submitted document).

GEGM09 Environmental Drone Remote Sensing

Credits: 20 Session: 2023/24 January-June

Pre-requisite Modules: GEGM03

Co-requisite Modules:

Lecturer(s): Dr JAB Rosette, Prof PRJ North

Format: 10 hours seminar
10 hours small group computer based tutorial
5 hours field data collection

Delivery Method:
All Programmes will employ a blended approach to delivery using the Canvas Digital Learning Platform for live and self-directed online activity, with live and self-directed on-campus activities each week. Students may also have the opportunity to engage with online versions of sessions delivered on-campus.

Module Aims: This module will teach students to plan, capture and process their own high-resolution datasets using multispectral, thermal and RGB sensors on board drone platforms. Students will learn the principles of photography applied to drone imagery, including multi-spectral analysis, and extended to 3D perception and stereo imagery analysis. Next, this knowledge will be related to image capture from a moving platform, and the effect of flight parameters. This knowledge will then be used to inform flight mission planning for a range of environmental monitoring applications. Students will apply and be tested in the skills learnt for real-world needs through three assessed project assignments, demonstrating application of multi-spectral, thermal and 3D structure data.

Module Content: Introduction
This module will teach students to plan, capture and process their own high-resolution datasets using multispectral, thermal and RGB sensors on board drone platforms. Students will learn the principles of photography applied to drone imagery, including multi-spectral analysis, and extended to 3D perception and stereo imagery analysis. Next, this knowledge will be related to image capture from a moving platform, and the effect of flight parameters. This knowledge will then be used to inform flight mission planning for a range of environmental monitoring applications. Students will apply and be tested in the skills learnt for real-world needs through three assessed project assignments, demonstrating application of multi-spectral, thermal and 3D structure data.

Indicative Lecture Topics
- Review of current environmental drone monitoring applications
- Flight mission planning principles and software
- Principles of high spatial resolution image processing
- Mosaicing and image geometric correction
- Interpretation of multi-spectral imagery
- Interpretation of thermal imagery
- 3D reconstruction through structure from motion
- 3D reconstruction using lidar point clouds

Indicative field data collection
- Data collection over vegetated plots to analysis vegetation cover fraction and health
- Urban data collection to analyse thermal and height variation

Indicative Computer Project Exercises
- Flight mission planning using UgCS software
- Analysis of multispectral drone data using ENVi software
- Analysis of thermal drone data using ENVI software
- 3D reconstruction from drone imagery using structure from motion software

Intended Learning Outcomes: At the end of this module, the student will be able to:
1) Discuss aspects of a range of environmental issues suitable to be addressed by drone remote sensing
2) Apply concepts of multispectral remote sensing to the interpretation of drone imagery
3) Summarise the principles of 3D reconstruction from drone imagery
4) Design flight missions to capture thermal, multispectral and 3D data
5) Use image processing software to analyses high spatial resolution drone imagery

Assessment: Coursework 1 (25%)
Coursework 2 (25%)
Coursework 3 (50%)

Assessment Description: 25% Coursework 1: Multispectral remote sensing: Practical assignment comprising mission design and planning; flight campaign; data capture and data analysis (1000 words) 25% Coursework 2: Thermal remote sensing: practical assignment comprising mission design and planning; flight campaign; data capture and data analysis (1000 words) 50% Coursework 3: Structure from Motion: Practical assignment comprising mission design and planning; flight campaign; data capture and multi-stage data analysis (1500 words)
Moderation approach to main assessment: Universal Non-Blind Double Marking of the whole cohort
Assessment Feedback: Continual assessment feedback is given in writing on standard departmental feedback forms.
Failure Redemption: Resubmit continual assessment material.
Additional Notes: Delivery of both teaching and assessment will be blended including live and self-directed activities online and on campus.

GEGM10 Satellite Remote Sensing

Credits: 20 Session: 2023/24 September-January

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr JAB Rosette

Format: 20
Contact Hours will be delivered through a blend of live activities online and on-campus, and may include, for example, lectures, seminars, practical sessions and Academic Mentoring sessions.

Delivery Method: All Programmes will employ a blended approach to delivery using the Canvas Digital Learning Platform for live and self-directed online activity, with live and self-directed on-campus activities each week. Students may also have the opportunity to engage with online versions of sessions delivered on-campus

Primarily on campus

Module Aims: This module explains the use of remote sensing as a tool for gathering and analyzing information about human resources and the natural environment. It is appropriate for students who would find it valuable to understand how information about human activity and environmental change is retrieved from images of the Earth acquired by satelite or aircraft instruments. Emphasis is placed on the role of ongoing missions in providing operational information for science and society. Lecture material is supported by hands-on experience exploring satellite images in a computer environment.

Module Content: This module explains the use of remote sensing as a tool for gathering and analysing information about human resources and the natural environment. It is appropriate for students who would it valuable to understand how information about human activity and environmental change is retrieved from images of the Earth acquired by satellite or aircraft instruments. Emphasis is placed on the role of ongoing missions in providing operational information for science and society.
Elements of Geographic Information Systems (GIS) appropriate for dealing with spatially-explicit image data are examined. Lecture material is supported by hands on experience exploring satellite images in a computer environment.
Outline of lecture topics:
The role of remote sensing in providing information about human acitivity and environmental processes.
Principles behind the technology of satellites, imaging intruments and data analysis.
Applications of remote sensing: The following topics will be examined in terms of their requirement for infomation, the development of specific tools and techniques, and the results achieved:
a. Human resources: Forestry and agriculture
b. The human environment: The urban landscape
c. The natural environment: The atmosphere and oceans
d. Environmental change: The land surface and global vegetation
Environmental monitoring: Snow and ice
Example practical sessions:
Practical sessions will be carried out in a computer laboratory and written reoprts of the findings will form the continuous assessment assignments. These sessions will include:
Exploring spatial and spectral features in optical satellite images
Comparing data image data from different parts of the spectrum
Global satellite data and time-series analysis
Topographic analysis and visualisation of remotely-sensed data
Finding and acquiring remote-sesing sata using catalogues and archives.

Intended Learning Outcomes: Conceptual understanding of the purpose and scope of remote sensing.
Comprehensive understanding of how remote sensing techniques provide information about human resources and environmental processes.
Critical awareness of current remote sensing systems and ongoing research for monitoring human and natural environments.
Ability to explore, interpret and analyze satellite images in a computer environment.

Assessment: Examination 1 (50%)
Coursework 1 (50%)

Assessment Description: Exam (50%) - 2 hour exam
Coursework (50%) - 2500 word practical report

Moderation approach to main assessment: Universal Non-Blind Double Marking of the whole cohort

Assessment Feedback: Students will receive examination feedback after exams if taken in January. Continual assessment feedback is given in writing on standard departmental feedback forms.

Failure Redemption: resit examination or resubmit continual assessment whichever if applicable

Reading List: James B. Campbell 1944-, Randolph H Wynne, Introduction to remote sensing / James B. Campbell, Randolph H. Wynne., Guilford Press, 2011.ISBN: 9781609181765
Campbell, James B.,, Introduction to remote sensing / James B. Campbell., Taylor & Francis,, c2007..ISBN: 9780415416887
Robert A. Schowengerdt author., Remote sensing : models and methods for image processing / Robert A. Schowengerdt., Burlington, MA : Academic Press is an imprint of Elsevier, 2007.ISBN: 9780123694072
Paul M. Mather, Magaly Koch, Computer processing of remotely-sensed images : an introduction / Paul M. Mather and Magaly Koch., Wiley-Blackwell, 2011.ISBN: 9780470742389
Liang, Shunlin., Quantitative remote sensing of land surfaces / Shunlin Liang., Wiley-Interscience,, c2004..ISBN: 0471281662
Lillesand, Thomas M., author., Kiefer, Ralph W., author.; Chipman, Jonathan W., author., Remote sensing and image interpretation, Wiley, 2015.ISBN: 111834328X

Additional Notes: Delivery of both teaching and assessment will be blended including live and self-directed activities online and on-campus.

Available to visiting or exchange students with permission from scheme coordinator.

GEGM21 Climate Change - Past, Present and Future

Credits: 20 Session: 2023/24 January-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr J Hiemstra, Dr PG Albert

Format: LECTURES (18 hours)

Delivery Method: LECTURES (video materials and face-to-face sessions)

Module Aims: This module will examine the Earth's climate system, and the principal natural and anthropogenic forcing mechanisms controlling it. The detection and nature of recent environmental changes will be discussed within the context of the Earth's climate history . The tools and methods used to measure, predict and study climate changes will be introduced. This will include the fundamental structure of General Circulation Models and how these techniques may be employed in conjunction with instrumental and proxy data to study the climate of the past and to reduce uncertainty in future climate change projections.

Module Content: Outline of lecture topics:

Fundamentals of climatology:

The development of the global climate system - an introduction.
Internal climate forcings (thermohaline circulation, greenhouse gases and ice cores)
External climate forcings (solar variability, volcanic eruptions, asteroid impacts)
Large-scale climate phenomena e.g., SE Asian Monsoon, El Niño/Southern Oscillation, Arctic Oscillation, ITCZ.
Recent climatic change - magnitude, detection, evidence and attribution.
The international response - IPCC, Kyoto, wider climate change debate.

Reducing uncertainty in future climate change projections:

Past Climatic Change the key to understanding the future? - Glacial/Interglacial, evidence for the “Little Ice Age” and “Medieval Warm Period”.
Methods in quantitative palaeoclimatology - the last 1000 years.
Modelling Climate - an introduction.
Combining climate model and proxy data to refine estimates of future environmental change.

Intended Learning Outcomes: See Module Aims

Assessment: Examination 1 (80%)
Coursework 1 (20%)

Assessment Description: Exam (80%) - 2 hour exam
Coursework (20%) - 7 Canvas quizzes

Moderation approach to main assessment: Universal Non-Blind Double Marking of the whole cohort

Assessment Feedback: Students will receive examination feedback after exams. Continual assessment feedback is given in sessions.

Failure Redemption: Re-sit examination.

Reading List: Ruddiman, W. F. (William F.), Earth's climate : past and future / William F. Ruddiman., W.H. Freeman and Company, 2013.ISBN: 9781429255257
Stocker, Thomas, Climate change 2013 : the physical science basis : Working Group I contribution to the Fifth assessment report of the Intergovernmental Panel on Climate Change / edited by Thomas F. Stocker, Working Group I co-chair, University of Bern [and nine others]., 2014.ISBN: 9781107661820
Raymond S. Bradley 1948- author., Paleoclimatology : reconstructing climates of the quaternary / Raymond S. Bradley., Oxford : Academic Press is an imprint of Elsevier, 2015.ISBN: 9780123869135
Lowe, J. J. (Joseph John); Walker, M. J. C. (Michael James Cawthorne), Reconstructing quaternary environments / John Lowe and Mike Walker., 2014.ISBN: 9780131274686
Kump, Lee R., Crane, Robert G., Kasting, James F., The earth system / Lee R. Kump ; James F. Kasting ; Robert G. Crane., Pearson Education,, 2011.ISBN: 9780321733283
Barry, Roger Graham., Chorley, Richard J., Atmosphere, weather, and climate / Roger G. Barry and Richard J. Chorley., Routledge,, 2010.ISBN: 9780415465700

Additional Notes: Delivery of both teaching and assessment will be blended including live and self-directed activities online and on-campus.

N/A

GEGM22 Geographical Information Systems

Credits: 20 Session: 2023/24 September-January

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Prof AJ Luckman, Dr RJ Fry, Dr Y Sun

Format: 32
Contact Hours will be delivered through a blend of live activities online and on-campus, and may include, for example, lectures, seminars, practical sessions and Academic Mentoring sessions.

Delivery Method: Online asynchronous mini-lectures and demonstrations, remote or in-person computer lab access for working through exercises at a time to suit the student, one hour per week timetabled in-person contact for help and advice, and 3 hours per week synchronous timetabled help session via zoom

Module Aims: This module will provide students from a range of disciplines including Geography and Bioscience with a comprehensive understanding of Geographic Information Systems, and key practical skills in the market-leading open-source GIS software tool Quantum GIS (QGIS). At the end of the module students will know how and where to acquire geospatial data, how to combine and analyse these data for specific objectives, and how to visualise primary and derived data in the form of maps.

Module Content: INTRODUCTION
This module will provide students from a range of disciplines including geography and bioscience, with a comprehensive understanding of Geographical Information Systems and key skills in using GIS within their research work and future careers. It will take a hands-on approach in a computer lab, combined with a series of lectures, to address the learning outcomes. Emphasis will be placed on equipping students with practical skills in the Quantum GIS (QGIS) software, and giving them the ability to import, combine, spatially analyse, and map a range of data from field survey, government agencies and census statistics.

INDICATIVE LECTURE TOPICS
- Introduction to GIS in Geography and Bioscience
- Sources and types of geospatial data relevant to Geography and Bioscience
- Aspects of visualizing and manipulating data from understanding the geographic reference frame through to spatial filters, spatial interpolation and map projections
- Approaches to querying data including combining attributes, selection of elements using spatial and attribute data, containment within regions and selection through proximity
- Elements of data analysis including spatial statistics, analysis of road and other communication networks, and surface elevation studies including line-of-sight visibility
- Basics of mapping and map design from cartographic principles, through symbolism and generalization, to human perception of space and essential reference data.

INDICATIVE COMPUTER PRACTICAL EXERCISES
- Importing and manipulating GIS layers
- Digitising and geocoding new data
- Querying, measurement and retrieval
- Raster and vector analysis
- Combining layers using containment and buffering
- Analysis of pathways within a transport network
- Topographic analysis, visualisation and viewsheds

Intended Learning Outcomes: At the end of this module, the student will:
1) Have a critical awareness of the purpose, scope and potential applications of Geographical Information Systems (GIS).
2) Understand the nature of geospatial data and be able to critically evaluate a range of geospatial data types.
3) Be able to synthesize a range of primary (e.g. GPS, remote sensing) and secondary (e.g. Ordnance Survey, UK census) sources of geospatial data.
4) Be familiar with the QGIS software package whilst having a critical awareness of the strengths and weaknesses of alternative commercial and freeware GIS software tools.
5) Have the skills to import, combine and synthesize geographic data from multiple map sources in QGIS.
6) Understand data standards and formats such as GeoTiff, Shape Files and KML, and be able to exchange geospatial data between software packages.
7) Be skilled in applying a range of GIS analysis tools from basic data editing to view-shed and network analysis.
8) Be able to critically evaluate evaluate maps using cartographic principles and results from advanced applications of GIS, based on case studies from epidemiology, demography, biological habitat mapping and geography.
9) Have the skills to develop a GIS project from basic data sourcing to spatial analysis and map visualization.

Assessment: Coursework 1 (10%)
Coursework 2 (20%)
Coursework 3 (10%)
Coursework 4 (60%)

Assessment Description: Coursework 1: Specimen Map. Individual formative assignment submitted through Turnitin and marked online
Coursework 2: Project proposal with map of indicative dataset. Individual Turnitin assignment submitted through Turnitin and marked online
Coursework 3: Multiple Choice Quiz. Individual randomized MCQ based on the course content and marked automatically online
Coursework 4: Project report. Individual summative assignment submitted through Turnitin and marked online

Moderation approach to main assessment: Moderation of the entire cohort as Check or Audit

Assessment Feedback: Student will receive feedback within 3 weeks of submission on all assignments. Feedback will include both individual formative comments and general group comments.

Failure Redemption: Resubmit failed component(s)

Reading List: QGIS, QGIS Tutorial.
D. Ian Heywood author., Sarah Cornelius author.; Steve Carver author., An introduction to geographical information systems / Ian Heywood, Sarah Cornelius, Steve Carver., Harlow : Pearson Education Limited, 2011.ISBN: 9780273722595
Paul. Longley, Geographic information science & systems / Paul A. Longley, University College London, UK, Michael F. Goodchild, University Of California, Santa Barbara, USA, David J. Maguire, Birmingham City University, UK, and David W. Rhind, City University, London, UK., Hoboken, NJ : Wiley, 2015.ISBN: 9781118676950
Burrough, P. A., author., McDonnell, Rachael, author.; Lloyd, Christopher D., author., Principles of geographical information systems, Oxford University Press, 2015.ISBN: 9780198742845
Christopher B. Jones, Geographical information systems and computer cartography / by Christopher B. Jones., Longman, 1997.ISBN: 9780582044395

Additional Notes: Delivery of both teaching and assessment will be blended including live and self-directed activities online and on-campus.

This module is available to all postgraduate students within the Faculty of science and engineering, Medicine and Human and Health Sciences. Student should be familiar with basic computing and will benefit from numeracy skills.