MODULE DESCRIPTION FORM

نموذج وصف المادة الدراسية

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| **Module Information****معلومات المادة الدراسية** |
| **Module Title** | Satellite Positioning Systems | **Module Delivery** |
| **Module Type** | Core | * **☒ Theory**
* **☒ Lecture**
* **☒ Lab**
* **☐ Tutorial**
* **☒ Practical**
* **☐ Seminar**
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| **Module Code** | / |
| **ECTS Credits**  | 6 |
| **SWL (hr/sem)** |  150 |
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| **Module Level** | UGx11 4 | **Semester of Delivery** | 7 |
| **Administering Department** | Type Dept. Code |  **College** |  Type College Code |
| **Module Leader** | Zahraa Ezzulddin Hussein |  **e-mail** | Zahraa\_azeldeen@coeng.uobaghdad.edu.iq |
| **Module Leader’s Acad. Title** | Assistant Professor | **Module Leader’s Qualification** | MSC |
| **Module Tutor** | Name (if available) |  **e-mail** | E-mail |
| **Peer Reviewer Name** | Name |  **e-mail** | E-mail |
| **Scientific Committee Approval Date** | 01/06/2023 | **Version Number** | 1.0 |

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| **Relation with other Modules****العلاقة مع المواد الدراسية الأخرى** |
| **Prerequisite module** | None | **Semester** |  |
| **Co-requisites module** | None | **Semester** |  |

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| **Module Aims, Learning Outcomes and Indicative Contents****أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية** |
|  **Module Objectives****أهداف المادة الدراسية** | 1. The course aims to give comprehensive [information](https://dictionary.cambridge.org/dictionary/english/training) in all [aspects](https://dictionary.cambridge.org/dictionary/english/aspect) of the subject of [surveying](https://dictionary.cambridge.org/dictionary/english/business) with GNSS systems.
2. To understand principles, observation methods, data transfer , basic process.
3. This course aims to give basic information of GNSS segments, GNSS Signal structure
4. Basic concept of the GNSS receivers in terms of types, parts, and it is work.
5. Give principle of GNSS orbits types , Reference Coordinate Systems
6. To understanding Mathematical Models for Positioning by GNSS for each cases with specific configuration.
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| **Module Learning Outcomes****مخرجات التعلم للمادة الدراسية** | Important: Write at least 6 Learning Outcomes, better to be equal to the number of study weeks.1. Explore the features, applications, and societal significance of GNSS in today's world.
2. Define various coordinate systems encountered by GNSS users, calculate GPS coordinates, and engage in a discussion about them.
3. Describe global satellite navigation systems, satellite orbital characteristics, and the structure of satellite signals.
4. Outline the fundamental characteristics of GPS/GNSS and trace their developmental history.
5. Discuss the principles of GNSS observations, conduct observations using a GNSS receiver, and analyze the collected data.
6. Explain different techniques employed in GNSS observations, calculate and evaluate the levels of accuracy associated with them.
7. Identify and discuss essential project planning considerations when utilizing GNSS, and outline the key steps involved in planning a GNSS data collection project for asset mapping.
8. Explain the procedures involved in GNSS data collection and processing, including Differential GNSS techniques (code and phase), and assess the collected and processed data.
9. The students get basic techniques to perform plan and measurements by GNSS receivers based on receiver type and observation method requirement for specific project.
10. Represent GPS with other geospatial data on a map.
11. Apply GPS technologies to real world scenarios using an understanding of GPS theory and practices.
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| **Indicative Contents****المحتويات الإرشادية** | Indicative content includes the following.Part A - GNSS principle, segments and structureOverview of GPS/ GNSS concept , Introduction to the satellite-based positioning systems ,GPS/GNSS segments. Overview of GNSS positioning system work in practical case and define the common terms used in practical GNSS survey. Overview of GNSS receiver types and comparison between them in terms of accuracy, cost, data results, and limitations …etc. present and describe each parts of grad survey GNSS receiver and explained how it is work (mechanical and physical) [12 hrs]Theory and practical of GNSS receiver work,GPS/GNSS observable (Carrier phase vs code measurement),Pseudo-Random Noise (PRN) codes and modulation, Navigation Message (NAV)present manual of handheld GPS receiver and show how we can use the manual for observations (guide students for using the manual for training as self-learning) ,Field work for collecting data using handheld GNSS receiver and use all techniques that were learned from the handheld manual for create a way points and perform the stake out using compass with special technique, Transfer data (way points coordinates) from the handheld receiver using USB / Serial cable, and import it in Google earth map, and make a report included coordinates, distances, close errors, and accuracy), present manual of survey-grade GNSS receiver for define its parts and make a main configuration (like interval, mask angle, receiver antenna type, observation method, initialization time, coordinates system, precision, and ..etc) [20 hrs]Introduction to basic concept of Satellite orbital motions,Types of satellite orbits (almanc, broadcast, and precise orbit), basic concept to configure geodesy GNSS receiver and make observations using static method. [12 hrs]Part B - GNSS mathematical and observation techniquesReference Coordinate Systems (ECI, ECEF),Geodetic Datum (WGS 84, North American Datum 1983) International Terrestrial Reference Frames ITRF, field work for configure geodesy GNSS receiver and make observations using static method. [12]Observation Method teqhniches (single point positioning vs relative point positioning),Mathematical Models for Positioning by GNSS (code ranges using Static and RTK technique),Mathematical Models for Positioning by GNSS (carrier phase using Static and RTK technique)[16hrs]change the elements of configuration receiver and find the effect on horizontal and vertical accuracy. (like change cut angle, interval, epoch, initialization time, satellite system, frequency ...etc)determine different lengths ranging from .5 meter to 20 meter and observe them by GNSS receiver, feet bar, and Total Stations. Then compute the horizontal and vertical differences of different lengths resulted from above devices to determine the accuracy .[16]Process GNSS data and Download observation files from Iraqi cors using NGS services . [12] |

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| **Learning and Teaching Strategies****استراتيجيات التعلم والتعليم** |
| **Strategies** | Active Learning: This approach encourages learners to actively engage in the learning process through activities such as discussions, problem-solving, group work, and hands-on experiments. It promotes critical thinking, collaboration, and retention of information.Inquiry-Based Learning: In this strategy, learners are presented with open-ended questions or problems to investigate and explore. They develop their understanding and knowledge through research, experimentation, and analysis, fostering curiosity, problem-solving skills, and independent thinking.Collaborative Learning: This strategy emphasizes group work and cooperation among learners. It promotes communication, teamwork, and the sharing of ideas and knowledge. Collaborative learning can involve activities such as group projects, discussions, and peer teaching.Flipped Classroom: In a flipped classroom model, learners study the material independently outside of class, typically through pre-recorded lectures or online resources. Class time is then used for discussions, problem-solving, and clarification of concepts, allowing for more interactive and personalized learning experiences.Visual Aids and Multimedia: Incorporating visual aids, such as diagrams, charts, and videos, can enhance understanding and retention of information. Multimedia tools and technologies can be used to present content in an engaging and interactive manner, catering to different learning preferences..Feedback and Assessment: Providing timely and constructive feedback is crucial for effective learning. It helps learners understand their strengths and areas for improvement. Various assessment methods, including formative assessments (e.g., quizzes, discussions) and assessments (e.g., exams, projects), can be used to evaluate learning progress and provide feedback. |

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| **Student Workload (SWL)****الحمل الدراسي للطالب محسوب لـ ١٥ اسبوعا** |
| **Structured SWL (h/sem)****الحمل الدراسي المنتظم للطالب خلال الفصل** | 78 | **Structured SWL (h/w)****الحمل الدراسي المنتظم للطالب أسبوعيا** | 7 |
| **Unstructured SWL (h/sem)****الحمل الدراسي غير المنتظم للطالب خلال الفصل** | 72 | **Unstructured SWL (h/w)****الحمل الدراسي غير المنتظم للطالب أسبوعيا** | 6 |
| **Total SWL (h/sem)****الحمل الدراسي الكلي للطالب خلال الفصل** | **150** |

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| **Module Evaluation****تقييم المادة الدراسية** |
| **As** | **Time/Number** | **Weight (Marks)** | **Week Due** | **Relevant Learning Outcome** |
| **Formative assessment** | **Quizzes** | 2 | 10% (10) | 5 and 10 | LO #1, #2 and #10, #11 |
| **Assignments** | 2 | 10% (10) | 2 and 12 | LO #3, #4 and #6, #7 |
| **Projects / Lab.** | 1 | 10% (10) | Continuous | All  |
| **Report** | 1 | 10% (10) | 13 | LO #5, #8 and #10 |
| **Summative assessment** | **Midterm Exam** | 2hr | 10% (10) | 7 | LO #1 - #7 |
| **Final Exam** | 3hr | 50% (50) | 16 | All |
| **Total assessment** | 100% (100 Marks) |  |  |

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| **Delivery Plan (Weekly Syllabus)****المنهاج الاسبوعي النظري** |
| **Week**  | **Material Covered** |
| **Week 1** | Overview of GPS/ GNSS concept |
| **Week 2** | Introduction to the satellite-based positioning systems |
| **Week 3** | GPS/GNSS segments |
| **Week 4** | Theory and practical of GNSS receiver work |
| **Week 5** | GPS/GNSS observable (Carrier phase vs code measurement) |
| **Week 6** | Pseudo-Random Noise (PRN) codes and modulation |
| **Week 7** | Navigation Message (NAV) |
| **Week 8** | Introduction to basic concept of Satellite orbital motions |
| **Week 9** | Types of satellite orbits (almanc, broadcast, and precise orbit) |
| **Week 10** | Reference Coordinate Systems (ECI, ECEF) |
| **Week 11** | Geodetic Datum (WGS 84, North American Datum 1983) |
| **Week 12** | International Terrestrial Reference Frames ITRF and comparison with other References  |
| **Week 13** | Observation Method techniques (single point positioning vs relative point positioning) |
| **Week 14** | Mathematical Models for Positioning by GNSS (code ranges using Static and RTK technique) |
| **Week 15** | Mathematical Models for Positioning by GNSS (carrier phase using Static and RTK technique) |
| **Week 16** | **Preparatory week before the final Exam** |

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| **Delivery Plan (Weekly Lab. Syllabus)****المنهاج الاسبوعي للمختبر** |
| **Week**  | **Material Covered** |
| **Week 1** | * 1. Overview of GNSS positioning system work in practical case and define the common terms used in practical GNSS survey.
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| **Week 2** | * 1. Overview of GNSS receiver types and comparison between them in terms of accuracy, cost, data results, and limitations …etc.
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| **Week 3** | * 1. present and describe each parts of grad survey GNSS receiver and explained how it is work (mechanical and physical)
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| **Week 4** | * 1. present manual of handheld GPS receiver and show how we can use the manual for observations (guide students for using the manual for training as self-learning)
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| **Week 5** | * 1. Field work for collecting data using handheld GNSS receiver and use all techniques that were learned from the handheld manual for create a way points and perform the stake out using compass with special technique,
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| **Week 6** | * 1. Transfer data (way points coordinates) from the handheld receiver using USB / Serial cable, and import it in Google earth map, and make a report included coordinates, distances, close errors, and accuracy)
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| **Week 7** | * 1. present manual of survey-grade GNSS receiver for define its parts and make a main configuration (like interval, mask angle, receiver antenna type, observation method, initialization time, coordinates system, precision, and ..etc)
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| **Week 8** | * 1. field work for configure geodesy GNSS receiver and make observations using static method.
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| **Week 9** | * 1. Transfer data from the geodesy GNSS receiver using SD memory card and cable, and import data using commercial software belongs to manufacturer of the receiver (like Topcon link software), and process data (like Topcon tools software).
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| **Week 10** | * 1. Field work: GNSS receiver configuration (RTK setting) and make observations using local RTK method
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| **Week 11** | * 1. Transfer RTK file from the controller, and import data using commercial software (like Topcon link).
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| **Week 12** | * 1. field work for accuracy assessment: change the elements of configuration receiver and find the effect on horizontal and vertical accuracy. (like change cut angle, interval, epoch, initialization time, satellite system, frequency ...etc)
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| **Week 13** | * 1. field work for accuracy assessment : determine different lengths ranging from .5 meter to 20 meter and observe them by GNSS receiver, feet bar, and Total Stations. Then compute the horizontal and vertical differences of different lengths resulted from above devices to determine the accuracy .
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| **Week 14** | * 1. field work for accuracy assessment : determine different lengths ranging from .5 meter to 20 meter and observe them by GNSS receiver, feet bar, and Total Stations. Then compute the horizontal and vertical differences of different lengths resulted from above devices to determine the accuracy .
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| **Week 15** | * 1. Download observation files from Iraqi CORS using NGS services (User Friendly CORS), https://geodesy.noaa.gov/UFCORS/ .
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| **Learning and Teaching Resources****مصادر التعلم والتدريس** |
|  | **Text** | **Available in the Library?** |
| **Required Texts** |  | Yes |
| **Recommended Texts** | 1. Bacci, G., Falletti, E., Fernández-Prades, C., Luise, M., Margaria, D. & Zanier, F. 2011. Chapter 2 - Satellite-Based Navigation Systems. Satellite and Terrestrial Radio Positioning Techniques. Oxford: Academic Press.
2. H. [Bernhard](http://www.amazon.co.uk/s/ref%3Dntt_athr_dp_sr_1?_encoding=UTF8&field-author=Bernhard%20Hofmann-Wellenhof&search-alias=books-uk), L. [Herbert](http://www.amazon.co.uk/s/ref%3Dntt_athr_dp_sr_2?_encoding=UTF8&field-author=Herbert%20Lichtenegger&search-alias=books-uk), and W. [Elmar](http://www.amazon.co.uk/s/ref%3Dntt_athr_dp_sr_3?_encoding=UTF8&field-author=Elmar%20Wasle&search-alias=books-uk) (2010) "GNSS - Global Navigation Satellite Systems: GPS, GLONASS, Galileo, & more", Spring Wien New York, Austria.
3. Kaplan, E. D. & Hegarty, C. J. (2006), "Understanding GPS: Principles and Applications", 2nd Edition, ARTECH HOUSE, Boston, London.
 | No |
| **Websites** |  |

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|  **Grading Scheme****مخطط الدرجات** |
| **Group** | **Grade** | **التقدير** | **Marks %** | **Definition** |
| **Success Group****(50 - 100)** | **A -** Excellent | **امتياز** | 90 - 100 | Outstanding Performance |
| **B -** Very Good | **جيد جدا**  | 80 - 89 | Above average with some errors |
| **C -** Good | **جيد** | 70 - 79 | Sound work with notable errors |
| **D -** Satisfactory | **متوسط**  | 60 - 69 | Fair but with major shortcomings |
| **E -** Sufficient | **مقبول**  | 50 - 59 | Work meets minimum criteria |
| **Fail Group****(0 – 49)** | **FX –** Fail | **راسب (قيد المعالجة)** | (45-49) | More work required but credit awarded |
| **F –** Fail | **راسب** | (0-44) | Considerable amount of work required |
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| **Note:** Marks Decimal places above or below 0.5 will be rounded to the higher or lower full mark (for example a mark of 54.5 will be rounded to 55, whereas a mark of 54.4 will be rounded to 54. The University has a policy NOT to condone "near-pass fails" so the only adjustment to marks awarded by the original marker(s) will be the automatic rounding outlined above. |