

**Integrated Learning in Medicine V and  
Bioinformatics**

Code: 106918  
ECTS Credits: 5

Degree	Type	Year	Semester
2502442 Medicine	OB	6	0

## Contact

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## Teaching groups languages

You can check it through this [link](#). To consult the language you will need to enter the CODE of the subject. Please note that this information is provisional until 30 November 2023.

## Teachers

Carlos Rodrigo Gonzalo De Liria

Vicenç Falco Ferrer

Gianluigi Caltabiano

Oriol Gasch Blasi

Angel Gonzalez Wong

## Prerequisites

It is advisable for the student to have achieved basic skills in clinical pathophysiology and semiology, structural pathology, complementary examination techniques, medical imaging, clinical and microbiological laboratory, as well as principles of pharmacology and therapeutics of the different devices and systems humans.

It is recommended that the student has achieved basic skills in the digital field, molecular biology, biostatistics and epidemiology.

Sufficient knowledge of physiopathology on the psychological bases of health and disease states is desirable, as well as an adequate level of knowledge in interpersonal communication

## Objectives and Contextualisation

This is a subject taught in the second semester of the fifth year of the Degree in Medicine. Like the other AIMs, it is a transversal subject that aims to develop some basic skills for the professional activity and scientific

thinking of medical graduates. It is intended to provide a comprehensive training of medical knowledge, so that the biological and pathophysiological bases of medicine and clinical disciplines are not considered isolated subjects without continuity.

During the course of the AIMs, they must try to develop some basic transversal skills for the professional activity and scientific thinking of medical graduates: argumentation based on evidence, ability to ask the most suitable questions, analysis and interpretation of data and application of physiopathological principles in the understanding of diseases. Generic self-learning skills such as teamwork, oral and written communication, reading and information research will also be developed, including the use of new information technologies and Bioinformatics.

During the teaching period, students will have to solve problem cases, the content of which will vary in each academic year. The work will be done in small groups and with the collaboration of a tutor responsible for each case and tutors responsible for the different course subjects involved in the development of the case. The subject will be developed in the problem-based learning format and combines tutoring sessions with independent work by the student.

In the presentation session of each case, the characteristics of the work to be developed will be explained. Students will have to attend the scheduled tutorials and consult all the sources they consider appropriate to solve the clinical problem raised, which will be presented to the whole class in the last session to close the case.

In the Bioinformatics Module, teaching will be of a mixed type..

An initial part of introduction to the different tools most used, a second part in which cases will be solved, first guided and tutored and then autonomously, to finally focus on a case, which will be worked on in small groups and what they will have to present at the last session (Congress).

The general training objectives of the subject are:

- Learn basic skills in medical practice
- Acquire the scientific bases of basic procedures in clinical medicine
- Learn basic skills in the use of information resources and Bioinformatics in medical research
- Integrate knowledge and content worked on in the rest of the core subjects of fifth year and previous years.
- Apply this knowledge to real situations based on simulated clinical cases.
- Develop syndromic and clinical diagnostic skills as well as therapeutic procedures.
- Develop generic self-learning skills: temporary organization of independent work, teamwork, information search, including new information technologies, critical analysis of information.
- Acquire the ability to prepare and present biomedical works-skills
- Communicate clearly, both orally and in writing, with other professionals and the media.
- Demonstrate that you understand the structure and function of the human body in a disease situation in the different stages of life and in both sexes.
- Demonstrate an understanding of the importance and limitations of scientific thinking in the study, prevention and management of disease.
- Demonstrate that you understand the manifestations of the disease on the structure and function of the human body.
- Demonstrate an understanding of the basic statistical methodologies used in biomedical and clinical studies and use the analysis tools of modern computational technology.
- Demonstrate a basic level of research skills. Demonstrate, in professional activity, a critical, creative and research-oriented point of view.
- Elaborate a diagnostic orientation and establish a reasoned action strategy, evaluating the results of the anamnesis and the physical examination, as well as the subsequent results of the indicated complementary examinations.
- Teach and communicate the knowledge and techniques learned to other professional groups.
- Listen carefully, obtain and synthesize relevant information about the problems that afflict the patient and understand the content of this information. Establish good interpersonal communication that enables you to address patients, relatives, companions, doctors and other healthcare professionals with efficiency and empathy.

- Formulate hypotheses and collect and critically assess information for problem solving following the scientific method. Indicate the most appropriate therapy for the most prevalent acute and chronic processes, as well as for terminally ill patients.
- Indicate the basic diagnostic techniques and procedures and analyze and interpret the results to better specify the nature of the problems.
- Maintain and update your professional competence, giving special importance to independent learning of new knowledge and techniques and to motivation for quality.
- Obtain and prepare a clinical history that contains all the relevant information, structured and focused on the patient, taking into account all age groups, sex, cultural, social and ethnic factors.
- Organize and plan appropriately the workload and time in professional activities.
- Carry out a general physical examination and by systems, appropriate to the patient's age and sex, in a complete and systematic way and a mental assessment.
- Recognize excellence, altruism, sense of duty, compassion, empathy, honesty, integrity and commitment to scientific methods as professional values.
- Recognize their role in multiprofessional teams, assuming leadership when appropriate, both for the provision of health care and in interventions for health promotion.
- Recognize the essential elements of the medical profession as a result of an evolutionary, scientific and sociocultural process, including ethical principles, legal responsibilities and patient-centered professional practice.
- Recognize one's own limitations and admit the opinions of other healthcare colleagues to be able to modify, if necessary, one's own initial opinion.
- Recognize, understand and apply the role of the doctor as manager of public resources.
- Write clinical histories, medical reports and other medical records in a way that is comprehensible to third parties.
- Use information and communication technologies in professional activity
- Critically evaluate and use clinical and biomedical information sources to obtain, organize, interpret and communicate scientific and health information.
- Effectively use electronic resources and Bioinformatics databases to obtain information. Identify the usefulness and potential of information technologies and bioinformatics resources in the different areas of knowledge and know how to apply them appropriately to draw relevant conclusions.

## Competences

- Communicate clearly, orally and in writing, with other professionals and the media.
- Convey knowledge and techniques to professionals working in other fields.
- Critically assess and use clinical and biomedical information sources to obtain, organise, interpret and present information on science and health.
- Demonstrate basic research skills.
- Demonstrate understanding of basic statistical methodologies used in biomedical and clinical studies and use the analytic tools of modern computational technology.
- Demonstrate understanding of the importance and the limitations of scientific thought to the study, prevention and management of diseases.
- Demonstrate understanding of the manifestations of the illness in the structure and function of the human body.
- Demonstrate understanding of the structure and function of the human organism in illness, at different stages in life and in both sexes.
- Demonstrate, in professional activity, a perspective that is critical, creative and research-oriented.
- Empathise and establish efficient interpersonal communication with patients, family-members, accompanying persons, doctors and other healthcare professionals.
- Engage in professional practice with respect for patients' autonomy, beliefs and culture, and for other healthcare professionals, showing an aptitude for teamwork.
- Establish a diagnostic approach and a well thought-out strategy for action, taking account of the results of the anamnesis and the physical examination, and the results of the appropriate complementary tests carried out subsequently.
- Formulate hypotheses and compile and critically assess information for problem-solving, using the scientific method.

- Indicate the basic diagnosis techniques and procedures and analyse and interpret the results so as to better pinpoint the nature of the problems.
- Indicate the most suitable treatment for the most prevalent acute and chronic processes, and for the terminally ill.
- Listen carefully, obtain and synthesise relevant information on patients' problems, and understand this information.
- Maintain and sharpen one's professional competence, in particular by independently learning new material and techniques and by focusing on quality.
- Obtain and prepare a patient record that contains all important information and is structured and patient-centred, taking into account all age and gender groups and cultural, social and ethnic factors.
- Organise and plan time and workload in professional activity.
- Perform a general and a system-by-system physical examination appropriate to the patient's age and sex, in complete and systematic way, and a mental evaluation.
- Recognise the basic elements of the medical profession as the result of an evolving, scientific, social and cultural process, including ethical principles, legal responsibilities and patient-oriented professional practice.
- Recognise the professional values of excellence, altruism, sense of duty, compassion, empathy, honesty, integrity and commitment to scientific methods.
- Recognise, understand and apply the doctor's role as a manager of public resources.
- Recognize one's role in multi-professional teams, assuming leadership where appropriate, both for healthcare provision and for promoting health.
- Use information and communication technologies in professional practice.
- Write patient records and other medical documents that can be understood by third parties.

## Learning Outcomes

1. Accept other viewpoints (lecturers, colleagues, etc.) regarding the problem or topic at hand.
2. Acquire the principles and values of good medical practice, both in health and in illness.
3. Adopt values of solidarity and service to others, both when dealing with patients and with the general public.
4. Apply analytic tests in accordance with their cost efficiency.
5. Appraise patients' expectations in order to respect them and act appropriately.
6. Assess the efficiency of the main therapeutic interventions.
7. Assess the importance of every sign and symptom in the current illness.
8. Assess the need, indications, contraindications, chronology, risk, benefits and costs of each examination.
9. Assess the relationship between efficacy and risk in the main therapeutic interventions.
10. Assess the semiological value of laboratory tests used in the most common human pathologies.
11. Be self-critical and reflect on one's own learning.
12. Calculate the cost efficiency of analytic tests.
13. Communicate clearly, orally and in writing, with other professionals and the media.
14. Compare one's own opinions with those of colleagues and other healthcare professionals as a basis for teamwork.
15. Conduct the interview correctly to obtain significant clinical data.
16. Convey knowledge and techniques to professionals working in other fields.
17. Correctly apply statistical techniques to obtain benchmark values and compare them to the results of analytic tests on patients.
18. Correctly record the information obtained in interviews with patients.
19. Critically assess the results of complementary examinations, taking their limitations into account.
20. Demonstrate basic research skills.
21. Demonstrate, in professional activity, a perspective that is critical, creative and research-oriented.
22. Describe the elements that should be considered when determining the reasons for a consultation and those of the patient's therapeutic itinerary.
23. Describe the organisation, characteristics and performance of the Spanish health system.
24. Describe the person as a multidimensional being in which the interplay of biological, psychological, social, environmental and ethical factors determines and alters the states of health and disease and their manifestations.
25. Distinguish normality from pathological alterations on performing a physical examination.

26. Distinguish situations that require hospitalisation and those that require intensive care.
27. Establish a method for complementary examinations, in accordance with the standard process and the diagnostic expectations.
28. Establish a therapeutic action plan considering the needs of patients and their family and social environment, and involving all members of the healthcare team.
29. Explain ethical, legal and technical features and those of confidentiality related to patient documentation.
30. Explain the mechanisms by which illness affects the different systems of the human body at different stages in life and in both sexes.
31. Formulate hypotheses and compile and critically assess information for problem-solving, using the scientific method.
32. Gather meaningful psychosocial data.
33. Gather, choose and record important information patient supplied by patients and accompanying persons.
34. Identify patients' social and health needs.
35. Identify serious clinical situations.
36. Identify sources of information on analytic tests for patients and professionals and critically evaluate their content.
37. Identify symptoms of anxiety, depression, psychosis, toxics consumption, delirium and cognitive deterioration.
38. Identify the basic principles of legislation on health and the right to health.
39. Identify the most efficient analytic tests for prevention, diagnosis and control of treatment for the most common human pathologies.
40. Identify the physical, chemical, environmental, psychological, social and occupational and carcinogenic factors, and the factors associated with food habits and drug use, that determine the development of the disease.
41. Identify type, evolution and limitations in chronic diseases, their possible treatments and prevention of complications.
42. Indicate and interpret the basic techniques and procedures for laboratory diagnosis, diagnostic imaging and others.
43. Indicate suitable therapeutic interventions for the main health problems.
44. Inform on the results of analytic tests.
45. Interpret population parameters of individual risks appropriately.
46. Involve the family in patient healthcare.
47. Maintain and sharpen one's professional competence, in particular by independently learning new material and techniques and by focusing on quality.
48. Obtain, in an appropriate way, clinical samples needed for laboratory tests.
49. Order signs and symptoms to perform a differential syndromic diagnosis.
50. Organise and plan time and workload in professional activity.
51. Summarise and order information on the problems of the sick.
52. Use appropriate statistical techniques to study the semiological value of analytic tests.
53. Use biomedical databases.
54. Use information and communication technologies in professional practice.

## Content

5 clinical cases are prepared based on the subjects and matters of Module 3 (human clinical training):

MIC IV (neurology, endocrinology, infectious diseases)

Pediatrics

Psychiatry

Clinical Dermatology

Some of the subjects from module 4 and module 2 are involved in solving the cases (when the case requires it):

Subjects of Module 4. Diagnostic and therapeutic procedures Medical microbiology and parasitology

Clinical radiology

Structural and molecular pathology

General pharmacology

Clinical pharmacology

Medical immunology

Subjects of Module 2.

Social medicine, communication skills and initiation into research

Preventive Medicine and Public Health

Legal Medicine and Toxicology

Bioinformatics module.

Practical sessions of Bioinformatics applied to Medicine

#### DISTRIBUTION BLOCKS

Presentation and solution of 5 reference cases of clinical pathology

Case 1 to be defined

Case 2 to be defined

Case 3 to be defined

Case 4 to be defined

Case 5 to be defined

Bioinformatics module: Guided sessions in the use of Bioinformatics techniques and information resources and tools

Resolution of 3 clinical cases to be defined by using the tools previously presented.

## Methodology

This Guide describes the framework, contents, methodology and general rules of the subject, in accordance with the current study plan. The final organization of the subject in terms of clinical cases, number and size of groups, distribution in the calendar and exam dates, specific evaluation criteria and review of exams, will be specified in each of the Units Hospital Teachers (UDH), who will explain this through their web pages and on the first day of class for each subject, through the professors responsible for the subject at the UDH.

For the current academic year, the professors designated by the Departments as responsible for the subject at Faculty and UDH level are:

Responsible department(s): Multidepartmental

Faculty Managers: Jaume Kulisevsky (jkulisevsky@santpau.cat)

Responsible UDH:UD Vall d'Hebron: Vicenç Falcó Ferrer vfalco@vhebron.net)

UD Germans Trias i Pujol: Carlos Rodrigo Gonzalo de Liria (crodrigo.germanstrias@gencat.cat)

UD Sant Pau: Jaume Kulisevsky Bojarski (jkulisevsky@santpau.cat)

UD Parc Taulí: Oriol Gasch Blasi (ogasch@tauli.cat)

Bioinformatics module: Angel González Wong (Angel.Gonzalez@uab.cat)

## TUTORS AND SESSIONS

Tutors: A case tutor for each of the subjects and/or subjects of module 3 that intervene in the clinical cases, who will be responsible for the cases, presentation, closure and specific tutoring.

Module 3: Human clinical training: MIC IV (neurology, endocrinology, infectious diseases): number of cases to be defined Pediatrics: number of cases to be defined Psychiatry: number of cases to be defined Clinical Dermatology: number of cases to be defined.

A reference tutor for each module 4 and module 2 subject that intervenes in the cases, responsible for the documentation, discussion and tutoring of their subject in the cases where it is necessary.

Module 4. Diagnostic and therapeutic procedures Medical microbiology and parasitology Clinical radiology Structural and molecular pathology General pharmacology, clinical pharmacology, medical immunology Module 2. Social medicine, communication skills and initiation into research-

Preventive Medicine and Public Health Legal Medicine and Toxicology

Sessions: Total activity: 3 ECTS credits = 75 hours.

Independent activity (55%; 41.25 hours): Personal study, preparation of cases and presentations

Directed activity: 40%, 30 hours (5 cases; one case = 6 hours; in 4 sessions) Assessment: 5%, 3.75 hours

Bioinformatics module:

Total activity: 2 ECTS credits = 50 hours.

Independent activity: Personal study, reading articles, work in computer rooms, preparation of cases and preparation of the presentation (52%; 26 hours)

Directed activity: Computer laboratory practices and attendance at the congress (44%, 22 hours)

Assessment: Oral presentation and defense of the resolution of a case -

Congress (4%, 2 hours)

Types of sessions

Sessions 1 and 4 (ABP typology): Initial presentation and final solution of the 5 cases 10h (Initial and final sessions 5h+5h)

Sessions 2,3.(ABP typology); 20 hours in two blocks of sessions:

Session 2 (ABP typology); Documentation sessions; block diagnostic and therapeutic procedures and social medicine, communication skills and initiation into research: 10 h (2 h per case; consecutive tutors are allowed)

Session 3 (ABP typology); Documentation sessions; block 4 and 2. Problem solving sessions, supervision of prepared simulated cases and presentation preparation: 10h (2h per case; allows consecutive tutors):

All students must know and participate more or less directly in the solution of all cases. The knowledge acquired and the participation and presentation of the solutions will be the basis of the evaluation of the subject. The enrollment group is divided into the corresponding groups of working students in each case. In the presentation session (session 1), led by the tutor responsible for the case, the entire registration group attends, the case is presented and the group of students working on the case is assigned. These groups will participate directly in the solution of each case in the documentation and problem-solving sessions (sessions 2-3), directed by the tutors of each subject involved in the case. In these sessions, the rest of the students in the enrollment group also participate as listeners, so they can also have direct access to the documentation and attend the discussion of problems in each case. In the final case solution session (session 4), led by the tutor responsible for the case, the group of students in the case present the solution to the entire enrollment group, so that all students have access to the discussion and solution final and can adequately acquire the knowledge essential for the final assessment, which includes all cases.

Example of temporal distribution

Week 1.

Presentation. ABP typology; enrollment group. Tutor responsible for the case. Presentation of the case, DD, methodology, referring tutors, sessions to follow. Case 1 1h Case 2 1h Case 3 1h Case 4 1h Case 5 1h

Week 2.

Documentation and problem solving. Typology ABP scheduled in the classroom of the enrollment group. Enrollment group attends, they work the case the case group. Tutors block PDT.

Documentation, problem solving and tutoring of the specific subjects of the case. Case 1 2h (3x40')\* Case 2 2h (3x40')\* Case 3 2h (3x40')\* Case 4 2h (3x40')\* Case 5 2h (3x40')\*\* 2, 3 or 4 consecutive sessions can be scheduled, depending on the number of reference tutors that suits each case (120' = 2x60', 3x40', 4x30')

Week 3. Problem solving and presentation supervision. Typology ABP scheduled in the classroom of the enrollment group.

Enrollment group attends, they work the case the case group. PDT block tutors and case tutor.

Problem solving and case presentation and solution tutoring

Case 1 2h (3x40')\*

Case 2 2h (3x40')\*

Case 3 2h (3x40')\*

Case 4 2h (3x40')\*

Case 5 2h (3x40')\*\*

2, 3 or 4 consecutive sessions can be scheduled, depending on the number of reference tutors that suits each case (120' = 2x60', 3x40', 4x30')

Week 4. Presentation and solution of the case. ABP typology; enrollment group

Tutor responsible for the case: Presentation of the case by the students, final diagnosis and closure of the case. Evaluation of the case and the presentation

Case 1 1h

Case 2 1h

Case 3 1h

Case 4 1h



Case 5 1h

Total case1: 6 h

Total case 2: 6 h

Total case 3: 6 h

Total case 4: 6 h

Total case 5: 6 h

Bioinformatics module:

All sessions are compulsory.

Sessions 1 to 4 (ABP typology): Introduction and use of the basic bioinformatics tools and resources to be used (4x2h)

Session 5 (ABP typology): Guided resolution of a case (2h)

Session 6-7 (ABP typology): Tutored resolution of a case (2x2h)

Session 8-9 (ABP typology): Resolution in groups (4-5 students) of the case to be presented in session 10 - Congress (2x2h)

Session 10 - Congress: Evaluated oral presentations of the case worked on in sessions 8-9 and independently / assistance in the presentations of the other cases (3x2h).

For all Bioinformatics sessions, the enrollment group is divided into the corresponding groups of students depending on the size of the IT classrooms where the sessions will be taught.

Exceptionally and according to the criteria of the responsible teaching staff, the available resources and the current health situation in the different Teaching Units, part of the content corresponding to the theoretical lessons, practicals and seminars may be taught face-to-face or virtually.

Note: 15 minutes of a class will be set aside, within the calendar established by the center/degree, for students to fill in the teacher performance and subject evaluation surveys/module.

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

## Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
PROBLEM-BASED LEARNING (PBL)	25	1	1, 2, 17, 4, 3, 12, 13, 14, 20, 21, 22, 23, 24, 25, 26, 16, 28, 27, 29, 11, 31, 41, 40, 30, 38, 37, 36, 34, 39, 35, 46, 42, 43, 44, 45, 47, 48, 49, 50, 15, 32, 33, 18, 51, 53, 54, 52, 19, 10, 6, 8, 9, 7, 5
Type: Autonomous			
PERSONAL STUDY / READING ARTICLES / REPORTS OF INTEREST	94.25	3.77	

## Assessment

### Evaluation activities

Each student will participate in the presentation and resolution of a case. The main evaluation methodology of this subject is the continuous evaluation of the groups during the four sessions in which the subject is divided.

These seek that students, regardless of the specific content of each case, learn to integrate concepts, to ask and answer appropriately, to work in teams assuming what others in the same group are doing and getting used to correcting others, so that the end result is common and shared.

### Presentation and discussion of the case

The presentation will be shared among all the students in the presentation group, on the scheduled day and in an equivalent presentation time. The case will be presented to the whole class (enrolment group), following a similar scheme and for a total approximate time of around 40 minutes

### Continued evaluation

It is mandatory to attend the presentation sessions of all the cases and the final sessions in which the students present the resolution of each of the cases.

Attendance at the various meetings held with the tutor is mandatory. These can be done electronically (TEAMS).

Non-attendance prevents the student from being assessed. Participation in discussions and consulting tasks with other tutors will be valued

At the end, each group will have to prepare a document with the summary of the case, the differential diagnosis and the learnings they have had. These documents will be given to all students of the course.

As a guide, the final document must include the following points:

- Summary of the case
- Differential diagnosis
- Diagnostic hypothesis and plan to follow
- Complementary explorations
- Indicated diagnostic test and risk benefit
- diagnosis
- Treatment and prognosis

Non-attendance prevents the student from being assessed. Participation in discussions and consulting tasks with other tutors will be valued.

### Bioinformatics module

Continuous assessment that will assess:

- Attendance (mandatory for all sessions), active participation in classes and the resolution of questionnaires to be completed in the different sessions using the Virtual Campus.
- The presentation, in the last session called Congress, of a PowerPoint with the analysis of the last of the cases worked on. The work will be done in small groups and will be in a free format. Students must use those tools, among those studied, that best fit the case.

With continued assessment, the student will be able to obtain a grade that can reach Excellent.

Students who wish to opt for Matricula will have to take a test-type exam of between 3 and 5 questions for each of the cases that have been worked on during the course by all groups and with 3-5 questions referring to the Bioinformatics Module regarding the tools worked. This test will be based on the documents prepared by each of the groups. The best grades will have an Honors Matriculation.

Students who have not passed the subject through continuous assessment will be classified as "NOT ASSESSABLE".

Although the assessment will follow a similar pattern, it can be adapted to the characteristics of each of the Teaching Units. An exam will be scheduled based on cases presented by students who have not passed the contents of the subject, with a format to be determined.

This subject does not provide the single assessment system.

## Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Assessments through practical cases and problem resolution (AIMV)	18% of the final mark	2	0.08	1, 2, 17, 4, 3, 12, 13, 14, 20, 21, 22, 24, 25, 26, 16, 28, 27, 11, 31, 40, 30, 37, 36, 34, 39, 35, 46, 42, 43, 44, 45, 47, 48, 49, 50, 15, 32, 33, 18, 51, 53, 54, 52, 19, 10, 6, 8, 9, 7, 5
Attendance and active participation (AIMV)	12% of the final mark	0	0	4, 14, 25, 26, 28, 11, 35, 48, 49, 15, 32, 53
Attendance and active participation (Bioinformatics)	12% of the final mark	0	0	4, 13, 14, 21, 11, 31
Congress / Presentation of works (Bioinformatics)	12% of the final mark	2	0.08	1, 2, 17, 13, 16, 11, 31, 40, 30, 45, 47, 51, 53, 54
Resolution of questionnaires (Bioinformatics)	16% of the final mark	0	0	20, 21, 31, 53, 54
Written evaluations through objectives tests (AIMV)	30% of the final mark	1.75	0.07	22, 23, 24, 28, 29, 11, 41, 40, 30, 38, 43, 49, 51, 19, 10, 6, 9, 7

## Bibliography

Consult the specific bibliography of the teaching guides for the different fifth year subjects.  
Introduction to Bioinformatics / Teresa K. Attwood, David J. Parry-Smith; translation: Fernando González Candelas. Madrid Prentice Hall, 2002.

software

At the beginning of the Bioinformatics module, the specific software will be provided.

Internet resources  
<http://www.nih.gov/>

<http://www.ncbi.nlm.nih.gov/>  
<http://www.ebi.ac.uk>  
<http://omim.org>  
<http://www.genome.gov/>  
<http://www.uniprot.org/>  
<http://www.rcsb.org/>  
<https://www.genome.jp/kegg/>

## **Software**

There is no need of a specific software