

28434 - Porcine Integrated Course

Syllabus Information

Academic Year: 2020/21

Subject: 28434 - Porcine Integrated Course

Faculty / School: 105 - Facultad de Veterinaria

Degree: 451 - Degree in Veterinary Science

ECTS: 8.0

Year: 4

Semester: Annual

Subject Type: Compulsory

Module: ---

1.General information

1.1.Aims of the course

The general goal of this course is the basic learning of the structural conditions of pig production, the strategies of feeding and management, the technology of reproduction and the diagnosis of pig diseases.

In order to achieve this general and the specific learning goals of this subject, will be set to ensure that the student is able to:

- Know the Spanish pig production chain. (Stocks or numbers of animals) and production structure. Markets and price formation.
- Know the technical bases of pig production. Knowledge of the environmental requirements of the species. Intensive and extensive production systems. Production by phases.
- Knowledge of the design of facilities and equipment in intensive and extensive pig farms. Environmental control. Batch handling and sizing.
- Know the reproductive planning and of the daily handling in the different productive phases.
- Know the final product. Characteristics and commercial types.
- Formulate diets for pigs in different productive phases and production conditions taking into account the practical criteria of feeding management, and relate the quality of the diet with the expected yields
- Know the characteristics that form part of the objectives and selection criteria in pigs, to interpret the results of the genetic evaluation of reproducers and to evaluate the application of molecular genetics in Swine Breeding.
- Understand the reproductive characteristics of the male and female in the porcine species, to plan and to carry out its reproductive control, to apply the biotechnology of the reproduction and the obstetric techniques.
- Know the symptoms and lesions characteristic of the main pathological processes of pigs.
- Know the different pathological agents that cause swine diseases and relate them to the symptoms and lesions they cause.
- Know the epidemiology and pathogenesis of the main pathological processes of pigs.
- Know the different laboratory tests available and to know how to choose, take and send the appropriate samples for the etiological diagnosis.
- Know the therapeutic and/or preventive possibilities that can be used against the different diseases.
- -Be able to follow a control plan of the main swine diseases.
- Know how to diagnose and treat the reproductive pathology of female and male pigs, including the basic techniques of anaesthesia and surgery applied to reproduction.

1.2.Context and importance of this course in the degree

It is a fourth year subject, so students need all the knowledge acquired in subjects such as Anatomy, Physiology, Microbiology and Immunology, General and Propaedeutic Pathology, Reproduction, Parasitology and Imaging Diagnosis over the previous years. Its bases focus on knowledge of special pathological anatomy, infectious and parasitic diseases of pigs, diseases of the reproductive system and their control. The knowledge acquired during this course will be completed with the practicum that all students must complete in the fifth year.

1.3.Recommendations to take this course

It is recommended that the student has studied the subjects of the previous courses and has especially approved the

subjects of Anatomy, Physiology, Microbiology and Immunology, Genetics, Nutrition, Ethnology and Ethology, General Pathology and Propaedeutics, Reproduction, Parasitology and Diagnostic Imaging, as a solid knowledge of these subjects is required to successfully address this subject of integration.

On the other hand, it is considered of utmost importance that the student actively participates in all the practical face-to-face sessions.

2. Learning goals

2.1. Competences

On successful completion of this course, students will be able to:

- Identify and evaluate the different aspects that influence and condition pig production in order to make the appropriate decisions.
- Design, interpret and evaluate a management by lots or bands in a pig farm, as well as the dimensioning of the farm and its adaptation to the different aspects that define biosecurity in pig facilities.
- Design and properly evaluate the facilities and equipment in intensive and extensive pig farms, as well as their adaptation to the different national and international welfare regulations, both current and future.
- Evaluate the suitability of the different environmental control systems present in pig farms and to identify possible problems as well as to propose the corresponding corrective measures.
- Establish and apply the criteria of waste as well as selection and breeding of replenishment in breeding farms.
- Apply the appropriate management guidelines in the different productive phases, both in the maternity ward (sows and piglets) and in gestation and in growth and fattening.
- Manage the management of the waste generated in the pig farm.
- Develop the technical and economic management of a pig farm and to adapt it to price fluctuations and changing market demands.
- Assess the quality of the carcass and the meat in the different commercial types present in the market. Recognise the characters that form part of the selection criteria and objectives in a pig improvement scheme.
- Get integrated as a technician in a pig production company to be integrated as a technician in a pig selection company.
- Know how to advise the productive sector in questions related to genetic improvement.
- Establish and modify practical feeding guidelines for breeders and growth animals, including the presentation of the feed and the raw materials used, as well as their limitations of use.
- Advise the productive sector on the principles of pig feeding in its different productive phases. Analyze, synthesize and solve problems, and make decisions.
- Flexibility to work effectively in uni or multi-disciplinary teams.
- Know how to look for and manage information related to professional activity.
- Know how to communicate the information obtained in professional practice to other colleagues, public or private bodies and the general public.
- Knowledge of objectives and selection criteria. Interpreting the results of the genetic evaluation and assessing the possibilities offered by molecular genetics in the genetic improvement of pigs.
- Schedule and carry out the reproductive control in the porcine species and to know the pathological consequences of an inadequate handling.
- Apply reproductive biotechnology and obstetric techniques in the porcine species.
- Identify and correctly name clinical signs and lesions, being able to associate them with specific pathological processes, making simple differential diagnoses based on these data.
- Write reports in a clear and concise way with the clinical history and the observed pathological findings.
- Take the appropriate samples and send them correctly, accompanied by a report, requesting the most suitable laboratory tests for the confirmation of reliable etiological diagnoses.
- Establish therapeutic measures based on scientific criteria. Establish and apply preventive and disease control programmes.

Diagnose and treat the reproductive pathology of the female and male pigs, including the basic techniques of anaesthesia and surgery.

2.2. Learning goals

If students complete the course successfully, they should be able to:

- Get to know the Spanish pig production chain. Census and production structure. Markets and price formation.
- Get to know the technical bases of pig production. Knowledge of the environmental requirements of the species. Intensive and extensive production systems. Production by phases.

- Knowledge of the design of facilities and equipment in intensive and extensive pig farms. Environmental control. Batch handling and sizing.
- Knows the reproductive planning and the daily management in the different productive phases. Knows the final product. Characteristics and commercial types
- Formulate diets for pigs in different productive phases and production conditions taking into account the practical criteria of feeding management, and relate the quality of the diet with the expected yields.
- Know the characteristics that are part of the objectives and selection criteria in pigs, interpret the results of genetic evaluation of breeders and assess the application of molecular genetics in Swine Breeding.
- Include the reproductive characteristics of the male and female in the porcine species, to plan and carry out its reproductive control, to apply the biotechnology of reproduction, the obstetric techniques and the care of the newborn.
- Know the symptoms and lesions characteristic of the main pathological processes of pigs.
- Know the different pathological agents that cause swine diseases and relates them to the symptoms and injuries they cause.
- Know the epidemiology and pathogenesis of the main pathological processes of pigs.
- Knows the different laboratory tests available and know how to choose, take and send the appropriate samples for the etiological diagnosis.
- Knows the therapeutic and/or preventive possibilities that can be used against the different diseases. Is able to follow a control plan of the main swine diseases.
- It knows how to diagnose and treat the reproductive pathology of female and male pigs, including the basic techniques of anaesthesia and surgery applied to reproduction.

2.3.Importance of learning goals

The content of this course is essential for the student to acquire the knowledge and skills necessary to develop, in their professional life, activities in the pig sector, since this course will address all aspects relating to knowledge of the structure of the pig sector, practical feeding including the formulation of rations and the management of the different production phases as well as the most common facilities and equipment affecting the organization and criteria of biosafety. The application of diagnostic techniques, identification of syndromes, application of medical and surgical treatments, establishment of preventive measures, elaboration of reports, etc. will also be addressed. In other words, the subject systematically brings together the most important knowledge about clinical and pig production.

3.Assessment (1st and 2nd call)

3.1.Assessment tasks (description of tasks, marking system and assessment criteria)

Assessment activities

1. The final **theoretical examination** will consist of both short answer and multiple choice questions. The latter will consist of several statements that must be qualified as true or false by the student. Each incorrectly answered statement annuls another correct one, so that if a negative value were obtained in a question, it would subtract it from the sum of the grades of the right answers. The theoretical exam is 80% of the final grade. The student will have to pass it (5 out of 10 at least) so that the other aspects of the final evaluation (work) can be considered.
2. In the **practice sessions**, it will be compulsory to attend at least 80% of the sessions. The passing of the practical activity will be valid for all the calls that the student needs to pass the subject. If 80% of the practical sessions have not been completed, the student may take an examination of the practices not completed in order to demonstrate the acquisition of the corresponding skills.
3. Likewise, the student will have to **draw up an assignment** of any aspect related to the health and porcine production, that will suppose the 20% of the final mark. Failure to present the work in a call will result in a grade of "0" in the same, so that the student must obtain a grade of at least 6.3 in the theoretical examination to pass the subject. The individual work will be valid for all the calls that the student needs to pass the subject.

Regarding the assessment of the essay:

Positive rating	Negative rating
Understanding laws, theories and concepts	Lack of explanations in the development of the problems
Skill and ability in the handling of mathematical tools	Messy and improper presentation
The correct use of magnitude units	Mistakes in simple mathematical calculations
Clarity in schemes, figures and graphical representations	Spelling mistakes

Proper approach and results, as well as their order, presentation and interpretation.

The global assessment will consist of a written part consisting of short answer and multiple-choice questions that represent 80% of the final mark. To this mark it will be added the score for the quality of the work presented, (equivalent to 20% of the final grade.)

Marking system:

According to the national regulation Law 1025/2003, 5th of September which lays down the European system of credits and marking system for the university degree.

0-4,9: FAIL.

5,0-6,9: PASS

7,0-8,9: GOOD (NT).

9,0-10: EXCELLENT (SB).

As the article 158 of the Statutes of the University of Zaragoza lays down, provisional grades will be displayed at least for 7 days and students will be able to review them on the date, time and place provided for that purpose.

4.Methodology, learning tasks, syllabus and resources

4.1.Methodological overview

Learning process designed for this particular subject (Integration in Pigs) is based on lectures, practical training and autonomous work.

Sixty six lectures will be given in the classroom assigned by the establishment. Students of the subject will be divided into two groups.

Thirty-four hours of practical training will be offered in different locations: experimental farm of the Veterinary Faculty, commercial farms, necropsy room, labs of different departments (infectious diseases, parasitology, reproduction) and computer room

Every student must perform an individual work about a particular aspect of pig health and production. Such individual work must be delivered to the teachers not later than May 30 (June call) or before the September examination.

4.2.Learning tasks

The programme that is offered to the student to help him/her achieve the expected results includes the following activities posted below

4.3.Syllabus

Lecture Schedule

Sixty eight lectures of 50 minutes time each of them:

Lesson 1. PIGMEAT SECTOR STRUCTURE (1). World, European and national relevance of the pig meat farming and industry. Pork foreign trade. Pork consumption. Main production indexes. Main reproductive indicators: litter size, piglets weaned, number of farrowings per sow and year...

Lesson 2. PIGMEAT SECTOR STRUCTURE (2). Organization and spread of the genetic improvement. Selection, multiplication and production farms. Business organization. Types of integration. Farm size. Forecast for future structures.

Lesson 3. ECONOMIC ASSESSMENT OF PIG FARMS. Economic indicators. Fixed and variable costs. Production costs of several products: weaned piglet, 2-months piglet and finished pig.

Lesson 4. BIOSECURITY IN PIG FARMS. How a disease can be introduced in pig farms. Biological isolation. Animal intake and movement controls. Biosecurity actions. Cleaning and disinfection. Insemination centers biosecurity.

Lesson 5. WASTE MANAGEMENT IN PIG FARMS. Rules. Slurry management. Animal carcasses management. Gas emissions.

Lesson 6. SELECTION CRITERIA IN PIG GENETIC IMPROVEMENT. Pig genetic characters of interest. Heredability and genetic and environmental correlations. Economic value of the different characters.

Lesson 7. PIG IMPROVEMENT STRATEGIES. Selection, crossing and heterosis. Control of blood relationship.

Lesson 8. GENETIC IMPROVEMENT OF THE MATERNAL LINES. Genetic basis. Genetic improvement of reproductive traits. Genetic improvement of survival and longevity. Genetic management. Genetic evaluations assessment.

Lesson 9. GENETIC IMPROVEMENT OF THE PATERNAL LINES. Genetic basis. Genetic improvement of production and carcass traits. Genetic improvement of meat quality. Genetic management. Genetic evaluations assessment

Lesson 10. GENETIC BIOTECHNOLOGY. Genes of interest in porcine genetic improvement. Genome improvement. Other biotechnological applications of genetics in pigs.

Lesson 11. PRIMIPAROUS SOWS. Puberty. Sexual cycle. Pregnancy. Farrowing. Lactation and weaning. MULTIPAROUS SOWS.

Lesson 12. THE BOAR. Puberty. Hormonal cycle. Spermatogenesis. Training and semen recovery procedures.

Lesson 13. REPRODUCTIVE CONTROL IN PIGS. Management and hormonal techniques. Pathological consequences of an incorrect control.

Lesson 14. REPRODUCTIVE BIOTECHNOLOGY. Semen recovery and evaluation. Semen preservation. Heat detection.

Mating. AI. Pregnancy diagnosis. FIV techniques. Embryo transfer.

Lesson 15. FARROWING. Types of farrowing. Obstetric care techniques in sows.

Lesson 16. THE NEWBORN PIGLET. Farrowing care. Newborn pathology: Congenital abnormalities, weakness, iron deficiency anaemia...

Lesson 17. PIG HOUSING. General criteria. Environmental standards in piglets, sows and boars.

Lesson 18. HOUSING OF DRY AND PREGNANT SOWS. European Directive of welfare. Individual stalls and group housing systems. Ad libitum feeding. Free access stalls. Short stalls. Electronic sow feeding system.

Lesson 19. HOUSING OF SOWS DURING FARROWING AND LACTATION. General criteria. The farrowing crate. Types. The farrowing pen. Possibilities of providing heat to piglets. Infrared lamps and heated floor.

Lesson 20. HOUSING OF WEANED PIGLETS. European welfare legislation. General criteria. Group size. General design and materials. Feeders and drinkers. Heating systems. Open facilities.

Lesson 21. HOUSING OF GROWING AND FINISHING PIGS. European welfare legislation. General criteria. Group size. General design and materials. Feeders and drinkers. Wean to Finish system.

Lesson 22. FARM PLANNING (I). Batch management farrowing system. Pros and cons. Farrowing every week vs every 3 and 5 weeks comparison.

Lesson 23. FARM PLANNING (II). Dimension and design of facilities for pigs. Practical examples.

Lesson 24. PIG FEEDING. Legislation. Labelling. Crossing contamination of medicated compound feeds.

Lesson 25. PIG FEEDING. Conventional and no conventional feedstuffs. Feed distribution. Liquid feeding.

Lesson 26. WEANED PIGLET FEEDING. Physiological characteristics. Additives. Starter feeds. Nutrition and pathology. Feed management.

Lesson 27. GROWING AND FINISHING PIG FEEDING. Sex, genetics and environment interactions. Protein retention. Energy consumption. Fat pig feeding.

Lesson 28. SOW FEEDING. Feeding management of replacement sows. Pregnant sows. Flushing. Effect of nutrition on fertility.

Lesson 29. SOW AND BOAR FEEDING. Feeding of sow during farrowing and lactation. Body fat reserves mobilization. Lactating piglet growth. Boar feeding.

Lesson 30. PIG FEEDING. Environmental impact. N and P contamination. Trace elements.

Lesson 31a. HYGIENE AND MANAGEMENT OF SOWS (I). Culling causes analysis in pig farms. Culling rate. Replacement sows management. Intrinsic and extrinsic factors influencing fertility.

Lesson 31b. HYGIENE AND MANAGEMENT OF SOWS (II). Lactating sow management. Milk production. Weaning and onset of oestrus. Live weight of piglets at farrowing. Factors of variation. Fostering. Piglet mortality before weaning.

Lesson 32. HYGIENE AND MANAGEMENT OF GROWING AND FINISHING PIGS. Intrinsic and extrinsic factors influencing growth, conversion index and other production traits. Casualties causes. Animals to and from management.

Lesson 33. CARCASS AND MEAT QUALITY IN PIGS. Commercial types. Carcass dressing percentage and quality. Tissue composition. Basic criteria in pork quality. Carcass classification. Legal rules.

Lesson 34a. OUTDOOR PIG PRODUCTION. Camping system. Aims, pros and cons. Management and financial analysis. Organic pig production.

Lesson 34b. IBERIAN PIG PRODUCTION SYSTEM. Genetic basis. Ecosystem analysis. Traditional breeding system of the Iberian Pig. The "dehesa". Sows and growing pigs management. The "montanera" fattening system. Intensive breeding systems adapted to the Iberian pig. Feeding of the Iberian pig in both intensive and traditional systems.

Lesson 35. MULTISISTEMIC DISEASES (I). Porcine Reproductive & Respiratory Syndrome (PRRS).

Lesson 36. MULTISISTEMIC DISEASES (II). Porcine circoviroses (PMWS & PDNS)

Lesson 37. MULTISISTEMIC DISEASES (III). Erysipela (*Erysipelothrix rhusiopathiae*)

Lesson 38. MULTISISTEMIC DISEASES (IV). Streptococcosis (*Streptococcus suis*), Glässer's disease (*Haemophilus parasuis*) and Oedema disease.

Lesson 39. ENFERMEDADES MULTISISTÉMICAS (V). Trichinellosis, cysticercosis, toxoplasmosis.

Lesson 40. DIGESTIVE PATHOLOGY (I). Introduction to digestive pathology.

Lesson 41. DIGESTIVE PATHOLOGY (II). Main gastroenteritis process in the lactation and growing processes

Lesson 42. DIGESTIVE PATHOLOGY (III). Other digestive pathologies I: Mouth, Gastric ulcers and Gastritis.

Lesson 43. DIGESTIVE PATHOLOGY (IV). Other digestive pathologies II: Rectal prolapse, rectal herniae, peritonitis and liver damages.

Lesson 44. DIGESTIVE PATHOLOGY (V). Porcine epidemic diarrhoea (PED) and Transmissible gastroenteritis (TGE).

Lesson 45. DIGESTIVE PATHOLOGY (VI). Scour (*Escherichia coli*) and Salmonellosis.

Lesson 46. DIGESTIVE PATHOLOGY (VII). Ileitis (*Lawsonia intracellularis*), Swine dysentery (*Brachyspira hyodysenteriae*) and Intestinal spirochetosis (*Brachyspira pilosicoli*).

Lesson 47. DIGESTIVE PATHOLOGY (VIII). Necrotic enteritis (*Clostridium perfringens*) and other clostridiosis (*Cl. difficile* and *Cl. novyi*).

Lesson 48. DIGESTIVE PATHOLOGY (IX). Coccidiosis.

Lesson 49. DIGESTIVE PATHOLOGY (X). Ascariasis and other parasitic diseases by nematodes

Lesson 50. RESPIRATORY PATHOLOGY (I). Introduction to respiratory pathology. Bronchopneumonia, pleurisy.

Lesson 51. RESPIRATORY PATHOLOGY (II). Swine Influenza and Enzootic pneumonia (*Mycoplasma hyopneumoniae*)

Lesson 52. RESPIRATORY PATHOLOGY (III). Porcine pleuropneumonia (*Actinobacillus pleuropneumoniae*) and other Actinobacillosis (*A. suis* and *A. equuli*)

Lesson 53. RESPIRATORY PATHOLOGY (IV). Atrophic rhinitis, Pasteurellosis (*Pasteurella multocida*) and Bordetellosis (*Bordetella bronchiseptica*).

Lesson 54a. RESPIRATORY PATHOLOGY (V). Metastrongylosis.

Lesson 54b. SKIN PATHOLOGY (I). Scabies and ticks.

Lesson 55. SKIN PATHOLOGY (II). Staphyloderma, Porcine parakeratosis. Porcine erysipela and dermatitis-nephrosis syndrome.

Lesson 56. OTHER PATHOLOGIES (I). Urinary system pathology. Congenital cysts, nephritis, pyelonephritis. polycystic kidneys.

Lesson 57 OTHER PATHOLOGIES (II). Nervous system pathology. Muscle pathology. Bone pathology.

Lesson 58. REPRODUCTIVE PATHOLOGIES (I). Reproductive pathology of sows: Congenital diseases, anestrus, silent estrus, estrus repetition. Pregnancy pathology, Seasonal, casual and toxic abortions. Farrowing pathology.

Lesson 59. REPRODUCTIVE PATHOLOGIES (II). Infectious abortions: Parvovirus, Leptospirosis and Brucellosis.

Lesson 60. REPRODUCTIVE PATHOLOGIES (III). Postpartum pathology: Postpartum metritis. Dirty sow syndrome.

Lesson 61. REPRODUCTIVE PATHOLOGIES (IV). Lactation pathology: Mastitis. Postpartum dysgalactia syndrome. Mastitis-metritis-agalactia syndrome.

Lesson 62. REPRODUCTIVE PATHOLOGIES (V). Boar reproductive pathology. Libido, erection and ejaculate abnormalities. Brucellosis.

Lesson 63. REPRODUCTIVE PATHOLOGIES (VI). In-farm anesthesia and surgery techniques: Castration, caesarean section, vasectomy, prolapses, reproductive biotechnology.

Lesson 64. COMPULSORY NOTIFICATION DISEASES (I). Vesicular diseases: Foot and mouth disease, Swine vesicular disease, Vesicular stomatitis y Vesicular exanthema

Lesson 65. COMPULSORY NOTIFICATION DISEASES (II). Classical swine fever and African swine fever

Lesson 66. COMPULSORY NOTIFICATION DISEASES (III). Aujeszky's disease

practical training schedule

Fourteen practical sessions. Total: 33.15 hours of practical training per student.

Practical session 1. PIG COMMERCIAL FARM. Study of genetic basis, batch organization and feeding. Management of farrowing, IA, weaning and finishing. 1 teacher: 4 h x 36 groups of students.

Practical session 2. COMPUTER SIMULATION OF GENETIC CONTROL OF A SELECTION PORCINE POPULATION. Maternal and paternal lines. Selection and crossing. 1 teacher: 2 h x 12 groups of students.

Practical session 3. PIG REPRODUCTION TECHNOLOGY. 1. PIG TEACHING FARM OF THE VETERINARY FACULTY. Sow choice. Gilt reproductive examination. Body condition assessment. Heat detection. AI. "Management and exploration of the sow. 1 teacher: 3 h x 24 groups of students.

Practical session 4. PIG REPRODUCTION TECHNOLOGY. 2. PIG TEACHING FARM OF THE VETERINARY FACULTY. Boar examination. Semen recovery. Reproductive examination of the pregnant sow. pregnancy diagnosis. Farrowing preparation. 1 teacher: 2.75 h x 24 groups of students.

Practical session 5. SEMINAL DOSIS PREPARATION IN LAB FOR AI. Spermogram, dilution, preservation. Computer management of seminal doses. Semen refrigeration and freezing. 1 teacher: 2 h x 24 groups of students.

Practical session 6. BUILDING MATERIALS AND ENVIRONMENTAL CONTROL IN PIG FARMS. EXPERIMENTAL FARM OF THE VETERINARY FACULTY. Building materials and building techniques. Practical ventilation. Thermal isolation. 1 teacher: 2 h x 12 groups of students.

Practical session 7. COMPUTER PROGRAM OF TECHNICAL MANAGEMENT OF PIG FARMS. COMPUTER ROOM. Output analysis. Technical indexes analysis. 1 teacher: 2 h x 12 groups of students.

Practical session 8. FEEDING (1). COMPUTER ROOM. Diet formulation for sows. 1 teacher: 2 h x 12 groups of students.

Practical session 9. FEEDING (2). COMPUTER ROOM. Diet formulation for growing pigs. 1 teacher: 2 h x 12 groups of students.

Practical session 10. MEAT AND CARCASS QUALITY. MEAT LAB. 1 teacher: 2 h x 12 groups of students.

Practical session 11. MICROBIOLOGICAL EVALUATION OF SEMINAL DOSIS. REPRODUCTION LAB. 1 teacher: 1.5 h x 24 groups of students.

Practical session 12. PARASITOLOGICAL DIAGNOSIS IN LAB. Intestinal, tisular and cutaneous parasites. 1 teacher: 2 h x 24 groups.

Practical session 13. NECROPSY ROOM. Clinical cases necropsy. 2 teachers: 3 h x 12 groups.

Practical session 14. CLINICAL CASES IN PIGLETS AND GROWING PIGS. 1 teacher: 2 h x 12 groups.

Practical session 15. CLINICAL CASES IN PIGLETS AND SOWS. 1 teacher: 2 h x 12 groups.

4.4. Course planning and calendar

Dates and scheduling of lectures and practical training of the subject can be found in the web page of the Veterinary Faculty at the beginning of each academic year.

4.5. Bibliography and recommended resources