# COURSE DETAILS

# "BIOCONVERSION PROCESSES"

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DEGREE PROGRAMME: PRECISION LIVESTOCK FARMING

ACADEMIC YEAR 25-26

## GENERAL INFORMATION – TEACHER REFERENCES

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## GENERAL INFORMATION ABOUT THE COURSE

INTEGRATED COURSE: BIOMASS VALORIZATION FOR ENERGY &COMMODITIES PRODUCTION AND GREENHOUSE GAS MITIGATION
MODULE: BIOCONVERSION PROCESSES
SSD OF THE MODULE: ICHI-02/A
TEACHING LANGUAGE: ENGLISH
CHANNEL: //
YEAR OF THE DEGREE PROGRAMME: I
SEMESTER: II
CFU: 5

## REQUIRED PRELIMINARY COURSES (IF MENTIONED IN THE COURSE STRUCTURE "REGOLAMENTO")

*none*

## PREREQUISITES (IF APPLICABLE)

*Basic concept of mathematics, phisycs and chemistry*

## LEARNING GOALS

*The course aims at providing students with fundamentals sufficient for enabling them to evaluate the chief chemico-physical properties of biomass to select the proper pre-treatments and the adequate conversion technologies depending on feedstock properties, and for further understanding of biomass thermo-chemical processes.*

*Moreover, the student must be able to select unit operations to exploit waste/residue streams of the livestock farming according to the biotechnological routes. Basic concept of operation of selected units must be known.*

## EXPECTED LEARNING OUTCOMES (DUBLIN DESCRIPTORS)

**Knowledge and understanding**

*This descriptor refers to disciplinary knowledge and describes how the student can elaborate on what has learnt to convert notions in more complex and partially original reflections.*

*The student must demonstrate to know and to understand the issues related to the selection and the operation of processes dedicated to bioconvert waste/residue streams of the livestock farming.*

**Applying knowledge and understanding**

*The student must demonstrate to be able to apply concepts for select an operate bioprocess flowsheets for the production of energy and matter by combining: 1) operation units dedicated to the exploitation of waste/residue streams of the livestock farming; 2) fermentation units; 3) recovery and purification units. The design should include assessments regarding the sustainability of the process.*

## COURSE CONTENT/SYLLABUS

| FRONTAL LESSONS | HOURS |
|---|---|
| ✓ *Review of bioconversion processes with particular reference to the sector of the valorisation of waste/residue streams of the livestock farming. Scenarios for the valuation of residues* | 5 |
| ✓ *Basic concept: macroscopic material balances applied to continuous or discontinuous equipment used in bioconversion processes* | 3 |
| ✓ *Recovery, yield, selectivity, pureness, productivity – concepts for operation units dedicated to bioconversion processes* | 3 |
| ✓ *Introduction to design equations of process equipment: balance and constitutive equations; conditions of thermodynamic equilibrium; kinetic and transport equations* | 3 |
| ✓ *Review delle apparecchiature (bioreattori, filtri, sedimentatori, centrifughe, ecc) per le operazioni unitarie ricorrenti nei processi di bioconversione: descrizione e schematizzazione degli aspetti progettuali* | 3 |
| ✓ *Review of equipment for recurrent unit operations in bioconversion processes: description and outline of design aspects, main current processes (mechanical, chemical, biotechnological and combination of these). Equilibrium stage based equipment and transfer rate based equipment. Criteria for the selection of the process. Design/operation of selected units* | 4 |
| ✓ *Flowsheet development – Sequence of operation units to exploit waste/residue streams of the livestock farming. Objective function of the flowsheet* | 3 |

| | |
|---|---|
| ✓ *Techno-economic analysis in biorefinery processes – notes on CAPEX and OPEX, Lang factor method, OPEX analysis in labour, utilities, materials, waste and consumables* | 3 |
| ✓ *Case study - Energy from waste/residue streams of the livestock farming, Bioproducts from waste/residue streams of the livestock farming and examples of biorefinery concepts* | 3 |
| **TOTAL** | **30** |

| PRACTICAL TEACHING | HOUR |
|---|---|
| ✓ *Exercises on material baalnces* | **5** |
| ✓ *Practical applications of material balances* | **4** |
| ✓ *Practical applications of filtration and sedimentation processes* | **5** |
| ✓ *Practical applications of fermentation processes* | **6** |
| **TOTALE** | **20** |

## READINGS/BIBLIOGRAPHY

- *Biorefineries –Industrial Processes and Products. Eds B. Kamm, P.R. Gruber, M. Kamm. Wiley, 2006*
- *Scientific papers*
- *Lecture notes provided during the course.*

## TEACHING METHODS

*Teachers will use:*

- *Frontal lessons for 60% of total hours;*
- *Practical activities (which practical exercises, practical activities at the Improsta farm) for 20% of total hours.*

*The teacher will use a student-centered method; tutorials; Practical lessons, learning by doing method. The lessons will be supported by multimedia teaching material available to students on the teacher's website, after registering for the course*

## EXAMINATION/EVALUATION CRITERIA

**a) Exam type:**

*For **integrated courses**, there should be one exam.*

| Exam type | |
|---|---|
| **written and oral** | x |
| **only written** | |
| **only oral** | |
| **project discussion** | x |
| **other** | |

| | | |
|---|---|---|
| **In case of a written exam, questions refer to: (*)** | **Multiple choice answers** | |
| | **Open answers** | x |
| | **Numerical exercises** | |

(*) multiple options are possible

**b) Evaluation pattern:**

*The exam consists in questions linked to the course content and in the discussion of a project.*

*The final mark will be weighted on CFU of each module and therefore will be made up of: Module '' Bioconversion Processes'' 5 CFU 55,6%; Module 'Biomass thermal conversion processes" 4 CFU 44,4%.*

*For the evaluation, the "Regulation for Guidelines_for_exams_management" approved by the Didactic Coordination Committee of the Master Degree in Precision Livestock Farming will be considered.*