| Unit title | Code | Module title | Details | Hours number | ECTS Credits |
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| | **BIOREF B1** | | | | |
| **Biotechnologues for biomass conversion** | **B1A** | Metabolic engineering of microorganisms: Strain engineering and development | The main objective of the course is to introduce to students basic microbial physiology concepts and to fermentation processes in order to understand the basic engineering concepts underlying biocatalytic conversion of raw materials to products including fuels and chemicals. Topics: industrial fermentation (media, microbial growth), enzymology, bioreactor design, enzyme kinetics, fermentation kinetics, batch/fed-batch/continuous bioreactor operations. Gas-liquid mass transfer. Yields and rates in a biotechnological process. | | **8** |
| | **B1B** | Metabolic engineering of microorganisms: Metabolic flux analysis | The main objective of the course is to introduce students to the basic methods employed to analyze, design and modify metabolic pathways in order to improve a microbial biocatalyst and convert more efficiently raw materials to products including fuels and chemicals. To accommodate the students who do not have the biological background, the course will first deal with the basic concepts of microbiology, biochemistry, and molecular biology. Topics: Cell metabolism, pathway design, bioenergetics, regulation of metabolism, metabolic modeling, and genetic engineering tools. Rational and random approaches to metabolic engineering. Analysis of a microbial biocatalyst: genomics, transcriptomics, proteomics, fluxomics, systems biology. Case studies relevant to applications of metabolic engineering in biorefineries will be presented. | | |
| | **B1C** | Enzymatic conversion of biomass for chemicals production | The main objective of the course is to introduce the students to the basic concepts of enzyme-mediated biocatalysis applied to biomass conversion to chemicals and fuels.<br><br>Topics: enzyme classification; enzymatic kinetics; mechanisms of enzymatic reactions; enzyme inhibition; regulation of enzymatic activity. Particular attention will be given to the industrial application of enzymes for biomass conversion and to the technologies employed to improve an enzymatic activity. | | |
| | **BIOREF B2** | | | | |
| **Oily biomass Production** | **B2A** | Harvesting treatment and fractionation of acquatic biomass | The objective of the course is the introduction to the production of acquatic biomass and extraction of bio-oil. In particular, will be discussed the characterization of aquatic biomass and its cultivation. Attention will be paid to harvesting techniques and composition of aquatic biomass as chemicals can be extracted from the aquatic biomass by using a variety of non-destructive technologies. | | **9** |
| | **B2B** | Extraction of oil | Technologies for algal oil and chemical extractiion. Conventional solvent extraction. Supercritical solvent extraction. Mechanical extraction. Biological extraction. Analyses of the processing cost. | | |
| | **B2C** | Comparison of oils from terrestrial drupes and seeds with oil from acquatic biomass | Physico-chemical properties of produced biodiesel form aquatic biomass and terrestrial drupes and seeds | | |
| | **B2D** | Enhannced production of acquatic biomass | Influence of the N: P supply ratio on biomass productivity and time-resolved changes in elemental and bulk biochemical composition | | |

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| | **BIOREF B3** | | | | |
| **Oily biomass refineries** | **B3A** | Oil chemistry and biotechnologies; conversion into chemicals monomers for polymers and fuels | Chemical processes (Catalytic and thermochemical processes) for the conversion of biomass to fuels and chemicals Biotechnologies for the production of chemicals and fuels from oleaginous biomass; use of triacylglycerols, fatty acids, and glycerol. Biocatalysis in biodiesel production. Oleaginous microorganisms (different from microalgae) and their biotechnological potential. | | **11** |
| | **B3B** | Waste treatment Biogas production | Anaerobic fermentation: biogas from waste. The aerobic and anaerobic processes of FVGs (fuel vegetal garden residues). | | |
| | **B3C** | Economic assessment of acquatic biomass | Technical and nontechnical gaps and barriers, cost of production, use of land, Parameters and values for the economic evaluation of biorefineries | | |
| | **BIOREF B4** | | | | |
| **Language** | **B4** | English | | | **5** |