# UNIVERSITÀ DEGLI STUDI DI PALERMO

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| **DEPARTMENT** | Ingegneria |
| **ACADEMIC YEAR** | 2017/2018 |
| **MASTER'S DEGREE (MSC)** | CHEMICAL ENGINEERING |
| **SUBJECT** | CONCEPTUAL DESIGN OF CHEMICAL PROCESSES |
| **TYPE OF EDUCATIONAL ACTIVITY** | B |
| **AMBIT** | 50352-Ingegneria chimica |
| **CODE** | 19399 |
| **SCIENTIFIC SECTOR(S)** | ING-IND/26 |
| **HEAD PROFESSOR(S)** | MICALE GIORGIO DOMENICO MARIA Professore Ordinario Univ. di PALERMO |
| **OTHER PROFESSOR(S)** | |
| **CREDITS** | 9 |
| **INDIVIDUAL STUDY (Hrs)** | 144 |
| **COURSE ACTIVITY (Hrs)** | 81 |
| **PROPAEDEUTICAL SUBJECTS** | |
| **MUTUALIZATION** | |
| **YEAR** | 2 |
| **TERM (SEMESTER)** | 1° semester |
| **ATTENDANCE** | Not mandatory |
| **EVALUATION** | Out of 30 |
| **TEACHER OFFICE HOURS** | **MICALE GIORGIO DOMENICO MARIA**<br>Monday 14:00 15:00<br>Tuesday 14:00 15:00<br>Wednesday 14:00 15:00<br>Thursday 14:00 15:00 |

**DOCENTE:** Prof. GIORGIO DOMENICO MARIA MICALE

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| **PREREQUISITES** | Unit Operations, Industrial Chemistry, Process Control |
| **LEARNING OUTCOMES** | Conoscenza e capacita' di comprensione<br>Lo studente, al termine del corso, avra' acquisito conoscenze e metodologie per affrontare e risolvere in maniera originale problematiche riguardanti lo sviluppo dei processi chimici.<br>Lo studente sara' in grado di analizzare criticamente le varie alternative su una specifica produzione, di effettuare scelte<br>operative anche relativamente alla conduzione del processo produttivo.<br>Capacita' di applicare conoscenza e comprensione<br>Lo studente avra' acquisito conoscenze e metodologie per analizzare e risolvere problemi tipici dell'ingegneria chimica ed avra' acquisito la capacita' di scelta decisionale sia dal punto di vista progettuale che da quello operativo. Egli sara' in grado di scegliere la migliore (piu' conveniente) alternativa, valutandone la convenienza dal punto di vista economico globale di azienda. Egli sara' anche in grado di utilizzare proficuamente almeno due specifici software di simulazione di processo normalmente utilizzati in campo industriale.<br>Autonomia di giudizio<br>Lo studente avra' acquisito una metodologia di analisi, di sviluppo del processo chimico che gli permette autonomamente e criticamente di giudicare quale sia la scelta progettuale, ed operativa, migliore, tenendo conto di tutti i vincoli imposti anche dalle condizioni relativa all'ambiente ed alla ricettivita' del mercato.<br>Abilita' comunicative<br>Lo studente sara' in grado di comunicare con competenza e proprieta' di linguaggio problematiche complesse di progettazione di processi<br>chimici anche in contesti altamente specializzati.<br>Capacita' d'apprendimento<br>Lo studente sara' in grado di affrontare in autonomia qualsiasi problematica relativa allo sviluppo dei processi chimici. Sara' in grado anche di<br>utilizzare le esperienze fatte su un particolare problema per risolvere al meglio casi analoghi e progettare correttamente lo sviluppo di un nuovo processo sull'esperienza di un precedente. Sara' anche in grado di effettuare ricerche per l'ottenimento dei dati necessari alla risoluzione dei problemi di sviluppo dei processi chimici,<br>tali dati saranno criticamente analizzati e correttamente utilizzati. |
| **ASSESSMENT METHODS** | The evaluation is based on a design project (assigned at the beginning of the course) and an oral interview.<br>The design project is presented and critically discussed during the interview.<br>The interview will verify: acquired knowledge; elaboration capability; talking capability; ability to build autonomous connections not explicitly bounded to the referring textbooks; capability to produce autonomous evaluations inherent the course topics; capability to understand the applications connected with the discipline areas; capability to connect the discipline topics with the referring professional and technological context.<br>All the questions asked during the final assessment will focus on the topics presented during the course and listed at the end of the present document.<br>The final assessment is on a 30 basis according to the criteria reported below:<br>30-30+: excellent knowledge of the topics, excellent language and vocabulary, good to excellent analytical capability, the student is able to apply knowledge to solve the proposed problems<br>27-29: Good management of the topics, appropriate language and vocabulary, the student is able to apply knowledge to solve the proposed problems;<br>24-26: basic knowledge of the topics, fair language and vocabulary, limited capability to apply autonomously knowledge to solve the proposed problems;<br>21-23: the student does not show full management of the main topics while possessing the knowledge, satisfactorily language and vocabulary, poor capability to apply autonomously the acquired knowledge;<br>18-20: minimal basic knowledge of the main topics and of the technical language and vocabulary, poor capability to apply autonomously the acquired knowledge.<br>The exam will be not passed if the student will show a not acceptable knowledge of the topics |
| **EDUCATIONAL OBJECTIVES** | The course provides all the necessary elements for development of the design of a chemical process. The students will be able to use process simulation software. The course will also provide the elements for the economical evaluation of a chemical process, in order to make proper comparisons among different altermatives. |
| **TEACHING METHODS** | The course is allocated in the first semester of the second year. It consists of theoretical lectures and numerical tutorials with the use of CAPE software. |
| **SUGGESTED BIBLIOGRAPHY** | R.Turton, R.C.Bailie, W.B.Whiting and J.A.Shaeiwitz, "Analysis, Synthesis, Design of Chemical Processes", Prentice Hall International<br>Douglas, "Conceptual design of chemical processes", McGraw-Hill<br>Smith, "Chemical process design", McGraw-Hill |

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| | Peters and Timmerhaus, “Plant design and economics for chemical engineers”, McGraw-Hill |

## SYLLABUS

| Hrs | Frontal teaching |
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| 1 | Introduction to the course |
| 1 | Macroscopic material and energy balances |
| 2 | Introduction to conceptual design of chemical processes |
| 2 | Choice of the process, Input-Output structure |
| 2 | Recycle structure |
| 2 | Reactor choice |
| 2 | Structure of separation systems |
| 2 | Process diagrams |
| 2 | Optimazion of chemical processes |
| 2 | Introduction to Process Simulators |
| 6 | Mutlicomponent distillation: rigorous methods |
| 6 | Gas absorption with chemical reaction |
| 8 | Heat exchanger networks, pinch method |
| 1 | Introduction to engineering economic analysis |
| 4 | Analysis of capital and operating costs |
| 3 | Profitability analysis |
| 1 | Mathematical modelling in chemical engineering |
| 1 | Computational fluid dynamics in chemical engineering |
| 3 | Project Management and Project Execution |

| Hrs | Practice |
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| 2 | Development of process flow diagrams |
| 4 | Use of process simulators |
| 4 | Numerical methods for the solution of design equations of chemical reactors |
| 5 | Mutlicomponent distillation: tray by tray methods |
| 5 | Heat exchanger networks, pinch method |
| 5 | Engineering economic analysis |
| 5 | Development of a case study |