MINISTRY OF EDUCATION AND TRAINING
**CAN THO UNIVERSITY**

**SOCIALIST REPUBLIC OF VIETNAM**
**Independence - Freedom - Happiness**

# SUBJECT OUTLINE DETAILS

**1. Subject:** BASIC BIOTECHNOLOGY

- **Code:** MM445C
- **Credits:** 04
- **Hours:** 60 theory hours, and 120 self-study hours.

**2. Management Unit:**

- Department of Microbial Biotechnology
- Biotechnology Research and Development Institute.

**3. Prerequisites:** none

**4. Subject objectives:**

**4.1. Knowledge:**

Students will develop knowledge and understanding of:
4.1.1. Help students to understand principles of biotechnology
4.1.2. Supply a basic knowledge of biotechnology including Molecular biology, Enzymology; Microbial, Plant and Environmental biotechnology.

**4.2. Skill:** students will be able to

4.2.1. increases awareness of different levels of thinking: comprehension, application, and evaluation.
4.2.2. apply investigative and problem-solving skills.
4.2.3. work individually and in teams

**4.3. Attitude:**

4.3.1. Actively participate in class activities
4.3.2. Students are encouraged to develop positive values and informed critical attitudes.
4.3.3. Develop a sense of independent learning and an inquiry mind for self-study.

5. **Brief description of subject content:** This course will acquaint students with the principles of biotechnology. Topics include the biochemistry, microbiology, genetics and general knowledge about fields of biotechnology such as molecular, microbial, food, plant, medical, and environmental biotechnology.

**6. Subject content structure:**

| Contents | Hours | Objectives |
|---|---|---|

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|---|---|---|
| **Part I. Fundamental and principles** | | |
| **Chapter 1. Introduction to basic biotechnology.**<br>1.1 Biotechnology?<br>1.2 What Are the Benefits of Biotechnology?;<br>1.3 What Did These Individuals Contribute to Biotechnology?;<br>1.4 Molecular Biotechnology;<br>1.5 Genetic Engineering;<br>1.6 History of Biotechnology;<br>1.7 Some Figures of transgenic crops;<br>1.8 Application of biotechnology (medicine, Agriculture, Animal , Environmental<br>1.9 Conclusion | **3** | 4.1.1 |
| **Chapter 2. Biochemistry and physiology of growth and metabolism**<br>2.1 Introduction<br>2.2 Metabolism<br>2.3 Catabolic pathways<br>2.4 Gluconeogenesis<br>2.5 Energy production in aerobic micro-organisms<br>2.6 Anaerobic metabolism<br>2.7 Biosynthesis<br>2.8 Control of metabolic processes<br>2.9 Efficiency of microbial growth<br>2.10 Conclusion | **3** | 4.1.1; 4.12 |
| **Chapter 3. Genetic engineering: yeasts and filamentous fungi**<br>3.1 Introduction<br>3.2 Introducing DNA into fungi (fungal transformation)<br>3.3 Gene cloning<br>3.4 Gene structure organisation and expression<br>3.5 Special methodologies<br>3.6 Biotechnological applications of fungi<br>3.7 Conclusion | **3** | 4.1.1; 4.12 |
| **Chapter 4. Microbial process kinetics**<br>4.1 Introduction<br>4.2. Kinetic modeling of cell growth<br>4.3. Mass balances for ideal bioreactors<br>4.4 Conclusion | **3** | 4.1.1; 4.12 |
| **Chapter 5. Downstream processing in biotechnology**<br>5.1 Introduction<br>5.2. Downstream processing: a multistage operation<br>5.3. Solid-liquid separation<br>5.4. Release of intracellular components<br>5.5. Concentration of biological products | **3** | 4.1.1; 4.12 |

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| 5.6 Purification by chromatography<br>5.7 Product formulation<br>5.8 Monitoring of downstream processing<br>5.9 Process integration<br>5.10 Conclusion | | |
| **Chapter 6. Measurement, monitoring, modeling and control**<br>6.1 Introduction<br>6.2 Terminology<br>6.3 Measurements generally accepted as standard<br>6.4 Non-standard monitoring techniques<br>6.5 Control<br>6.6 Conclusions | **3** | 4.1.1; 4.12 |
| **Part II. Practical Applications** | | |
| **Chapter 7. The business of Biotechnology**<br>7.1 Introduction<br>7.2 What is biotechnology used for?<br>7.3 Biotechnology companies, their care and nurturing<br>7.4 Investment in biotechnology<br>7.5 Who needs management?<br>7.6 Patents and biotechnology<br>7.7 Conclusion: jumping the fence | **3** | 4.1.1; 4.12 |
| **Chapter 8. Microbial polysaccharides and single cell oil**<br>8.1 Introduction<br>8.2 Microbial polysaccharides<br>8.3 Single cell oils<br>8.4 Conclusion | **3** | 4.1.1; 4.12 |
| **Chapter 9. Environmental applications**<br>9.1 Treatment of waste water<br>9.2 Digestion of organic slurries<br>9.3 Treatment of solid wastes<br>9.4 Treatment of waste gases<br>9.5 Soil remediation<br>9.6 Treatment of groundwater<br>9.7 Conclusion | **3** | 4.1.1; 4.12 |
| **Chapter 10. Production of antibiotics by fermentation**<br>10.1 Overview of antibiotic classes<br>10.2 Overview of β-lactam antibiotics<br>10.3 Penicillins, Cephalosporins, Tetracylines, Aminoglycosides<br>10.4 Strain improvement and Genetic engineering<br>10.5 Production processes<br>10.6 The growth medium and the production media | **3** | 4.1.1; 4.12 |

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| 10.7 Foam control, Fed-batch feeding, pH, and Dissolved oxygen<br>10.8 Culture preservation and aseptic propagation<br>10.9 Recovery and post-recovery processing<br>10.10 Future prospects for fermentation-based antibiotics<br>10.11 Conclusion | | |
| **Chapter 11. Recombinant proteins of high value**<br>11.1 Applications of high-value proteins<br>11.2 Analytical enzymes<br>11.3 Therapeutic proteins<br>11.4 Regulatory aspects of therapeutic proteins<br>11.5 Outlook to the future of protein therapies<br>11.6 Conclusion | **3** | 4.1.1; 4.12 |
| **Chapter 12. Insect and Mammalian cell culture**<br>12.1 Introduction<br>12.2 Mammalian cells<br>12.3 Insect cells<br>12.4 Mammalian and insect cell cycles<br>12.5 Flow cytometry<br>12.6 Bioprocess engineering considerations<br>12.7 Conclusion | **3** | 4.1.1; 4.12 |
| **Chapter 13. Plant cell biotechnology**<br>13.1 Introduction<br>13.2 Plant cell biotechnology<br>13.3 Plant cell-culture techniques<br>13.4 Optimization of productivity<br>13.5 Large-scale production<br>13.6 Conclusion | **3** | 4.1.1; 4.12 |
| **Chapter 14. Immunochemical applications**<br>14.1 Introduction<br>14.2 Antibody structure and functions<br>14.3 Antibody protein fragments<br>14.4 Antibody affinity<br>14.5 Antibody specificity<br>14.6 Immunisation and production of polyclonal antisera<br>14.7 Monoclonal antibodies<br>14.8 Antibody engineering<br>14.9 Combinatorial and phage display libraries<br>14.10 In vitro uses of recombinant and monoclonal antibodies<br>14.11 In vivo uses of recombinant and monoclonal antibodies<br>14.12 Conclusion | **3** | 4.1.1; 4.12 |

**7. Teaching methods:**

- Introducing and explaining.
- Providing supplements, media resources.
- Encourage tudents self- learning and - searching knowlegde for seminars

**8. Duties of student:**

- Lecture/Class attendance: not allow to absent more than 20% of lectures.
- Seminar attendance: mandatory.
- Discussion and homeworks: mandatory

**9. Assessment of student learning outcomes:**

**9.1. Assessment**

| No. | Point components | Rules and Requirement | Weights |
|---|---|---|---|
| 1 | Seminars | Oral presentation | 20% |
| 2 | Midterm exam | Tests | 30% |
| 3 | Final exam | Tests | 50% |

**9.2. Grading**

- Grading components and final test scores will be marked on a scale of 10 (0 to 10), rounded to one decimal place.
- Subject score is the sum of all the components of the evaluation multiplied by the corresponding weight. The subject score is marked on a scale of 10 and rounded to one decimal place, then is converted to A-B-C-D score and score on a scale of 4 under the academic provisions of the University.

**10. Materials:**

| Materials information | Code number |
|---|---|
| [1] Basic biotechnology (0 521 77074 2) / COLIN RATEDGE; Biên tập, hiệu đính: COLIN RATLEDGE, Bjorn Kristiansen: Cambridge, 2001, 0 521 77074 2.- 660.62/ B311 | MON.102641 |
| [2] Biotechnology (Fourth Edition): Studies in Biology, John E. Smith, Cambridge University Press, 2004. | Viện NC&PT CNSH |
| [3] Biotechnology A guide to genetic engineering / Pamela Peters.- 1st.- Boston, Massachusetts: McGraw-Hill, 1993, 253p, 0 697 12063 5.- 660.65/ P483 | KH000519; NN000220 |
| [4] Environmental biotechnology / ALAN SCRAGG.- 1st.- Edinburg Gate, England: Longman, 1999, 249p, 0 582 27682 9.- 628.5/ S433 | CN.001830 |
| [5] Introduction to biotechnology: An agricultural revolution / Ray V. Herren.- Victoria, Australia: Thomson / Delmar Learning, 2003.- xv, 413 p., 27 cm, 076684272X.- 660.6/ H564 Ký hiệu xếp trên kệ: 660.6/ H564 **MFN:** 117056 | |

**11. Self-study Guide:**

| Week | Content | Theory (hours) | Students' duties |
|---|---|---|---|
| **1** | Chapter 1: Introduction to biotechnology | 3 | Reading: [2] chapter 1 |

| | | | |
|---|---|---|---|
| **2** | Chapter 2: Biochemistry and physiology of growth and metabolism | **5** | Reading: [1] chapter 2;<br>Reviewing [ 2] chapter 1 |
| **3** | Chapter 3: Genetic engineering: yeasts and filamentous fungi<br>***Seminar*** | 3<br>2 | Reading: [1] chapter 5;<br>[3]<br>Reviewing: [1] chapter 2 |
| **4** | Chapter 4: Microbial process kinetics | 3 | Reading: [1] chapter 6<br><br>Reviewing [1] chapter 5 |
| **5** | Chapter 5: Downstream processcing in biotechnology<br>***Seminar*** | 3<br>2 | Reading: [1] chapter 9<br>[2] chapter 4<br>Reviewing [1] chapter 6 |
| **6** | Chapter 6: Measurement, monitoring, modeling and control | 3 | Reading: [1] chapter 10<br><br>Reviewing [1] chapter 9 |
| **7** | Chapter 7: The business of Biotechnology<br>***Seminar*** | 3<br>2 | **Taking the Midterm exam**<br>Reading: [1] chapter 13<br>Reviewing [1] chapter 10 |
| **8** | Chapter 8: Microbial polysaccharides and single cell oil | **5** | Reading: [1] chapter 16<br><br>Reviewing [1] chapter 13 |
| **9** | Chapter 9: Environmental applications<br>***Seminar*** | 3<br>2 | Reading: [1] chapter 17<br>[4]<br>Reviewing [1] chapter 16 |
| **10** | Chapter 10: Production of antibiotics by fermentation | 3 | Reading: [1] chapter 18<br>[3]<br>Reviewing [1] chapter 17 |
| **11** | Chapter 11: Recombinant proteins of high value<br>***Seminar*** | 3<br>2 | Reading: [1] chapter 21<br>[3]<br>Reviewing [1] chapter 18 |
| **12** | Chapter 12: Insect and Mammalian cell culture | 4 | Reading: [1] chapter 22<br>Reviewing [1] chapter 21 |
| **13** | Chapter 13: Plant cell biotechnology | 4 | Reading: [1] chapter 23<br>[3]<br>Reviewing [1] chapter 22 |
| **14** | Chapter 14: Immunochemical applications<br>***Seminar*** | 3<br>2 | Reading: [1] chapter 25<br>[3]<br>Reviewing [1] chapter 23 |
| | Total | 60 | |
| **16** | | | **Taking the Final exam** |

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**ON BEHALF OF RECTOR**
**DEAN/ DIRECTOR**

**HEAD OF DEPARTMENT**