IX AC- 9
11 & 15-5-2018

**GOA UNIVERSITY**
**Taleigao Plateau, Goa 403 206**

**UPDATED F I N A L A G E N D A**

**For the 9th Meeting of the**

**IX ACADEMIC COUNCIL**

**Day & Date**

**15th May 2018**

**Time**

**10.30 a.m.**

**Venue**
**COUNCIL HALL**
**Administration Block**

| | |
|---|---|
| | reading material in any subject or group of subject or group of subjects and names of persons recommended for appointment to make the selection.<br><br>**PART D**<br>**(XIII)** Recommendations regarding general academic requirements in the Department of University or affiliated Colleges.<br><br>**PART E**<br>**(XIV)** Recommendations of text books for the courses of study at the under-graduate level.<br><br>**(XV)** Recommendations of text books for the courses of study at Post-graduate level.<br><br>**PART F**<br><br>**(XVI)** The declaration by the Chairman, that the minutes were read out by the Chairman at the meeting itself.<br><br>**The Chairman read out the minutes of the meeting to all the members.**<br><br>Date: 23rd April, 2018 (Prof. C.U. Rivonkar)<br><br>Signature of the Chairman<br>Place: Goa University<br><br>PART G: The remark of the Dean of Faculty<br>1) The minutes are in order.<br>2) The minutes may be placed before the Academic Council with remark, if any<br>3) Approved syllabus at BOS held on 20.04.2018.<br><br>(Prof. M.K. Janarthanam)<br>Dean Faculty of LS & Environment<br>(Back to Index) |
| **D 3.8** | **Minutes of the Meeting of Board of Studies in Microbiology held on 13/04/2018.**<br><br>Part A<br><br>Recommendations regarding courses of study in the subject or group of subjects at the under-graduate level.<br><br>**(a) Course Structure of B.Sc. Microbiology, F.Y.B.Sc. Semester-I and Semester-II (Annexure I).**Practical component of papers MIC GE-1 and MIC GE-2 were replaced |

with theory component. 3 theory credits + 1 practical credit were changed to 4 theory credits in the present course structure. **Annexure I (refer page no 435)**

**(b) Syllabus of B.Sc. Microbiology-F.Y.B.Sc. Papers MIC GE-1 and MIC GE-2 (Annexure-II).** Syllabus of MIC GE-1 and MIC GE-2 was revised.

Recommendations regarding courses of study in the subject or group of subjects at the Post-graduate level.

**(XVII) Course Structure of M.Sc. Microbiology as per Goa University 64 credits under CBCS (Annexure-III).**

**(b) Syllabus of M.Sc. Microbiology as per 64 credits under CBCS (Annexure-IV).**

**I Course Structure of M.Sc. Marine Microbiology as per Goa University 64 credits under CBCS (Annexure-V).**

**(d) Syllabus of M.Sc. Marine Microbiology as per 64 credits under CBCS (Annexure-VI).**

Part B

(i) Scheme of examinations at under-graduate level. **Not in the agenda**

**(XVIII)** Panel of examiners for different examinations at the under-graduate level.

**Not in the agenda**

(iii) Scheme of examinations at the post-graduate level. **Not in the agenda**

**(XIX)** Panel of Examiners for different examinations at post-graduate level.

**Not in the agenda**

Part C

**(XX)** Recommendations regarding preparation and publication of selection of reading material in the subject or group of subject or group of subjects and names of persons recommended for appointment to make the selection.

**Not in the agenda**

Part D

(i) Recommendations regarding general academic requirements in the Departments of University or affiliated colleges. **Not in the agenda**

(ii) Recommendations of the Academic Audit Committee and status thereof: **Not Applicable**

Part E

**(XXI)** Recommendations of the text books for the courses of study at the undergraduate level:

**Submitted along with syllabus**

**(XXII)** Recommendations of text books for the courses of study at the post-graduate level:

**Submitted along with syllabus**

Part F

Important points for consideration/approval of Academic Council:

(i) The important points/recommendations of BOS that require consideration/ approval of Academic Council (points to be highlighted) are mentioned below:

**(a) Course Structure of B.Sc. Microbiology, F.Y.B.Sc. Semester-I and Semester-II (Annexure I).**

**(b) Syllabus of B.Sc. Microbiology-F.Y.B.Sc. Papers MIC GE-1 and MIC GE-2 (Annexure-II).**

**I Course Structure of M.Sc. Microbiology as per Goa University 64 credits under CBCS**

**(Annexure-III).**

**(d) Syllabus of M.Sc. Microbiology as per 64 credits under CBCS (Annexure-IV).**

**(e) Course Structure of M.Sc. Marine Microbiology as per Goa University 64 credits under CBCS (Annexure-V).**

**(f) Syllabus of M.Sc. Marine Microbiology as per 64 credits under CBCS (Annexure-VI).**

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| | **(XXIII)** The declaration by the Chairman, that the minutes were read out by the Chairman at the meeting itself.<br><br>(Prof. Sandeep Garg)<br>Signature of the<br>Chairperson<br>Date: 13.04.2018<br>Place: Department of Microbiology.<br><br>Part Gthe remarks of the Dean of the faculty<br>**(XXIV)** The minutes are in order.<br>(ii) The minutes may be placed before the Academic Council with remarks if any.<br>**(XXV)** May be recommended for approval of Academic Council.<br>**(XXVI)** Special remarks if any.<br><br>(Prof. M.K. Janarthanam)<br>Dean, Faculty of Life Science and Environment<br><br>(Back to Index) |
| **D 3.9** | **Minutes of the Meeting of Board of Studies in Philosophy held on 18/04/2018.**<br><br>**Part A**<br><br>(i)Recommendations regarding courses of study in the subject or group of subjects at the Under-Graduate level.<br>NIL<br><br>(ii)Recommendations regarding courses of study in the subject or group of subjects at the Post –Graduate level and Under-Graduate level.<br><br>**The draft Syllabus was placed before the BOS and the suggestions made by the members were incorporated and accordingly the titles of some of the Courses were revised. The list of Courses and the revised Syllabus was unanimously approved by the BOS (List of Courses and Syllabus enclosed)**<br>**Annexure I (refer page no 544)**<br>**Part B**<br>(i) Scheme of examinations at the Under-Graduate level.<br>NIL |

**D 3.8 Minutes of the Meeting of Board of Studies in Microbiology held on 13/04/2018.**

**Annexure I**

**Annexure I**
**Course Structure for B.Sc. Microbiology Part I – Semester I and Semester II**
**(with effect from the academic year 2018-2019)**

| **CBCS B.Sc. Microbiology Course Structure** | | | | |
|---|---|---|---|---|
| | | | | |
| **SEMESTER I** | | | | |
| **PAPER CODE** | **TITLE** | | **CREDITS** | **TOTAL** |
| MIC GC 1 | Microbiology and Biochemistry I | Theory<br>Practical | 4<br>2 | **6** |
| MIC GE-1 | Introduction and Scope of Microbiology | Theory | 4 | **4** |
| AECC 1 | English / EVS / MIL communication | Theory | 4 | **4** |
| **SEMESTER II** | | | | |
| **PAPER CODE** | **TITLE** | | **CREDITS** | **TOTAL** |
| MIC GC 2 | Microbiology and Biochemistry II | Theory<br>Practical | 4<br>2 | **6** |
| MIC GE-2 | Industrial and Food Microbiology | Theory | 4 | **4** |
| AECC 2 | English / EVS / MIL communication | Theory | 4 | **4** |

**Annexure – II**
**(with effect from the academic year 2018-2019)**

**SEMESTER –I**
**MIC GE-1: INTRODUCTION AND SCOPE OF MICROBIOLOGY**
**THEORY**

**CREDITS: 4** **TOTAL HOURS: 60**

**Unit 1 History of Development of Microbiology** **No. of Hours: 07**

Development of microbiology as a discipline, Spontaneous generation vs. biogenesis. Contributions of Leeuwenhoek, Pasteur, Koch, Lister, Fleming.

Role of microorganisms in fermentation, Germ theory of disease, Development of various microbiological techniques, Golden era of microbiology, Developments in the field of soil microbiology: Contributions of Beijerinck, Winogradsky, Waksman. Establishment of fields

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of medical microbiology and immunology through the works of Ehrlich, Metchnikoff, Jenner.

**Unit 2 Diversity of Microorganisms** **No. of Hours: 07**

Systems of classification: Binomial nomenclature, Whittaker's five kingdom and Carl Woese's three Domain classification systems and their utility.
General characteristics of different groups: Acellular microorganisms (viruses, viroids), cellular microorganisms (Prokarya: Archaea and Eubacteria; Eukarya : Algae, fungi and protozoa) and prions – giving definitions and citing examples.

**Unit 3 Microscopy** **No. of Hours: 05**

Bright Field Microscope, Electron Microscope.
Principle of stains and staining techniques (Gram staining, monochrome staining, negative staining).

**Unit 4 Sterilization** **No. of Hours: 05**

Autoclave (moist heat), hot air oven (dry heat), Tyndallization, membrane filtration.

**Unit 5 Microbes in Human Health & Environment** **No. of Hours: 07**

Medical microbiology and immunology: List of important human diseases and their causative agents. Definitions of immunity (active/passive), primary and secondary immune response, antigen, antibody and their types, vaccines.
Environmental microbiology: Definitions and examples of important microbial interactions – mutualism, commensalism, parasitism.
Application of microorganisms: bio-pesticides, bio-fertilizers, biodegradation, bio-deterioration and bioremediation (e.g. hydrocarbons in oil spills).

**Unit 6 Industrial Microbiology** **No. of Hours: 07**

Definition of fermentation, primary and secondary metabolites, types of fermentations and fermenters, microbes producing important industrial products through fermentation. Biofuels.

**Unit 7 Food and Dairy Microbiology** **No. of Hours: 07**

Microorganisms as food (SCP), microorganisms in food fermentations (dairy and non-dairy based fermented food products) and probiotics. Microorganisms in food spoilage and food borne infections.

**Unit 8: Ecology and Ecosystems** **No. of Hours: 07**

Concept of ecosystem: Types. Structure and function of ecosystems. Trophic levels: Primary and secondary production. Energy flow: ecological pyramids (pyramid of numbers, pyramid of energy, pyramid of biomass), food chains and food webs. Community structure: succession, trophic structure – zonation and stratification.

**Unit 9: Soil Microbiology** **No. of Hours: 08**

Soil as a habitat for microorganisms. Microorganisms in soil and their significance: bacteria, fungi, algae, protozoa, rhizosphere and rhizoplane. Biogeochemical cycles: C, N and role of microorganisms.

**SUGGESTED READING** (Latest editions)

1. Tortora GJ, Funke BR and Case CL. Microbiology: An Introduction. Pearson Education

2. Madigan MT, Martinko JM, Dunlap PV and Clark DP. Brock Biology of Microorganisms. Pearson International Edition
3. Cappucino J and Sherman N. Microbiology: A Laboratory Manual. Pearson Education Limited
4. Wiley JM, Sherwood LM and Woolverton CJ. Prescott's Microbiology. McGraw Hill International.
5. Atlas RM. Principles of Microbiology. WM.T. Brown Publishers.
6. Pelczar MJ, Chan ECS and Krieg NR. Microbiology. McGraw Hill Book Company.
7. Stanier RY, Ingraham JL, Wheelis ML, and Painter PR. General Microbiology. McMillan.
8. Odum E. Fundamentals of Ecology. Belmont CA: Thomson Brooks/Cole.
9. Coyne M. Soil Microbiology. Cengage Learning, Inc.
10. Rao NS Subba. Soil Microorganisms and Plant Growth. Oxford and IBH Publishing Co, Pvt. Ltd.
11. Alexander M. Introduction to Soil Microbiology. Krieger Publishing Company.

**SEMESTER – II**

**MIC GE-2: INDUSTRIAL AND FOOD MICROBIOLOGY**

**THEORY**

**CREDITS: 4** **TOTAL HOURS: 60**

**Unit 1 Introduction to Industrial Microbiology** **No. of Hours: 08**

Brief history and developments in industrial microbiology.
Types of fermentation processes – solid state, batch, continuous.
Types of fermenters – laboratory, pilot-scale and industrial-scale fermenters.

**Unit 2 Maintenance of sterility** **No. of Hours: 07**

Sterilization of equipment: Batch and continuous.
Sterilization of production media: Batch and continuous.
Sterilization of air: filtration, heat, electrostatic precipitation, UV light and chemical agents.

**Unit 3 Isolation of industrially important strains and Study of Fermentation Media**
**No. of Hours: 07**

Primary and secondary screening.
Preservation and maintenance of industrial strains.
Components of fermentation media – molasses, corn steep liquor, whey and yeast extract.

**Unit 4 Microbial fermentation processes** **No. of Hours: 08**

Downstream processing – filtration, centrifugation, cell disruption, solvent extraction.
Microbial production of industrial products – Vitamin $B_{12}$ and Penicillin.
Industrial applications of the enzymes – amylases, pectinases and proteases.

**Unit 5 Food as a substrate for microbial growth** **No. of Hours: 07**

Intrinsic and extrinsic parameters affecting microbial growth in food.
Microbial spoilage of food – milk, eggs and canned foods.

**Unit 6 Principles and methods of food preservation and food sanitation**
**No. of Hours: 07**

Physical methods – high temperature, low temperature, irradiation, aseptic packaging.
Chemical methods – salt, sugar, benzoates, citric acid, ethylene oxide, nitrate and nitrite.

Food sanitation and control – HACCP.

**Unit 7 Microbiology of milk** **No. of Hours: 08**

Sources of microorganisms in milk.
Microbiological examination of milk: SPC and Breed's smear, advantages and disadvantages.
Grading of milk by dye reduction test: MBRT and Resazurin test.
Pasteurization of milk: LTH, HTST, UHT and efficacy of pasteurization – Phosphatase test.

**Unit 8 Dairy products, probiotics and Food-borne Diseases** **No. of Hours: 08**

Butter, Fermented dairy product – cheese and yogurt.
Probiotics definition, examples and benefits.
Food intoxication by *Clostridium botulinum* and *Staphylococcus aureus.*
Food infections by *Salmonella* and *Listeria.*

**SUGGESTED READING (Latest editions)**

1. Crueger, W. And Crueger, A. Biotechnology: A textbook of Industrial Microbiology. Panima Publishing Company, New Delhi.
2. Patel, A.H. Industrial Microbiology. MacMillan India Limited Publishing
3. Company Ltd. New Delhi, India.
4. Tortora, G.J., Funke, B.R. and Case, C.L. Microbiology: An introduction. Pearson Education.
5. Willey, J.M., Sherwood, L.M. and Woolverton, C.J. Prescott, Harley and Klein's Microbiology. McGraw Hill Higher education.
6. Casida, L.E. Industrial Microbiology. Wiley Eastern Limited.
7. Stanbury, P.F., Whitaker, A. And Hall, S.J. Principles of Fermentation Technology. Elsevier Science Ltd.
8. Adams, M.R and Moss, M.O. Food Microbiology. New Age International (P) Limited Publishers, New Delhi, India.
9. Banwart, J.M. Basic Food Microbiology. CBS Publishers and Distributors, Delhi, India.
10. Frazier, W.C. and Westhoff, D.C. Food Microbiology. Tata McGraw-Hill Publishing Company Ltd, New Delhi, India.
11. Jay, J.M., Loessner, M.J. and Golden, D.A. Modern Food Microbiology. CBS Publishers and Distributors, Delhi, India.

**Annexure III**

**Course Structure of M.Sc. Microbiology**

| **Semester 1 – Core Papers** | | | | |
|---|---|---|---|---|
| **Code** | **Title of paper** | **Theory/ Practical** | **Credit** | **CH** |
| MIC 101-T | Microbial Biochemistry | Theory | 3 | 36 |
| MIC 102-T | Microbial Genetics | Theory | 3 | 36 |
| MIC 103-T | Microbial Taxonomy and Systematics | Theory | 3 | 36 |
| MIC 104-T | Biostatistics | Theory | 3 | 36 |
| MIC 105-P | Practical I | Practical | 4 | 96 |
| | | | | |

| Semester 2 – Core Papers | | | | |
|---|---|---|---|---|
| MIC 201-T | Techniques and Instrumentation in Microbiology | Theory | 3 | 36 |
| MIC 202-T | Industrial Microbiology | Theory | 3 | 36 |
| MIC 203-T | Molecular Biology | Theory | 3 | 36 |
| MIC 204-T | Mycology | Theory | 3 | 36 |
| MIC 205-P | Practical II | Practical | 4 | 96 |
| | | | | |
| **Semester 3 & 4 – Optional Papers** | | | | |
| MIO 101-T | Medical Virology | Theory | 3 | 36 |
| MIO 102-T | Archaea [T] | Theory | 3 | 36 |
| MIO 102-P | Archaea [P] | Practical | 1 | 24 |
| MIO 103-T | Marine Microbiology [T] | Theory | 3 | 36 |
| MIO 103-P | Marine Microbiology [P] | Practical | 1 | 24 |
| MIO 104-T | Environmental Microbiology and Bioremediation [T] | Theory | 3 | 36 |
| MIO 104-P | Environmental Microbiology and Bioremediation [P] | Practical | 1 | 24 |
| MIO 105-T | Genetic Engineering [T] | Theory | 3 | 36 |
| MIO 105-P | Genetic Engineering [P] | Practical | 1 | 24 |
| MIO 106-T | Immunology [T] | Theory | 3 | 36 |
| MIO 106-P | Immunology [P] | Practical | 1 | 24 |
| MIO 107-T | Extremophilic Microorganisms [T] | Theory | 3 | 36 |
| MIO 107-P | Extremophilic Microorganisms [P] | Practical | 1 | 24 |
| MIO 108-T | Research Methodology [T] | Theory | 1 | 12 |
| MIO 108-P | Research Methodology [P] | Practical | 1 | 24 |
| MIO 109-T | Microbial Technology [T] | Theory | 3 | 36 |
| MIO 109-P | Microbial Technology [P] | Practical | 1 | 24 |
| MIO 110-T | Food Microbiology [T] | Theory | 3 | 36 |
| MIO 110-P | Food Microbiology [P] | Practical | 1 | 24 |
| MIO 111-T | Agriculture Microbiology [T] | Theory | 3 | 36 |
| MIO 111-P | Agriculture Microbiology [P] | Practical | 1 | 24 |
| MIO 112-T | Medical Microbiology and Epidemiology [T] | Theory | 3 | 36 |
| MIO 112-P | Medical Microbiology and Epidemiology [P] | Practical | 1 | 24 |
| MIO 113-T | Marine Microbial Interactions [T] | Theory | 3 | 36 |
| MIO 113-P | Marine Microbial Interactions [P] | Practical | 1 | 24 |
| MIO 201-P | Field Trip/Study Tour [P] | Practical | 1 | 24 |
| MIO 202 | Training in an Institute/ Industry/ University | | 1 | |
| MID | Dissertation | | 8 | |

Under Optional Courses:

- The theory course is a prerequisite for any practical course.
- Students of Microbiology and Marine Microbiology Programmes shall be required to take both Theory and Practical Courses under a given Course Title.

**Annexure IV**

**Goa University**
**P.O. Goa University, Taleigao Plateau, Goa 403 206, India**

## Syllabus of M.Sc. (Microbiology) Programme

The Programme is meant for students of B.Sc. (Microbiology) to pursue higher studies in Microbiology. It serves to impart advanced training to the students in the field of Microbiology with focus on microbial diversity, bioprospecting and applications of microbes for obtaining various biologically significant metabolites and in bioremediation of polluted environments. Students undergo hands-on training with state-of-the art technologies and are trained so as to develop an aptitude for independent research. The Programme equips students for higher research leading to the Ph.D. Degree in India or in International Universities overseas, or for employment in Research Institutes, in teaching, and in Industry.

**Prerequisites:** B. Sc. (Microbiology)

**Course Structure of M.Sc. Microbiology**

| **Semester 1 – Core Papers** | | | | |
|---|---|---|---|---|
| **Code** | **Title of paper** | **Theory/ Practical** | **Credit** | **CH** |
| MIC 101-T | Microbial Biochemistry | Theory | 3 | 36 |
| MIC 102-T | Microbial Genetics | Theory | 3 | 36 |
| MIC 103-T | Microbial Taxonomy and Systematics | Theory | 3 | 36 |
| MIC 104-T | Biostatistics | Theory | 3 | 36 |
| MIC 105-P | Practical I | Practical | 4 | 96 |
| | | | | |
| **Semester 2 – Core Papers** | | | | |
| MIC 201-T | Techniques and Instrumentation in Microbiology | Theory | 3 | 36 |
| MIC 202-T | Industrial Microbiology | Theory | 3 | 36 |
| MIC 203-T | Molecular Biology | Theory | 3 | 36 |
| MIC 204-T | Mycology | Theory | 3 | 36 |
| MIC 205-P | Practical II | Practical | 4 | 96 |
| | | | | |
| **Semester 3 & 4 – Optional Papers** | | | | |
| MIO 101-T | Medical Virology | Theory | 3 | 36 |
| MIO 102-T | Archaea [T] | Theory | 3 | 36 |
| MIO 102-P | Archaea [P] | Practical | 1 | 24 |
| MIO 103-T | Marine Microbiology [T] | Theory | 3 | 36 |
| MIO 103-P | Marine Microbiology [P] | Practical | 1 | 24 |
| MIO 104-T | Environmental Microbiology and Bioremediation [T] | Theory | 3 | 36 |

| | | | | |
|---|---|---|---|---|
| MIO 104-P | Environmental Microbiology and Bioremediation [P] | Practical | 1 | 24 |
| MIO 105-T | Genetic Engineering [T] | Theory | 3 | 36 |
| MIO 105-P | Genetic Engineering [P] | Practical | 1 | 24 |
| MIO 106-T | Immunology [T] | Theory | 3 | 36 |
| MIO 106-P | Immunology [P] | Practical | 1 | 24 |
| MIO 107-T | Extremophilic Microorganisms [T] | Theory | 3 | 36 |
| MIO 107-P | Extremophilic Microorganisms [P] | Practical | 1 | 24 |
| MIO 108-T | Research Methodology [T] | Theory | 1 | 12 |
| MIO 108-P | Research Methodology [P] | Practical | 1 | 24 |
| MIO 109-T | Microbial Technology [T] | Theory | 3 | 36 |
| MIO 109-P | Microbial Technology [P] | Practical | 1 | 24 |
| MIO 110-T | Food Microbiology [T] | Theory | 3 | 36 |
| MIO 110-P | Food Microbiology [P] | Practical | 1 | 24 |
| MIO 111-T | Agriculture Microbiology [T] | Theory | 3 | 36 |
| MIO 111-P | Agriculture Microbiology [P] | Practical | 1 | 24 |
| MIO 112-T | Medical Microbiology and Epidemiology [T] | Theory | 3 | 36 |
| MIO 112-P | Medical Microbiology and Epidemiology [P] | Practical | 1 | 24 |
| MIO 113-T | Marine Microbial Interactions [T] | Theory | 3 | 36 |
| MIO 113-P | Marine Microbial Interactions [P] | Practical | 1 | 24 |
| MIO 201-P | Field Trip/Study Tour [P] | Practical | 1 | 24 |
| MIO 202 | Training in an Institute/ Industry/ University | | 1 | |
| MID | Dissertation | | 8 | |

Under Optional Courses:
- The theory course is a prerequisite for any practical course.
- Students of Microbiology and Marine Microbiology Programmes shall be required to take both Theory and Practical Courses under a given Course Title.

**Programme: M.Sc. (Microbiology)**

**Course Code: MIC 101-T**

**Title of the Course: MICROBIAL BIOCHEMISTRY**

**Number of Credits: 3**

**Effective from Academic Year: 2018-19**

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| | | |
|---|---|---|
| **Prerequisites** | The student should be familiar with the different biomolecules and their metabolism. | |
| **Objective:** | This course deals with the characteristics, properties and biological significance of the biomolecules of life. In depth knowledge of the 451atheteri and regulation of different metabolic processes in microorganisms. | |
| **Content:** | | |
| **1.** | **Biological Molecules** | **(12)** |

| | | |
|---|---|---|
| **1.1** | **Proteins** | |
| | Amino acids: features and properties. | |
| | Protein: structure, principles of separation and purification, molecular weight determination; sequencing and synthesis. | |
| | Enzymes: activity, inhibition, mechanism of action; regulatory – allosteric and covalently modulated enzymes and their significance in metabolism. | |
| **1.2** | **Carbohydrates** | |
| | Monosaccharides: types, characteristics and properties. | |
| | Disaccharides, oligosaccharides, polysaccharides – biological significance. | |
| **1.3** | **Lipids** | |
| | Fatty acids: saturated and unsaturated, structure and properties. | |
| | Lipids: biological significance; lipid composition of microorganisms. | |
| | | |
| **2.** | **Bioenergetics and Carbohydrate Metabolism** | **(12)** |
| **2.1** | **Bioenergetics** | |
| | Thermodynamics, exergonic and endergonic reactions, redox potential, high energy compounds, ATP structure and significance. | |
| **2.2** | **Oxidative Phosphorylation** | |
| | Redox enzymes, aerobic electron transport and oxidative phosphorylation. | |
| **2.3** | **Carbohydrate metabolism** | |
| A. | Carbohydrates: Central pathways of metabolism – regulatory mechanisms, bioenergetics and significance – EMP, TCA cycle (glucose aerobic and anaerobic metabolism, malate metabolism), Glyoxylate cycle. | |
| B. | Gluconeogenesis from TCA intermediates / amino acids / acetyl-CoA; biosynthesis of polysaccharides and sugar interconversions. | |
| | | |
| **3.** | **Lipids, Amino Acids, Nucleotides and other Metabolic Paths** | **(12)** |
| **3.1** | **Lipid Metabolism** | |
| A. | Anabolism: Biosynthesis of fatty acids: saturated and unsaturated, triglycerides, phospholipids, | |
| **3.2** | **Amino Acid and Nucleotide Biosynthesis** | |
| A. | Amino acid biosynthetic pathways and their regulation. | |
| B. | Purine and pyrimidine nucleotides, Deoxyribonucleotides: biosynthesis and regulation. | |
| C. | Biosynthesis of nucleotide coenzymes. | |
| **3.3** | **Photosynthetic Metabolism** | |
| A. | Organisms and photosynthetic pigments, fundamental processes in Photosynthesis. | |
| B. | Photosynthetic electron transport and photophosphorylation. | |
| **3.4** | **Chemolithotrophy** | |
| | Organisms, substrates, bioenergetics of metabolism. | |

| | | |
|---|---|---|
| | | |
| **Pedagogy:** | Lectures/tutorials/assignments/self-study | |
| | | |
| **References/ Readings** | Lehninger, A., Cox, M. and Nelson, D. L., Principles of Biochemistry, W. H. Freeman & Company. | |
| | Moat, A. G., Foster, J. W. and Spector, M. P., Microbial Physiology, A. John Wiley & Sons Inc. Publication. | |
| | Bull, A. T. and Meadow, P., Companion to Microbiology, Longman Group Limited, New York. | |
| | Voet, D., Voet, J. G. and Pratt, C. W., Principles of Biochemistry, John Wiley and Sons Inc. | |
| | Murray, R. K., Bender, D. A., Botham, K. M., Kennelly, P. J., Rodwell, V. W. and Weil, P. A., Harper's Illustrated Biochemistry, The McGraw-Hill Companies, Inc. | |
| | Plummer, D. T., An Introduction to Practical Biochemistry, Tata McGraw Hill Publishing Company. | |
| | Sadasivam, S., Manickam, A., Biochemical Methods, New Age International (P) Limited. | |
| | Jayaraman, J., Laboratory Manual in Biochemistry, John Wiley & Sons, Limited, Australia. | |
| | | |
| **Learning Outcomes** | 1. Apply the knowledge to understand the microbial physiology and to identify the microorganisms.<br>2. Understand the regulation of the biochemical pathway and possible process modifications for improved control over microorganisms for microbial product synthesis. | |

**Programme: M.Sc. (Microbiology)**

**Course Code: MIC 102-T**

**Title of the Course: MICROBIAL GENETICS**

**Number of Credits: 3**

**Effective from Academic Year: 2018-19**

| | | |
|---|---|---|
| **Prerequisites** | It is assumed that students have basic knowledge of Mendelian genetics, structure of DNA and RNA, Prokaryotic and eukaryotic genome organisation, mutation concept, basic knowledge about replication, transcription and translation. | |
| **Objective:** | This course develops concept of Classical Mendelian genetics and deviation from Mendelian principles, Microbial genome organization (Prokaryotic and Eukaryotic), Viral Genetics, Mutagenesis, Bacterial plasmids as research tools, transcription and translation in prokaryotes and eukaryotes and application of Microbial Genetics. | |

**GOA UNIVERSITY**

**Taleigao Plateau, Goa 403 206**

# M I N U T E S

**of the 9th Meeting of the**

**IX ACADEMIC COUNCIL**

**Day & Date**

**11th, 15th and 18th May, 2018**

**Time**

**10.30 a.m.**

**Venue**

**COUNCIL HALL**
**Administration Block**

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| **D 3.6** | **Minutes of the Meeting of Board of Studies in Earth Science held on 03/04/2018.**<br>The Academic Council did not approve the minutes of the meeting of the Board of Studies in Earth Science held on 03/04/2018.<br><br>The Chairperson, Board of Studies was requested to take the matter back to the Board of Studies. The House did not agree to the Proposal to start a Distance Education Programme and then place the same before the Academic Council for approval. The House noted the following: (a) Weightage in hours need to be indicated in the Syllabus. (b) Details with regard to Courses GLO – 276 to GLO – 278 need to be given.<br><br>**(Action: AR-PG)** |
| **D 3.7** | **Minutes of the Meeting of Board of Studies in Marine Science held on 20/04/2018.**<br>The Academic Council did not approve the minutes of the meeting of the Board of Studies in Marine Science held on 20/04/2018.<br><br>The Chairperson, Board of Studies was requested to take the matter back to the Board of Studies and then place the same before the Academic Council/ Standing Committee of the Academic Council for approval.<br><br>**(Action: AR-PG)** |
| **D 3.8** | **Minutes of the Meeting of Board of Studies in Microbiology held on 13/04/2018.**<br>The Academic Council approved the minutes of the Meeting of the Board of Studies in Microbiology held on 13/04/2018.<br><br>**(Action: AR-PG)** |
| **D 3.9** | **Minutes of the Meeting of Board of Studies in Philosophy held on 18/04/2018.**<br>The Academic Council approved the minutes of the Meeting of the Board of Studies in Philosophy held on 18/04/2018 with the following suggested changes:<br><br>1. Course Codes to be changed.<br>2. Compulsory Courses to be changed to Core Courses.<br><br>**(Action: AR-PG)** |
| **D 3.10** | **Minutes of the Meeting of Board of Studies in Women's Studies held on 19/04/2018.**<br>The Academic Council approved the minutes of the Meeting of the Board of Studies in Women's Studies held on 19/04/2018 with the following changes:<br>1. Compulsory Courses to be changed to Core Courses.<br>2. Coding to be changed.<br>3. The proposal to introduce a Compulsory Foundation Course - WSF – 201 Gender Sensitivity and Equity was not accepted. The Chairperson, Board of Studies was requested to place the same before the Faculty Board.<br><br>**(Action: AR-PG)** |
| **D 3.11** | **Minutes of the meeting of Board of Studies in Social Work held on 23/03/2018.**<br>The Academic Council approved the Minutes of the meeting of the Board of Studies |