

ಮಂಗಳೂರು ವಿಶ್ವವಿದ್ಯಾನಿಲಯ
MANGALORE UNIVERSITY



(Accredited by NAAC with 'A' Grade)

ಕ್ರಮಾಂಕ/ No. : MU/ACC/CR.7/CBCS-PG(SLB)/2017-18/A2

ಕುಲಸಚಿವರ ಕಛೇರಿ
ಮಂಗಳಗಂಗೋತ್ರಿ - 574 199
Office of the Registrar
Mangalagangothri - 574 199
ದಿನಾಂಕ/Date: 10.05.2017

NOTIFICATION

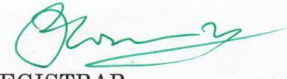
Sub: Changes in the title of some courses of I & II semester M.Sc. in Biochemistry degree programme and syllabus thereon.

- Ref: 1) This Office Notification No.: MU/ ACC/ CR.7/ CRCS-PG(SLB)/ 2016-17/ A2, dated 17.08.2016
2) Proceedings of the meeting of BOS in Biochemistry held on 7.09.2016.
3) Approval of the Academic Council at its meeting held on 3.02.2017 vide Agenda No.3:21 (2016-17)

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Pursuant to the above, the P.G. Board of Studies in Biochemistry has changed the title of the courses BCH403, BCP407 and BCP459 of M.Sc. in Biochemistry degree programme and framed the syllabus for these courses.

The Academic Council at its meeting held on 3.02.2017 has approved this changes in course titles and syllabus thereon which is hereby notified from the academic year 2017-18 onwards.

  
REGISTRAR.

To:

- 1) The Chairman of the department concerned.
- 2) The Principals of the Colleges concerned.
- 3) The Registrar (Evaluation), Mangalore University.
- 4) The Chairman, P.G. BOS in Biochemistry, Mangalore University.
- 5) The Superintendent (ACC), O/o the Registrar, Mangalore University.
- 6) Guard File.

# MANGALORE UNIVERSITY

## Department of Studies in Biochemistry, Mangalore University

PG Centre, Chikka Aluvara, Thorennoor Post, Kodagu District, Karnataka, 571 232

### PREAMBLE

Revision of syllabi for the two years' Master Degree (Choice Based Credit System- Semester Scheme)  
Program in Biochemistry.

PG BOS in Biochemistry has revised and prepared the syllabi (CBCS based) for the PG course in Biochemistry

by giving certain guidelines to offer Hard Core, Soft Core and Open Elective courses with credits to each course amounting to 90 credits for the entire program.

There are totally 9 Hard Core theory courses, 3 Hard Core practical courses and one Hard core project work in 4<sup>th</sup> semester with a total Hard Core credits of 53. In the 4<sup>th</sup> semester, each student has to take up a research project for which 5 credits are allotted. A total of 9 Soft Core theory courses and 3 Soft Core practical courses with a total of 31 Soft Core credits are being introduced. Board of Studies in Biochemistry has carefully chosen two Open Elective courses for the selection by the students from other disciplines, one each in 2<sup>nd</sup> and 3<sup>rd</sup> semester, with total credits of 6. Therefore, grand total credits for the program = **90**.

We have given choice for the soft core courses in the 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> semesters for Biochemistry post graduates.

A detailed skeleton of the entire program is being tabulated for the benefit of the aspiring post graduates. Syllabi of all the four semesters are prepared and being uploaded.

Other important aspects such as University question paper pattern, internal assessment examinations, allotment of marks and the approximate dates of the internal examinations are being tabulated with a discussion in the Board of Studies in Biochemistry.

### Two-year Master's Degree Course (Four Semesters) M Sc Biochemistry (CBCS)

| S. No. | Semester     | Hard core credits | Soft core credits | Open elective credits | Practical, Project* | Theory     | Total credits |
|--------|--------------|-------------------|-------------------|-----------------------|---------------------|------------|---------------|
| 1.     | I Semester   | 20                | 3                 | -                     | 2 (H)               | 3(H) +1(S) | 23            |
| 2.     | II Semester  | 12                | 9                 | 3                     | 1 (H)               | 2(H)+4(S)  | 24            |
| 3.     | III Semester | 12                | 9                 | 3                     | 2(S)                | 3(H)+2(S)  | 24            |
| 4.     | IV Semester  | 09                | 10                | -                     | 1(S)                | 1(H)+2(S)  | 19            |
|        |              |                   |                   |                       | 1Project*(H)        |            |               |
|        | Total        | 53                | 31                | 6                     | 6 + 1*              | 18         | <b>90</b>     |

H = Hard core; S = Soft core

## MSc Biochemistry CBCS (All 4 Semesters)

### HARDCORE

| Serial No. | Paper code | Title of the paper                          |
|------------|------------|---------------------------------------------|
| 1.         | BC H 401   | Bioorganic & Biophysical Chemistry          |
| 2.         | BC H 402   | Biomolecules                                |
| 3.         | BC H 403   | Analytical Biochemistry                     |
| 4.         | BC P 406   | General Biochemistry                        |
| 5.         | BC P 407   | Biochemical Techniques                      |
| 6.         | BC H 451   | Enzymology                                  |
| 7.         | BC H 452   | Metabolism of Fuel Molecules                |
| 8.         | BC P 458   | Practical Enzymology                        |
| 9.         | BC H 501   | Molecular Biology                           |
| 10.        | BC H 502   | Immunology                                  |
| 11.        | BC H 503   | Metabolism of Nitrogen Containing Compounds |
| 12.        | BC H 551   | Biotechnology                               |
| 13.        | BC H 555   | Project                                     |

### SOFTCORE

| Serial No. | Paper code | Title of the paper              |
|------------|------------|---------------------------------|
| 1.         | BC S 404   | Human Physiology                |
| 2.         | BC S 405   | General Microbiology            |
| 3.         | BC S 453   | Nutrition                       |
| 4.         | BC S 454   | Plant Biochemistry              |
| 5.         | BC S 455   | Clinical Biochemistry           |
| 6.         | BC S 456   | Bioethics & Biosafety           |
| 7.         | BC P 459   | Practical Clinical Biochemistry |
| 8.         | BC S 504   | Genetics                        |
| 9.         | BC S 505   | Nanotechnology                  |
| 10.        | BC S 506   | Food Science                    |
| 11.        | BC P 508   | Molecular Biology & Immunology  |
| 12.        | BC P 509   | Microbiology & Cell Biology     |
| 13.        | BC S 552   | Cell Biology                    |
| 14.        | BC S 553   | Bioinformatics & Biostatistics  |
| 15.        | BC P 554   | Practical Biotechnology         |

### OPEN ELECTIVES FOR OTHER DISCIPLINES

| Serial No. | Paper code | Title of the paper              |
|------------|------------|---------------------------------|
| 1.         | BC E 457   | Biochemistry in Day-To-Day Life |
| 2.         | BC E 507   | Health and Disease              |

## FIRST SEMESTER

| Serial No. | Paper Code | Title of the paper                 | Instruction hours /week | Duration of Examination in hours | Marks     | Credits | Theory(T)/ Practical(P) | Hardcore(HC) / Soft core(SC) |
|------------|------------|------------------------------------|-------------------------|----------------------------------|-----------|---------|-------------------------|------------------------------|
| 1.         | BC H 401   | Bioorganic & Biophysical Chemistry | 4                       | 3                                | 70+30=100 | 4       | T                       | HC                           |
| 2.         | BC H 402   | Bio-molecules                      | 4                       | 3                                | 70+30=100 | 4       | T                       | HC                           |
| 3.         | BC H 403   | Analytical Biochemistry            | 4                       | 3                                | 70+30=100 | 4       | T                       | HC                           |
| 4.         | BC S 404   | Human Physiology*                  | 3                       | 3                                | 70+30=100 | 3       | T                       | SC                           |
| 5.         | BC S 405   | General Microbiology#              |                         |                                  |           |         |                         |                              |
| 6.         | BC P 406   | General Biochemistry               | 8                       | 6                                | 70+30=100 | 4       | P                       | HC                           |
| 7.         | BC P 407   | Biochemical Techniques             | 8                       | 6                                | 70+30=100 | 4       | P                       | HC                           |

\*# There is a choice between BC S 404 and BC S 405.

## SECOND SEMESTER

| Serial No. | Paper Code | Title of the paper              | Instruction hours /week | Duration of Examination in hours | Marks     | Credits | Theory(T)/ Practical(P) | Hardcore(HC) / Soft core(SC) |
|------------|------------|---------------------------------|-------------------------|----------------------------------|-----------|---------|-------------------------|------------------------------|
| 1.         | BC H 451   | Enzymology                      | 4                       | 3                                | 70+30=100 | 4       | T                       | HC                           |
| 2.         | BC H 452   | Metabolism of Fuel Molecules    | 4                       | 3                                | 70+30=100 | 4       | T                       | HC                           |
| 3.         | BC S 453   | Nutrition*                      | 3                       | 3                                | 70+30=100 | 3       | T                       | SC                           |
|            | BC S 454   | Plant Biochemistry#             |                         |                                  |           |         |                         |                              |
| 4.         | BC S 455   | Clinical Biochemistry*          | 3                       | 3                                | 70+30=100 | 3       | T                       | SC                           |
| 7.         | BC S 456   | Bioethics & Biosafety#          |                         |                                  |           |         |                         |                              |
| 9.         | BC E 457   | Biochemistry in Day-To-Day Life | 2                       | 3                                | 70+30=100 | 3       | T                       | SC                           |
| 8.         | BC P 458   | Practical Enzymology            | 8                       | 6                                | 70+30=100 | 4       | P                       | HC                           |
| 9.         | BC P 459   | Practical Clinical Biochemistry | 8                       | 6                                | 70+30=100 | 3       | P                       | SC                           |

\*# There is a choice between - 1. BC S 453 and BC S 454. & 2. BC S 455 and BC S 456.  
3. BC E 457 is an open elective course for other disciplines.

THIRD SEMESTER

| Serial No. | Paper Code | Title of the paper                          | Instruction hours /week | Duration of Examination in hours | Marks     | Credits | Theory(T)/ Practical(P) | Hardcore(HC) / Soft core(SC) |
|------------|------------|---------------------------------------------|-------------------------|----------------------------------|-----------|---------|-------------------------|------------------------------|
| 1.         | BC H 501   | Molecular Biology                           | 4                       | 3                                | 70+30=100 | 4       | T                       | HC                           |
| 2.         | BC H 502   | Immunology                                  | 4                       | 3                                | 70+30=100 | 4       | T                       | HC                           |
| 3.         | BC H 503   | Metabolism of Nitrogen Containing Compounds | 4                       | 3                                | 70+30=100 | 4       | T                       | HC                           |
| 4.         | BC S 504   | Genetics*                                   | 3                       | 3                                | 70+30=100 | 3       | T                       | SC                           |
| 5.         | BC S 505   | Nanotechnology#                             |                         |                                  |           |         |                         |                              |
| 6.         | BC S 506   | Food Science \$                             | 3                       | 3                                | 70+30=100 | 3       | T                       | SC                           |
| 7.         | BC E 507   | Health and Disease                          | 2                       | 3                                | 70+30=100 | 3       | T                       | SC                           |
| 8.         | BC P 508   | Molecular Biology & Immunology              | 8                       | 6                                | 70+30=100 | 3       | P                       | SC                           |
| 9.         | BC P 509   | Microbiology & Cell Biology @               | 8                       | 6                                | 70+30=100 | 3       | P                       | SC                           |

\*# There is a choice between BC S 504 and BC S 505

\$@ There is a choice between BC S 506 and BC P 509

FOURTH SEMESTER

| Serial No. | Paper Code | Title of the paper             | Instruction hours /week | Duration of Examination in hours | Marks     | Credits | Theory(T)/ Practical(P) | Hardcore(HC) / Soft core(SC) |
|------------|------------|--------------------------------|-------------------------|----------------------------------|-----------|---------|-------------------------|------------------------------|
| 1.         | BC H 551   | Biotechnology                  | 4                       | 3                                | 70+30=100 | 4       | T                       | HC                           |
| 2.         | BC S 552   | Cell Biology                   | 3                       | 3                                | 70+30=100 | 3       | T                       | SC                           |
| 3.         | BC S 553   | Bioinformatics & Biostatistics | 3                       | 3                                | 70+30=100 | 3       | T                       | SC                           |
| 4.         | BC P 554   | Practical Biotechnology        | 8                       | 4                                | 70+30=100 | 4       | P                       | SC                           |
| 5.         | BC P 555   | Project Work *                 | 10                      | -                                | 70+30=100 | 5       | Project                 | HC                           |

\*BC P 555 Research project work is compulsory to all students.

### University theory question paper pattern

| Ser. No. | Question type                                                                                                        | Marks       |
|----------|----------------------------------------------------------------------------------------------------------------------|-------------|
| 1.       | Answer any ten questions out of twelve                                                                               | 2 x 10= 20  |
| 2.       | Answer any five questions out of eight                                                                               | 10 x 5 = 50 |
|          | Hard core: Two questions from each Unit and the remaining questions from any of the four units for short answers     |             |
|          | Soft core: Three questions from each unit and the remaining questions from any of the three units for short answers. |             |

### Internal Assessment (Theory & Practical) Examination

| Ser. No. | Description                         | Test     | Marks          |
|----------|-------------------------------------|----------|----------------|
| 1.       | At the end of 8 <sup>th</sup> week  | C1       | 30             |
| 2.       | At the end of 14 <sup>th</sup> week | C2       | 30             |
|          |                                     | C1+C2 /2 | Average of two |

### C1/ C2 Theory Marks Allotment

| Ser. No. | Description | Marks |
|----------|-------------|-------|
| 1.       | Assignment  | 10    |
| 2.       | Test        | 20    |
|          | Total       | 30    |

### Allotment of C1/C2 Practical Marks

| Ser. No. | Description                       | Marks |
|----------|-----------------------------------|-------|
| 1.       | Practical Test C1                 | 30    |
| 2.       | Practical Test C2 + Class Seminar | 30    |

# I SEMESTER –ANALYTICAL BIOCHEMISTRY: BCH 403 HARD CORE

Total Number of Lecture Hours: 56

Total Number of Credits: 04

## Unit I

14 hrs.

**Preliminary techniques in Biochemistry:** Animal and plant models, Investigation with isolated organs and tissues, Introduction to animal and plant cell culture. Investigation with microorganism and their mutant (auxotroph), yeast, *Ceanorhabditis elegans*, *Arabidopsis thaliana* and *Drosophila melanogaster* as model specimen for biochemical investigations. **Cell fractionation techniques:** Cell lysis, homogenization, extraction, salting in, salting out, dialysis and ultra-filtration. **Centrifugation:** Basic principles of sedimentation, types of centrifuges and rotors. Preparative Centrifugation – Differential and Density gradient, Sub-cellular fractionation, Marker enzyme analysis, Analytical Centrifugation - application and design.

## Unit II

14 hrs.

**Chromatography:** Introduction, partition coefficient, Modes of chromatography, liquid and solid phases, paper chromatography and Thin-layer Chromatography (TLC): Principle, procedure and application, Column chromatography: Basic components, selection of stationary and mobile phase, matrices. Adsorption chromatography (hydroxyapatite and Hydrophobic interaction), Partition (normal phase and reverse phase) Ion exchange (Cation and anion exchange), Gel filtration, affinity chromatography, High performance liquid chromatography (HPLC), Fast protein liquid chromatography (FPLC), Gas liquid chromatography (GLC).

## Unit III

14 hrs.

**Electrophoretic techniques:** Principle, Non-denaturing, denaturing electrophoresis, agarose gel electrophoresis, isoelectric focusing, pulsed field electrophoresis, capillary electrophoresis, Visualising separated components - staining for proteins and nucleic acids, fluorescence, PAS staining, zymogram. **Spectroscopic techniques:** Beer-Lambert's Law and its limitations, Extinction coefficient, Principles & Applications: Colorimeter, UV-Vis Absorption spectroscopy, Fluorescence Spectroscopy, Mass spectrometry, Infrared and Raman Spectroscopy, Nuclear Magnetic Resonance, Electron Spin Resonance, Circular dichroism spectroscopy, X-ray crystallography.

## Unit IV

14 hrs.

**Isotopes in Biochemistry:** Isotopes, Types of radioactive decay, Units of radioactivity, Interaction of radioactivity with matter, Detection and measurement of radioactivity: Methods based on gas ionization (Geiger-Muller counter), Excitation (Scintillation counting) and Photographic methods. Specific activity, commonly used isotopes (Tritium, Carbon-14, Phosphorous-32, Sulfur-35, Iodine-131), Advantages and restriction of radiotracer experiments, safety aspects, Applications of radioisotopes in biological sciences.

## REFERENCES:

1. Freifelder D. M. Physical Biochemistry- Application to Biochemistry and Molecular Biology, 2<sup>nd</sup> ed., W.H. Freeman, 1982.
2. Principles and Techniques of Biochemistry and Molecular Biology, ed., Keith Wilson & John Walker, March 2010, Cambridge Univ. Press.
3. West & Todd. Biochemistry. 4<sup>th</sup> ed., Oxford and IBH.
4. Upadhyay and Upadhyay. Biophysical Chemistry

## **I SEMESTER - GENERAL BIOCHEMISTRY: BC P 406**

### **PRACTICAL - HARD CORE: 4 CREDITS- 8 HOURS/WEEK**

1. Buffers: a) Introduction b) Preparation
2. Quantitative determination of protein concentration by Biuret method.
3. Estimation of proteins by Lowry's method.
4. Estimation of proteins by Bradford method.
5. Bicinchonic acid protein assay.
6. Measurement of protein concentration by UV spectroscopy.
7. Estimation of glucose by Dinitrosalicylic acid method.
8. Estimation of glucose by Anthrone method.
9. Estimation of ascorbic acid by DNPH method.
10. Estimation of inorganic phosphate by Fiske- Subba Raw's method.

#### **REFERENCES:**

1. Introduction to practical Biochemistry. David T. Plummer
2. Lab Manual of Biochemistry. By Nigam. 2007. Tata McGraw-Hill Education, USA.

## **I SEMESTER - BIOCHEMICAL TECHNIQUES: BC P 407**

### **PRACTICAL - HARD CORE: 4 CREDITS- 8 HOURS/WEEK**

1. Detection of amino acids by circular chromatography
2. Detection of amino acids by ascending chromatography.
3. Detection of amino acids by descending chromatography.
4. Detection of amino acids by 2D- paper chromatography.
5. Detection of amino acids by thin layer chromatography.
6. Detection of lipids by thin layer chromatography.
7. Detection of carbohydrates by paper chromatography.
8. Saponification number of oil and fat.
9. Iodine number of oil and fat.
10. Acid precipitation of proteins.
11. Preparation of casein from milk and qualitative estimation of proteins.
12. Purification of proteins: Ammonium sulphate precipitation (salting out), Dialysis, Ion exchange, Gel filtration.
13. Separation and detection of proteins – Native PAGE, Denaturing PAGE, IEF.
14. Agarose gel electrophoresis – DNA.

#### **REFERENCES:**

1. Practical Clinical Biochemistry, Harold Varley, Inter science Publishers Inc, 2002
2. Clinical Chemistry: Theory, Analysis and Correlation. Kaplan, L.A. and Pesce, A.J., 4th ed. Mosby, 2003.
3. Introduction to practical Biochemistry. David T. Plummer
4. Nigam. 2007. Lab Manual of Biochemistry. By. Tata McGraw-Hill Education, USA



## **II SEMESTER - PRACTICAL ENZYMOLOGY: BC P 458**

### **PRACTICAL - HARD CORE: 4 CREDITS- 8 HOURS/WEEK**

**Salivary Amylase:** Activity, Specific activity, Optimum pH and Temperature, pH and Temperature Stability, energy of activation,  $K_m$ ,  $V_{max}$ , effect of metal ions, Purification by ammonium sulphate fractionation and enzyme characterization.

**Assay methods** and some characterization of invertase from yeast, acid phosphatase from potato, protease from papaya and esterase from peas.

#### **REFERENCES:**

1. Enzymes: A Practical Introduction to Structure, Mechanism, and Data Analysis; Robert A. Copeland, Wiley- VCH Publishers (2000).
2. Enzyme Kinetics and Mechanism; Paul F. Cook, W. W. Cleland, Garland Science (2007).
3. Biochemical Calculations, Irwin H. Segel (1976) 2nd Ed. John Wiley and Sons.
4. Methods in Enzymology; Colowick S.P. et al., Vol. 152, Academic Press, (1987).
5. Methods of Enzymatic Analysis; Berg Meyer Vol. 1-X, (1974).
6. Basic Biochemical Laboratory Procedures and Computing, R. Cecil Jack (1995) Oxford University.
7. Enzyme Kinetics; Roberts, D.V. (1977), Cambridge University Press.

## **II SEMESTER PRACTICAL CLINICAL BIOCHEMISTRY: BC P 459**

### **PRACTICAL - SOFT CORE: 3 CREDITS- 8 HOURS/WEEK**

1. Urinalysis – Normal and Abnormal.
2. Estimation of serum cholesterol by Zak's method.
3. Estimation of protein and A-G ratio by biuret method
4. Estimation of glucose by Folin- Wu method.
5. Estimation of glucose by Somogyi-Shaffer-Hertmann method.
6. Estimation of glucose by Hegedson Jenson method
7. Estimation of Iron by Wong's method
8. Estimation of Serum SGOT, SGPT, LDH, ALP using kits.
9. Estimation of Urea, uric acid, creatinine using kits.
10. Estimation of TAG, Cholesterol using kits. Determination of HDL and LDL cholesterol.
11. Electrophoresis of hemoglobin and isoenzymes.

#### **REFERENCES:**

1. Tietz Fundamentals of Clinical Chemistry and Molecular Diagnostics, Carl A. Burtis, David E. Bruns. 7th ed. Elsevier, 2014.
2. Practical Clinical Biochemistry, Harold Varley, Interscience Publishers Inc, 2002
3. Clinical Chemistry: Theory, Analysis and Correlation. Kaplan, L.A. and Pesce, A.J., 4th ed. Mosby, 2003.
4. Introduction to Practical Biochemistry. David T. Plummer
5. Lab Manual of Biochemistry. By Nigam. 2007. Tata McGraw-Hill Education, USA.