MAR ATHANASIUS COLLEGE (AUTONOMOUS)

KOTHAMANGALAM, KERALA 686 666

NAAC Accredited 'A^{+}' Grade Institution

Email: mac@macollege.in

www.macollege.in

SCHEME AND SYLLABUS

FOR

POST GRADUATE PROGRAMME

UNDER CREDIT SEMESTER SYSTEM

MAC-PG-CSS 2020

IN

M.Sc.BIOCHEMISTRY

EFFECTIVE FROM THE ACADEMIC YEAR 2020-2021

BOARD OF STUDIES IN BIOCHEMISTRY (PG)

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BOARD OF STUDIES IN BIOCHEMISTRY (PG)

Academic Council

COMPOSITION – With Effect From 01-06-2020

Chairperson : **Dr. Shanti. A. Avirah**
Principal
Mar Athanasius College (Autonomous), Kothamangalam

Experts/Academicians from outside the college representing such areas as Industry, Commerce, Law, Education, Medicine, Engineering, Sciences etc.

1. **Dr. Winny Varghese**
Secretary
Mar Athanasius College Association
Kothamangalam

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Former Vice-Chairman
University Grants Commission,
New Delhi.

3. **Dr. R.K. Chauhan**
Former Vice-Chancellor, Lingaya's University,
Faridabad, Haryana -121002

4. **Dr. Sheela Ramachandran**
Pro-Chancellor,
Atmiya University
Rajkot.

5. **Prof. Kuruvilla Joseph**
Senior Professor and Dean,
Indian Institute of Space Science and Technology (IIST),
Department of Space, Govt. of India, Valiyamala, Thiruvananthapuarm

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Former Vice Chancellor
SreeSankaracharya Sanskrit University
Kalady, Kerala, India

7. **Dr. Mathew. K.**
Principal
Mar Athanasius College of Engineering,
Kothamangalam, Kerala - 686 666

8. **Adv. George Jacob**
Senior Advocate
High Court of Kerala
Ernakulam

Nominees of the university not less than Professors

9. **Dr. Biju Pushpan**
SAS SNDP Yogam College
Konni

10. **Dr. Suma Mary Sacharia**
UC College
Aluva

11. **Dr. V.B. Nishi**
Associate Professor
Sree Shankara College, Kalady.

Member Secretary

12. Dr. M.S.Vijayakumary

Dean – Academics

Mar Athanasius College (Autonomous)

Kothamangalam

Four teachers of the college representing different categories of teaching staff by rotation on the basis of seniority of service in the college.

13. **Dr. Bino Sebastian. V** (Controller of Examinations)

14. **Dr. Manju Kurian,** Asst. Professor, Department of Chemistry

15. **Dr. Smitha Thankachan**, Asst. Professor, Department of Physics

14. **Dr. Asha Mathai**, Asst. Professor, Department of Malayalam

Heads of the Departments

15. Dr. Mini Varghese, Head, Department of Hindi
16. Dr. Jayamma Francis, Head, Department of Chemistry
17. Dr. Igy George, Head, Department of Economics
18. Ms. Shiny John, Head, Department of Computer Science
19. Dr. Deepa. S, Head, Department of Physics
20. Dr. Rajesh. K. Thumbakara, Head, Department of Mathematics
21. Dr. Aji Abraham, Head, Department of Botany
22. Dr. Selven S., Head, Department of Zoology
23. Dr. Diana Ann Issac, Head, Department of Commerce
24. Smt. Sudha. V, Head, Department of Statistics
25. Dr. Aswathy Balachandran, Head, Department of English
26. Dr. Diana Mathews, Head, Department of Sociology
27. Dr. Jani Chungath, Head, Department of History
28. Dr. Seena John, Head, Department of Malayalam
29. Mr. Haary Benny Chettiamkudiyil, Head, Department of Physical Education
30. Ms. Shari Sadasivan, Head, Department of International Business
31. Ms. Sheeba Stephen, Head, Department of B. Com Tax Procedure and Practice
32. Dr. Julie Jacob, Head, Department of Biochemistry
33. Ms. Nivya Mariyam Paul, Head, Department of Microbiology
34. Ms. Jaya Vinny Eappen, Head, Department of Biotechnology
35. Ms. Shalini Binu, Head, Department of Actuarial Science
36. Prof. Dilmol Varghese , Head, Department of M. Sc Zoology
37. Ms. Simi. C.V, Head, Department of M.A.History
38. Ms. Bibin Paul, Head, Department of M. A. Sociology

39. Ms. Shari Thomas, Head, Department of M.Sc Statistics

BOARD OF STUDIES FOR M.Sc BIOCHEMISTRY PROGRAMME

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Professor,
Department of Biochemistry,
Indian Institute of Science (IISc),
Bengaluru

SUBJECT EXPERTS

1. Dr. R. Ajay Kumar (University Nominee)
   Scientist F
   Mycobacterium Research Laboratory,
   Rajiv Gandhi Centre for Biotechnology (RGCB),
   Thiruvananthapuram

1. Dr. Tapas Manna
Associate Professor and Head,
Department of Biology,
Indian Institute of Science Education and Research (IISER),
Thiruvananthapuram.

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Department of Aquatic Animal Health Management,
Kerala University of Fisheries and Ocean Studies (KUFOS), Ernakulam.

3. Dr.Julie Jacob
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Dept of Biochemistry, Mar Athanasius College

4. Dr.Asha Gangadharan
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Dept of Biochemistry, Mar Athanasius College

5. Ms. Elizabeth Jacob
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Dept of Biochemistry, Mar Athanasius College.

6 Ms.Jaya Vinny Eapen
Assistant Professor

Dept of Biotechnology, Mar Athanasius College

7.Mr.Paul George

Assistant Professor

Dept of Biotechnology, Mar Athanasius College

8. Dr. Jithin Thomas

Assistant Professor

Dept of Biotechnology, Mar Athanasius College

9. Ms. Nivya Mariam Paul

Assistant Professor

Dept of Microbiology, Mar Athanasius College

10. Ms Elza John

Assistant Professor

Dept of Microbiology, Mar Athanasius College

11. Dr. Nayomi John

Assistant Professor

Dept of Microbiology, Mar Athanasius College

MEMBER FROM INDUSTRY

Dr. Anu Yamuna Joseph

Principal Scientist

Primordia Life science

BIONEST,

Kochi

MEMBER FROM ALUMINI

Dr. Vishnu K V

Project Scientist B,

CMLRE,Ministry of Earth Sciences,

Kakkanad, Kochi

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PREFACE

Education in India has always been valued more than mere considering it as a means towards earning a good living. Right from pre-historic days, Education, especially higher education, has been given a predominant position in the Indian society. Ancient India considered knowledge as the third eye that gives insight into all affairs of life. Indian Higher Education Structure is traced back to Nalanda and Takshashila Institutions. Nevertheless, Gurukulas, Agrahars, Viharas and Madarasas were the nerve centres of knowledge and wisdom. The great universities flourished in India even centuries back, when most of the western world was groping in the dark. Those were the halcyon days when India led the world in scientific knowledge and philosophical speculations. Great scholar Max Muller has narrated in his own words: "If I were asked under what sky the human mind has most fully developed some of its choicest gifts, has most deeply pondered on the greatest problems of life, and has found solutions to some of them which well deserve the attention of even those who have studied Plato and Kant, I should point to India".

Mar Athanasius College has been instrumental in providing knowledge to thousands and thousands of students in the realm of Higher Education. The educational framework of the institution creates an atmosphere to flourish arts, science and research. The institution has crossed another milestone on its path towards academic excellency when the autonomy was conferred on it in March 2016. In order to fulfill the dreams of academic autonomy, the institution had resolved to constitute Board of Studies for all PG Programmes for restructuring the Curriculum and Syllabi, subject to the Regulations and Guidelines of the Parent University, i.e, Mahatma Gandhi University, Kottayam and also in accordance with the UGC rules. This regulation is the accomplishment of the task of imparting knowledge and wisdom to the students at the higher education level, so as to prepare them to live with dignity and noble thoughts.

The task of restructuring was done by the proposals and recommendations of the members of Board of Studies constituted by the institution for each PG Programme. The duration of the programme, examination pattern, method of valuation and number of credits assigned to each course remain on par with that of the parent university.

LIST OF PG PROGRAMMES IN MAR ATHANASIUS COLLEGE (AUTONOMOUS), KOTHAMANGALAM

SL. NO.	PROGRAMME	DEGREE	FACULTY
1	ENGLISH	MA	LANGUAGE AND LITERATURE
2	ECONOMICS	MA	SOCIAL SCIENCES
3	SOCIOLOGY	MA	SOCIAL SCIENCES
4	HISTORY	MA	SOCIAL SCIENCES
5	MATHEMATICS	M.Sc	SCIENCE
6	CHEMISTRY	M.Sc	SCIENCE
7	PHYSICS	M.Sc	SCIENCE
8	BOTANY	M.Sc	SCIENCE
9	STATISTICS	M.Sc	SCIENCE
10	ZOOLOGY	M.Sc	SCIENCE
11	BIOCHEMISTRY	M.Sc	SCIENCE
12	BIOTECHNOLOGY	M.Sc	SCIENCE
13	MICROBIOLOGY	M.Sc	SCIENCE
14	ACTUARIAL SCIENCE	M.Sc	SCIENCE
15	FINANCE	M.Com	COMMERCE
16	MARKETING AND INTERNATIONAL BUSINESS	M.Com	COMMERCE

REGULATIONS OF THE POSTGRADUATE PROGRAMMES UNDER CREDIT SEMESTER SYSTEM MAC-PG-CSS2020 (2020 Admission onwards)

1. SHORT TITLE

1.1 These Regulations shall be called "Mar Athanasius College (Autonomous) Regulations (2020) governing Postgraduate Programmes under the Credit Semester System (MAC-PG-CSS2020)".

1.2 These Regulations shall come into force from the Academic Year 2020-2021.

2. SCOPE

2.1 The regulations provided herein shall apply to all Regular Postgraduate (PG) Programmes, M.A. /M.Sc. /M.Com. conducted by Mar Athanasius College (Autonomous) with effect from the academic year 2020-2021 admission onwards.

3. DEFINITIONS

3.1 **'Academic Committee'** means the Committee constituted by the Principal under this regulation to monitor the running of the Post-Graduate programmes under the Credit Semester System (MAC-PG-CSS2020).

3.2 **'Academic Week'** is a unit of five working days in which distribution of work is organized from day one to day five, with five contact hours of one hour duration on each day. A sequence of 18 such academic weeks constitutes a semester.

3.3 '**Audit Course**' is a course for which no credits are awarded.

3.4 **'CE' means Continuous Evaluation (Internal Evaluation)**

3.5 **'College Co-ordinator'** means a teacher from the college nominated by the Principal to look into the matters relating to MAC-PG-CSS2020 for programmes conducted in the College.

3.6 **'Comprehensive Viva-Voce'** means the oral examinations conducted by the appointed examiners and shall cover all courses of study undergone by a student for the programme.

3.7 **'Common Course'** is a core course which is included in more than one programme with the same course code.

3.8 '**Core Course**' means a course that the studentadmitted to a particular programme must successfully complete to receive the Degree andwhich cannot be substituted by any other course.

3.9 '**Course**' means a segment of subject matter to be covered in a semester. Each Course is tobe designed variously under lectures / tutorials / laboratory or fieldwork / seminar / project /practical training / assignments/evaluation etc., to meet effective teaching and learning needs.

3.10 **'Course Code'** means a unique alpha numeric code assigned to each course of a programme.

3.11 '**Course Credit**' One credit of the course is defined as a minimum of one hour lecture /minimum of 2 hours lab/field work per week for 18 weeks in a Semester. The course will beconsidered as completed only by conducting the final examination.

3.12 **'Course Teacher'** means the teacher of the institution in charge of the course offered in the programme.

3.13 **'Credit (Cr)'** of a course is a numerical value which depicts the measure of the weekly unit of work assigned for that course in a semester.

3.14 '**Credit Point(CP)**' of a course is the value obtained by multiplying the grade point (GP) by theCredit (Cr) of the course **CP=GP x Cr**.

3.15 '**Cumulative Grade Point Average(CGPA)**' is the value obtained by dividing the sum ofcredit points in all the courses taken by the student for the entire programme by the total number of credits and shall be rounded off to two decimal places.CGPA determines the overall performance of a student at the end of a programme.

(CGPA = Total CP obtained/ Total credits of the programme)

3.16 '**Department**' means any teaching Department offering a programme of study in the institution.

3.17 '**Department Council**' means the body of all teachers of a Department in a College.

3.18 **'Dissertation'** means a long document on a particular subject in connection with the project /research/ field work etc.

3.19 '**Duration of Programme**' means the period of time required for the conduct of theprogramme. The duration of post-graduate programme shall be 4 semesterspread over two academic years.

3.20 '**Elective Course**' means a course, which can besubstituted, by equivalent course from the same subject.

3.21 **'Elective Group'** means a group consisting of elective courses for the programme.

3.22 **'ESE' means End Semester Evaluation (External Evaluation).**

3.23 **'Evaluation'** is the process by which the knowledge acquired by the student is quantified as per the criteria detailed in these regulations.

3.24 **External Examiner** is the teacher appointed from other colleges for the valuation of courses of study undergone by the student in a college. The external examiner shall be appointed by the college.

3.25 '**Faculty Advisor**' is a teacher nominated by a Department Council to coordinate the continuous evaluation and other academic activities undertaken in the Department.

3.26 '**Grace Grade Points**' means grade points awarded to course(s), recognition of the students' meritorious achievements in NSS/ Sports/ Arts and cultural activities etc.

3.27 '**Grade Point**' (GP) Each letter grade is assigned a Grade point (GP) which is an integer indicating thenumerical equivalent of the broad level of performance of a student in a course.

3.28 '**Grade Point Average(GPA)**' is an index of the performance of a student in a course. It isobtained by dividing the sum of the weighted grade point obtained in the course by the sum ofthe weights of Course.**(GPA= ∑WGP / ∑W)**

3.29 '**Improvement Course**' is a course registered by a student for improving his performance in that particular course.

3.30 **'Internal Examiner'** is a teacher nominated by the department concerned to conduct internal evaluation.

3.31 '**Letter Grade**' or '**Grade**' for a course is a letter symbol (A+, A, B+, B, C+, C, D) which indicatesthe broad level of performance of a student for a course.

3.32 **MAC-PG-CSS2020 means Mar Athanasius College Regulations Governing Post Graduate programmes under Credit Semester System, 2020.**

3.33 '**Parent Department**' means the Department which offers a particular postgraduateprogramme.

3.34 '**Plagiarism**' is the unreferenced use of other authors' material in dissertationsand is a serious academic offence.

3.35 '**Programme**' means the entire course of study and Examinations.

3.36 **'Project'** is a core course in a programme. It means a regular project work with stated credits on which the student undergo a project under the supervision of a teacher in the parent department/ any appropriate research centre in order to submit a dissertation on the project work as specified. It allows students to work more autonomously to construct their own learning and culminates in realistic, student-generated products or findings.

3.37 '**Repeat Course**' is a courseto complete the programme in an earlier registration.

3.38 '**Semester**' means a term consisting of a minimum of 90 working days, inclusive ofexamination, distributed over a minimum of 18 weeks of 5 working days each.

3.39 '**Seminar**' means a lecture given by the student on a selected topic and expected to train the student in self-study, collection of relevant matter from various resources, editing, document writing and presentation.

3.40 '**Semester Grade Point Average(SGPA)**' is the value obtained by dividing the sum of credit points (CP) obtained by the student in the various courses taken in a semester by the total number of credits for the course in that semester. The SGPA shall be rounded off to two decimal places. SGPA determines the overall performance of a student at the end of a semester (SGPA = Total CP obtained in the semester / Total Credits for the semester).

3.41 '**Tutorial**' means a class to provide an opportunity to interact with students at their individual level to identify the strength and weakness of individual students.

3.42 '**Weight**' is a numeric measure assigned to the assessment units of various components of a course of study.

3.43 **University** means Mahatma Gandhi University Kottayam to which the college is affiliated.

3.44 '**Weighted Grade Point (WGP)**' is grade points multiplied by weight. **(WGP=GPxW)**

3.45 'Weighted Grade Point Average (WGPA)' is an index of the performance of a student in a course. It is obtained by dividing the sum of the weighted grade points by the sum of the weights. WGPA shall be obtained for CE (Continuous Evaluation) and ESE (End Semester Evaluation) separately and then the combined WGPA shall be obtained for each course.

4. ACADEMIC COMMITTEE

4.1. There shall be an Academic Committee constituted by the Principal to Manage and monitor the working of MAC-PG-CSS2020.

4.2. The Committee consists of:

1. Principal
2. Dean, Administration
3. Dean, Academics

4. IQAC Coordinator
5. Controller of Examinations
6. One Faculty each representing Arts, Science, Commerce, Languages, and Self Financing Programmes

5. PROGRAMME STRUCTURE

5.1 Students shall be admitted to post graduate programme under thevarious Faculties. The programme shall include three types of courses, Core Courses, Elective Courses and Common core courses. There shall be a project with dissertation and comprehensive viva-voce as core courses for all programmes. The programme shall also include assignments / seminars/ practical's etc.

5.2 No regular student shall register for more than 25 credits and less than16 credits per semester unless otherwise specified. The total minimum credits, required for completing a PG programme is 80.

5.3. Elective Courses and Groups

5.3.1 There shall be various groups of Programme Elective courses for a Programme such as Group A, Group B etc. for the choice of students subject to the availability of facility andinfrastructure in the institution and the selected group shall be the subject of specialization ofthe programme.

5.3.2 The elective courses shall be either in fourth semester or distributed among third and fourth semesters. There may be various groups of Elective courses (three elective courses in each group) for a programme such as Group A, Group B etc. for the choice of students, subject to the availability of facility and infrastructure in the institution.

5.3.3 The selection of courses from different elective groups is not permitted.

5.3.4 The elective groups selected for the various Programmes shall be intimated to the Controller of Examinations within two weeks of commencement of the semester in which the elective courses are offered. The elective group selected for the students who are admitted in a particular academic year for various programmes shall not be changed.

5.4 Project Work

5.4.1. Project work shall be completed in accordance with the guidelines given in the curriculum.

5.4.2 Project work shall be carried out under the supervision of a teacher of the department concerned.

5.4.3. A candidate may, however, in certain cases be permitted to work on the project in an Industrial/Research Organization on the recommendation of the supervising teacher.

5.4.4 There shall be an internal assessment and external assessment for the project work.

5.4.5. The Project work shall be evaluated based on the presentation of the project work done by the student, the dissertation submitted and the viva-voce on the project.

5.4.6 The external evaluation of project work shall be conducted by two external examiners from different colleges and an internal examiner from the college concerned.

5.4.7 The final Grade of the project (External) shall be calculated by taking the average of the Weighted Grade Points given by the two external examiners and the internal examiner.

5.5 **Assignments:** Every student shall submit at least one assignment as an internal component for each course.

5.6 **Seminar Lecture:** Every PG student shall deliver one seminar lecture as an Internal component for every course with a weightage of two. The seminar lecture is expected to train the student in self-study, collection of relevant matter from the various resources, editing, document writing and presentation.

5.7 **Test Papers(Internal):**Every PG student shall undergo at least two class tests as an internal component for every course with a weight one each. The best two shall be taken for awarding the grade for class tests.

5.8. **No courses shall have more than 5 credits unless otherwise specified.**

5.9. **Comprehensive Viva-Voce** -Comprehensive Viva-Voce shall be conducted at the end of fourth semester of the programme and its evaluation shall beconducted by the examiners of the project evaluation.

5.9.1. Comprehensive Viva-Voce shall cover questions from all courses in the Programme.

5.9.2. There shall be an internal assessment and an external assessment for the Comprehensive Viva-Voce.

6. ATTENDANCE

6.1. The minimum requirement of aggregate attendance during a semesterfor appearing at the end-semester examination shall be 75%. Condonation of shortage of attendance to a maximum of 15 days in a semester subject to a maximum of two times during the whole period of the programme may be granted by the University.

6.2 If a student represents his/her institution, University, State or Nation inSports, NCC, or Cultural or any other officially sponsored activities such as college union/ university union etc., he/she shall be eligible to claim the attendance for the actual number of days participated subject to a maximum 15 days in a Semester based on the specific recommendations of the Head of the Department or teacher concerned.

6.3 Those who could not register for the examination of a particularsemester due to shortage of attendance may repeat the semester along with junior batches, without considering sanctioned strength, subject to the existing University Rules and Clause 7.2.

6.4. A Regular student who has undergone a programme of study under earlier regulation/ Scheme and could not complete the Programme due to shortage of attendance may repeat the semester along with the regular batch subject to the condition that he has to undergo all the examinations of the previous semesters as per the MAC-PG-CSS2020 regulations and conditions specified in 6.3.

6.5 A student who had sufficient attendance and could not register for fourth semester examination can appear for the end semester examination in the subsequent years with the attendance and progress report from the principal.

7. REGISTRATION/ DURATION

7.1 A student shall be permitted to register for the programme at the time of admission.

7.2 A student who registered for the Programme shall complete the Programmewithin a period of four years from the date of commencement of the programme.

7.3 Students are eligible to pursue studies for additional post graduate degree. They shall be eligible for award of degree only after successful completion of two years (four semesters of study) of college going.

8. ADMISSION

8.1 The admission to all PG programmes shall be done through the Centralised Allotment Process of Mar Athanasius College (Autonomous), Kothamangalam(MAC-PG CAP) as per the rules and regulations prescribed by the affiliating university and the Government of Kerala from time to time.

8.2 The eligibility criteria for admission shall be as announced by the Parent University from time totime.

9. ADMISSION REQUIREMENTS

9.1 Candidates for admission to the first semester of the PG programme through CSS shall berequired to have passed an appropriate Degree Examination of Mahatma Gandhi University asspecified or any other examination of any recognized University or authority accepted by the Academic council of Mahatma Gandhi University as eligible thereto.

9.2 Students admitted under this programme are governed by theRegulations in force.

10. PROMOTION:

10.1 A student who registers for the end semester examination shall bepromoted to the next semester

10.2 A student having 75% attendance and who fails to register forexamination of a particular semester will be allowed to register notionally and is promoted to

the next semester, provided application for notional registration shall be submitted within 15 days from the commencement of the next semester.

10.3 The medium of Instruction shall be English except programmes underfaculty of Language and Literature.

11. EXAMINATIONS

11.1 **End-Semester Examinations**: The examinations shall be at the end of each Semester of three hour duration for each centralised and practical course.

11.2 Practical examinations shall be conducted at the end of each semester or at the end of even semesters as prescribed in the syllabus of the particular programme. The number of examiners for the practical examinations shall be prescribed by the Board of Studies of the programmes.

11.3 A question paper may contain short answer type/annotation, shortessay type questions/problems and long essay type questions. Different types of questions shall have differentweightage.

12. EVALUATION AND GRADING

12.1 **Evaluation:** The evaluation scheme for each course shall contain two parts; (a) End Semester Evaluation(ESE) (External Evaluation) and (b) Continuous Evaluation(CE)(Internal Evaluation). 25% weightage shall be given to internal evaluation and the remaining 75% to external evaluation and the ratio and weightage between internal and external is 1:3. Both End Semester Evaluation(ESE) and Continuous Evaluation(CE) shall be carried out using direct grading system.

12.2 **Direct Grading: The direct grading for CE (Internal) and ESE(External Evaluation) shall be based on 6 letter grades (A+, A, B, C, D and E) with numerical values of 5, 4, 3, 2, 1 and 0 respectively.**

12.3 **Grade Point Average (GPA):Internal and External components are separately graded and the combined grade point with weightage 1 for internal and 3 for external shall be applied to calculate the Grade Point Average (GPA) of each course. Letter grade shall be assigned to each course based on the categorization provided in 12.16.**

12.4 **Internal evaluation:** The internal evaluation shall be based on predetermined transparent system periodic written tests, assignments, seminars, lab skills, records, viva-voce etc.

12.5 Components of internal (CE) and External Evaluation (ESE): Grades shall be given to the evaluation of theory / practical / project / comprehensive viva-voce and all internal evaluations are based on the Direct Grading System.

Proper guidelines shall be prepared by the BOS for evaluating the assignment, seminar, practical, project and comprehensive viva-voce within the framework of the regulation.

12.6 There shall be no separate minimum grade point for internal evaluation.

12.7 **The model of the components and its weightages for Continuous Evaluation (CE) and End Semester Evaluation (ESE) are shown in below:**

a) For Theory (CE) (Internal)

	Components	Weightage
i.	Assignment	1
ii.	Seminar	2
iii.	Best Two Test papers	2(1 each)
Total		**5**

(Average grade of the best two papers can be considered. For test paper all the Questions shall be set in such a way that the answers can be awarded A+, A, B, C, D, E grades)

b) For Theory (ESE) (External)

Evaluation is based on the pattern of Question specified **in 12.15.5**

c) For Practical(CE) (Internal)

Components	Weightage
Written / Lab Test	2
Lab Involvement and Record	1
Viva	2
Total	**5**

(The components and the weightage of practical(Internal) can be modified by the concerned BOS without changing the total weightage 5)

d) For Practical(ESE) (External)

Components	Weightage
Written / Lab Test	7
Lab Involvement and Record	3
Viva	5
Total	**15**

(The components and weightage of the practical (External) can be modified by the concerned BOS without changing the total weightage 15)

e) For Project(CE) (Internal)

Components	Weightage
Relevance of the topic and analysis	2
Project content and presentation	2
Project viva	1
Total	**5**

(The components and the weightage of the components of the Project (Internal) can be modified by the concerned BOS without changing the total weightage 5)

f) For Project(ESE) (External)

Components	Weightage
Relevance of the topic and analysis	3
Project content and presentation	7
Project viva	5
Total	**15**

(The components and the weightage of the components of the Project (External) can be modified by the concerned BOS without changing the total weightage 15)

g) Comprehensive viva-voce (CE) (Internal)

Components	Weightage
Comprehensive viva-voce(all courses from first semester to fourth semester)	5
Total	**5**

(Weightage of the components of the Comprehensive viva-voce(Internal) shall not be modified.)

h)Comprehensive viva-voce (ESE) (External)

Components	Weightage
Comprehensive viva-voce(all courses from first semester to fourth semester)	15
Total	**15**

(Weightage of the components of the Comprehensive viva-voce(External) shall not be modified.)

12.8 **All grade point averages shall be rounded to two digits.**

12.9 To ensure transparency of the evaluation process, the internal assessment grade awarded to the students in each course in a semester shall be published on the notice board at least one week before the commencement of external examination.

12.10 **There shall not be any chance for improvement for Internal Grade.**

12.11 The course teacher and the faculty advisor shall maintain the academic record of each student registered for the course and a copy should be kept in the college for verification for at least two years after the student completes the programme.

12.12 **External Evaluation.** The external examination in theory courses is to be conducted by the College at the end of the semester. The answers may be written in English or Malayalam except those for the Faculty of Languages. The evaluation of the answer scripts shall be done by examiners based on a well-defined scheme of valuation. The external evaluation shall be done immediately after the examination.

12.13 Photocopies of the answer scripts of the external examination shall be made available to the students on request as per the rules prevailing in the University.

12.14 The question paper should be strictly on the basis of model question paper set and directions prescribed by the BOS.

12.15. **Pattern of Questions**

12.15.1 **Questions shall be set to assess knowledge acquired, standard, and application of knowledge, application of knowledge in new situations, critical evaluation of knowledge and the ability to**

synthesize knowledge. Due weightage shall be given to each module based on content/teaching hours allotted to each module.

12.15.2 The question setter shall ensure that questions covering all skills are set.

12.15.3 A question paper shall be a judicious mix of short answer type, short essay type /problem solving type and long essay type questions.

12.15.4 The question shall be prepared in such a way that the answers can be awarded A+, A, B, C, D, E grades.

12.15.5 Weight: Different types of questions shall be given different weights to quantify their range as follows:

Sl.No.	Type of Questions	Weight	Number of questions to be answered
1	Short Answer type questions	1	8 out of 10
2	Short essay / problem solving type questions	2	6 out of 8
3	Long Essay Type questions	5	2 out of 4

12.16**Pattern of question for practical**. The pattern of questions for external evaluation of practical shall be prescribed by the Board of Studies.

12.17**DirectGradingSystem**

Direct Grading System based on a 6- point scale is used to evaluate the Internal and External examinations taken by the students for various courses of study.

Grade	Grade point(G)	Grade Range
A+	5	4.50 to 5.00
A	4	4.00 to 4.49
B	3	3.00 to 3.99
C	2	2.00 to 2.99
D	1	0.01 to 1.99
E	0	0.00

12.18**Performance Grading**

Students are graded based on their performance (GPA/SGPA/CGPA) at the examination on a 7-point scale as detailed below.

Range	Grade	Indicator
4.50 to 5.00	A+	Outstanding
4.00 to 4.49	A	Excellent
3.50 to 3.99	B+	Very good
3.00 to 3.49	B	Good(Average)
2.50 to 2.99	C+	Fair
2.00 to 2.49	C	Marginal
up to 1.99	D	Deficient(Fail)

12.19 No separate minimum is required for Internal Evaluation for a pass, but a minimum grade is required for a pass in an External Evaluation.

However, a minimum C grade is required for pass in a Course

12.20 A student who fails to secure a minimum grade for a pass in a course will be permitted to write the examination along with the next batch.

12.21 **Improvement of Course**- The candidate who wish to improve the grade/grade point of the external examination of the of a course/ courses he/ she has passed can do the same by appearing in the external examination of the semester concerned along with the immediate junior batch. This facility is restricted to first and second semester of the programme.

12.22 **One Time Betterment Programme**- A candidate will be permitted to improve the **CGPA** of the programme within a continuous period of four semesters immediately following the completion of the programme allowing only once for a particular semester. The **CGPA** for the betterment appearance will be computed based on the **SGPA** secured in the original or betterment appearance of each semester whichever is higher.

If a candidate opts for the betterment of **CGPA** of a programme, he/she has to appear for the external examination of the entire semester(s) excluding practical /project/comprehensive viva-voce. One time betterment programme is restricted to students who have passed in all courses of the programme at the regular (First appearance)

12.23 **Semester Grade Point Average(SGPA) and Cumulative Grade Point Average** (**CGPA) Calculations.** The SGPA is the ratio of sum of the credit point of all courses taken by a student in a semester to the total credit for that semester. After the successful completion of a semester, Semester Grade Point Average(SGPA) of a student in that semester is calculated using the formula given below.

Semester Grade Point Average -SGPA (S_j) = $\sum(C_i \times G_i) / \sum C_i$

(SGPA= Total credit Points awarded in a semester / Total credits of the semester)

Where 'S_j' is the j^{th} semester, 'G_i' is the grade point scored by the student in the i^{th} course 'C_i' is the credit of the i^{th} course.

12.24 Cumulative Grade Point Average (**CGPA)** of a programme is calculated using the formula:-

Cumulative Grade Point Average (CGPA) = $\sum(C_i \times S_i) / \sum C_i$

(CGPA= Total credit Points awarded in all semester / Total credits of the programme)

Where 'C_i' is the credit for the i^{th} semester, 'S_i' is the SGPA for the i^{th} semester. The **SGPA** and **CGPA** shall be rounded off to 2 decimal points.

For the successful completion of semester, a student shall pass all courses and score a minimum **SGPA** of 2.0. However a student is permitted to move to the next semester irrespective of her/his **SGPA**

13. GRADE CARD

13.1 The Institution under its seal shall issue to the students, a consolidated grade card on completion of the programme, which shall contain the following information.

a) Name of the University.

b) Name of college

c) Title of the PG Programme.

d) Name of Semesters

e) Name and Register Number of students

f) Code, Title, Credits and Max GPA(Internal, External & Total) of each course (theory &practical), project, viva etc in each semester.

g) Internal, external and Total grade, Grade Point (G), Letter grade and Credit point (P) in each course opted in the semester.

h) The total credits and total credit points in each semester.

i) Semester Grade Point Average (SGPA) and corresponding Grade in each semester

j) Cumulative Grade Point Average (CGPA), Grade for the entire programme.

k) Separate Grade card will be issued.

l) Details of description of evaluation process- Grade and Grade Point as well as indicators, calculation methodology of SGPA and CGPA as well as conversion scale shall be shown on the reverse side of the grade card.

14. AWARD OF DEGREE - The successful completion of all the courses with 'C' grade within the stipulated period shall be the minimum requirement for the award of the degree.

15. MONITORING COMMITTEE

There shall be a Monitoring Committee constituted by the Principal to monitor the internal evaluations conducted.

16. RANK CERTIFICATE

Rank certificate shall be issued to candidates who secure positions 1st and 2nd. Candidates shall be ranked in the order of merit based on the CGPA secured by them. Grace grade points awarded to the students shall not be counted for fixing the rank. Rank certificate shall be signed by the Principal and the Controller of Examinations.

17. **GRIEVANCE REDRESSAL COMMITTEE**

17.1 Department level: The College shall form a Grievance Redressal Committee in each Department comprising of the course teacher and one senior teacher as members and the Head of the Department as Chairperson. The Committee shall address all grievances relating to the internal assessment grades of the students.

17.2. College level: There shall be a college level Grievance RedressalCommittee comprising of faculty advisor, college co-ordinator, one senior teacher and one staff council member and the Principal as Chairperson.

18. FACTORY VISIT / FIELD WORK/VISIT TO A REPUTED RESEARCH INSTITUTE/ STUDENT INTERACTION WITH

RENOWNED ACADEMICIANS may be conducted for all Programmes before the commencement of Semester III.

19. Each student may undertake **INTERNSHIP/ON THE JOB TRAINING** for a period of not less than 15 days. The time, duration and structure of internship/on the job training can be modified by the concerned Board of Studies.

20. **TRANSITORYPROVISION**

Notwithstanding anything contained in these regulations, the Principal shall, for a period of three year from the date of coming into force of these regulations, have the power to provide by order that these regulations shall be applied to any programme with such modifications as may be necessary.

21. **REPEAL**

The Regulations now in force in so far as they are applicable to programmes offered by the college and to the extent they are inconsistent with these regulations are hereby repealed. In the case of any inconsistency between the existing regulations and these regulations relating to the Credit Semester System in their application to any course offered in a College, the latter shall prevail.

22. **Credits allotted for Programmes and Courses**

22.1 Total credit for each programme shall be **80**.

22.2 Semester-wise total credit can vary from 16to25

22.3 The minimum credit of a course is 2 and maximum credit is 5

23. **Common Course:** If a course is included as a common course in more than one programme, its credit shall be same for all programmes.

24. **Course Codes:** The course codes assigned for all courses (Core Courses, Elective Courses, Common Courses etc.) shall be unique.

25. **Models of distribution of courses, course codes, type of the course, credits, teaching hours for a programme are given in the following tables**

Programmes with practical -Total Credits 80- Scheme of MSc Biochemistry syllabus

Semester	Course-Code	Course Name	Type of the Course	Teaching Hours Per Week	Credit	Total Credits
I	PG20BS101	Biochemistry	core	4	4	19
	PG20BS102	Cell Biology and Genetics	core	4	4	
	PG20BS103	Biophysics, bioinstrumentation and Bioinformatics	core	4	4	
	PG20BS104	Human Physiology and Biostatistics	core	3	3	
	PG20BSP1-BC	Laboratory Course I	core	10	4	
II	PG20BS205	General Microbiology	core	3	3	19
	PG20BS206	Immunology	core	4	4	
	PG20BS207	Molecular Biology and Genetic Engineering	core	4	4	
	PG20BS208	Metabolism and Bioenergetics	core	4	4	
	PG20BSP2-BC	Laboratory Course II	core	10	4	
III	PG20BS309-BC	Enzymology	core	4	4	19
	PG20BS310-BC	Plant Biochemistry	core	4	4	
	PG20BS311-BC	Molecular Endocrinology	core	4	4	
	PG20BS312-BC	Neurobiology	Elective	3	3	
	PG20BSP3-BC	Laboratory CourseIII	core	10	4	
IV	PG20BS413-BC	Clinical Biochemistry	Core	5	4	23
	PG20BS414-BC	Environmental Science	Elective	5	3	
	PG20BS415-	Plant and	Elective	5	3	

	BC	Animal Cell culture				
	PG20BSP4-BC	Laboratory CourseIV	core	10	5	
	PG20BS4P-BC	Project	core		5	
	PG20BS4V-BC	Viva Voce	core		3	
	Total					**80**

Appendix

1. Evaluation first stage – Both internal and external to be done by the teacher)

Grade	Grade Points	Range
A+	5	4.50 to 5.00
A	4	4.00 to 4.49
B	3	3.00 to 3.99
C	2	2.00 to 2.99
D	1	0.01 to 1.99
E	0	0.00

The final Grade range for courses, SGPA and CGPA

Range	Grade	Indicator
4.50 to 5.00	A+	Outstanding
4.00 to 4.49	A	Excellent
3.50 to 3.99	B+	Very good
3.00 to 3.49	B	Good
2.50 to 2.99	C+	Fair
2.00 to 2.49	C	Marginal
Upto1.99	D	Deficient(Fail)

Theory-External-ESE

Maximum weight for external evaluation is 30. Therefore Maximum Weighted Grade Point (WGP) is 150

Type of Question	Qn. No.'s	Grade Awarded	Grade Point	Weights	Weighted Grade Point
Short Answer	1	A+	5	1	5
	2	-	-	-	-
	3	A	4	1	4
	4	C	2	1	2
	5	A	4	1	4
	6	A	4	1	4
	7	B	3	1	3
	8	A	4	1	4
	9	B	3	1	3

	10	-	-	-	
Short Essay	11	B	3	2	6
	12	A+	5	2	10
	13	A	4	2	8
	14	A+	5	2	10
	15	-	-	-	-
	16	-	-	-	-
	17	A	4	2	8
	18	B	3	2	6
Long Essay	20	A+	5	5	25
	21	-	-	-	-
	22	-	-	-	-
	23	B	3	5	15
			TOTAL	**30**	**117**
Calculation : **Overall Grade of the theory paper = Sum of Weighted Grade Points /Total Weight = 117/30 = 3.90 = Grade B+**					

Theory-Internal-CE

Maximum weight for internal evaluation is 5. Therefore Maximum Weighted Grade Point (WGP) is 25.

Components	Weight (W)	Grade Awarded	Grade Point(GP)	WGP=W *GP	Overall Grade of the Course
Assignment	1	A	4	4	**WGP/Total Weight= 24/5 =4.8**
Seminar	2	A+	5	10	
Test Paper 1	1	A+	5	5	
Test Paper 2	1	A+	5	5	
Total	**5**			**24**	**A+**

Practical-External-ESE

Maximum weight for external evaluation is 15. Therefore Maximum Weighted Grade Point (WGP) is 75

Components	Weight(W)	Grade Awarded	Grade Point(GP)	WGP=W*GP	Overall Grade of the Course
Written/Lab Test	7	A	4	28	**WGP/Total Weight= 58 / 15 = 3.86**
Lab involvement & record	3	A+	5	15	
Viva	5	B	3	15	
Total	**15**			**58**	**B+**

Practical-Internal-CE

Maximum weight for internal evaluation is 5. Therefore Maximum Weighted Grade Point (WGP) is 25

Components	Weight (W)	Grade Awarded	Grade Point(GP)	WGP=W *GP	Overall Grade of the Course
Written/ Lab Test	2	A	4	8	**WGP/Total Weight=17/5 =3.40**
Lab involvement & record	1	A+	5	5	
Viva	2	C	2	4	
Total	**5**			**17**	**B**

Project-External-ESE

Maximum weight for external evaluation is 15. Therefore Maximum Weighted Grade Point (WGP) is 75

Components	Weight (W)	Grade Awarded	Grade Point(GP)	WGP= W*GP	Overall Grade of the Course
Relevance of the topic & Analysis	3	C	2	4	**WGP/Total Weight = 59/15= 3.93**
Project Content &Presentation	7	A+	5	40	
Project Viva- Voce	5	B	3	15	
Total	**15**			**59**	**B+**

Practical-Internal-CE

Maximum weight for internal evaluation is 5. Therefore Maximum Weighted Grade Point (WGP) is 25

Components	Weight (W)	Grade Awarded	Grade Point(GP)	WGP=W *GP	Overall Grade of the Course
Relevance of the topic & Analysis	2	B	3	6	**WGP/Total Weight= 21/5 = 4.2**
Project Content & Presentation	2	A+	5	10	

Project Viva-Voce	1	A+	5	5	
Total	**5**			**21**	**A**

Comprehensive viva-voce-External-ESE

Maximum weight for external evaluation is 15. Therefore Maximum Weighted Grade Point (WGP) is 75

Components	Weight (W)	Grade Awarded	Grade Point(GP)	WGP=W*GP	Overall Grade of the Course
Comprehensive viva-voce	15	A	4	60	**WGP/Total Weight = 60 / 15 = 4**
Total	**15**			**60**	**A**

Comprehensive viva-voce-Internal-CE

Maximum weight for internal evaluation is 5. Therefore Maximum Weighted Grade Point (WGP) is 25

Components	Weight (W)	Grade Awarded	Grade Point(GP)	WGP=W *GP	Overall Grade of the Course
Comprehensive viva-voce	5	A+	5	25	**WGP/Total Weight = 25/ 5 = 5**
Total	**5**			**25**	**A+**

2. Evaluation Second stage-(to be done by the College)

Consolidation of the Grade(GPA) of a Course PC-1

The End Semester Evaluation (ESE) (External evaluation) grade awarded for the course PC-1 is A and its Continuous Evaluation (CE) (Internal Evaluation) grade is A. The consolidated grade for the course PC-1 is as follows

Evaluation	Weight	Grade awarded	Grade Points awarded	Weighted Grade Point
External	3	A	4.20	12.6
Internal	1	A	4.40	4.40

Total	**4**			**17**
Grade of a course.	GPA of the course =Total weighted Grade Points/Total weight= **17/4 =4.25 = Grade A**			

3. **Evaluation Third stage-(to be done by the College)**
   Semester Grade Point Average (SGPA)

Course code	Titleof the course	Credits (C)	Grade Awarded	Grade Points(G)	Credit Points (CP=C X G)
01	**PC-1**	**5**	**A**	**4.25**	**21.25**
02	**-----**	**5**	**A**	**4.00**	**20.00**
03	**-----**	**5**	**B+**	**3.80**	**19.00**
04	**-----**	**2**	**A**	**4.40**	**8.80**
05	**-----**	**3**	**A**	**4.00**	**12.00**
TOTAL		**20**			**81.05**
SGPA	**Total credit points / Total credits = 81.05/20 = 4.05= Grade- A**				

4. **Evaluation Third stage-(to be done by the College)**
   Cumulative Grade Point Average (CGPA)
   If a candidate is awarded three **A+** grades in semester 1(SGPA of semester 1), semester 2(SGPA of semester 2), semester 4(SGPA of semester 4) and **B** grades in semester 3(SGPA of semester 3). Then CGPA is calculated as follows:

Semester	Credit of the Semesters	Grade Awarded	Grade point (SGPA)	Credit points
I	20	A+	4.50	90
II	20	A+	4.60	92
III	20	B	3.00	60
IV	20	A+	4.50	90
TOTAL	**80**			**332**
CGPA= Total credit points awarded / Total credit of all semesters = 332 / 80= 4.15 (Which is in between 4.00 and 4.49 in 7-point scale) Therefore the overall Grade awarded in the programme is A				

ELIGIBILITY FOR ADMISSION

Academic eligibility should be satisfied as on the last date of submission of academic data. No candidate shall be admitted to the PG programme unless he/she possess the qualifications and minimum requirements thereof, as prescribed by Mahatma Gandhi University from time to time.

If an applicant for admission is found to have indulged in ragging in the past or if it is noticed later that he/she had indulged in ragging, admissions shall be denied or he/she will be expelled from Mar Athanasius College (Autonomous), Kothamangalam.

Candidates should have passed the corresponding Degree Examination under the 10 + 2 + 3 pattern with one core/main subject and two complementary/subsidiary subjects from any of the Universities in Kerala or of any other University recognized by Mahatma Gandhi University as equivalent thereto for admission, subject to the stipulation regarding marks.

OR

Candidates who have passed Degree examination with Double or Triple main subject and candidates who have passed the Degree Examination in Vocational or Specialized Programmes are also eligible for admission. However, they have to submit copy of the Equivalency/Eligibility Certificate from Mahatma Gandhi University, stating that, their Qualifying Examination is recognized for seeking admission to the relevant P.G. Degree Programme(s) as applicable, at the time of admission. This provision is not applicable in the case of those applicants who have passed their qualifying examination from MG University.

The minimum requirements for admission to PG Degree Programmes:

1. <u>M.Sc. Biochemistry (SF)</u>

Graduates who have passed qualifying examination in CBCS (2017)/CBCSS (2013) pattern	**Graduates who have passed qualifying examination in CBCSS (2009) pattern**	**Graduates who have passed qualifying examination in other patterns**
Graduation in Biological Sciences viz. Zoology, Botany, Biochemistry, Biophysics, Biotechnology, Biological Techniques & Specimen Preparation and Microbiology or Chemistry or MLT or Aquaculture of University of Calicut with not less than CGPA/CCPA of 5.00 out of 10.00 in Core Group(Core + Complementary + Open Courses).	Graduation in Biological Sciences viz. Zoology, Botany, Biochemistry, Biophysics, Biotechnology, Biological Techniques & Specimen Preparation and Microbiology or Chemistry or MLT or Aquaculture of University of Calicut with not less than CGPA of 2.00 out of 4 in Core Group (Core +Complementary + Open Courses).	Graduation in Biological Sciences viz. Zoology, Botany, Biochemistry, Biophysics, Biotechnology, Biological Techniques & Specimen Preparation and Microbiology or Chemistry or MLT or Aquaculture of University of Calicut with not less than 50% marks in Part III subjects (Main/Core + subsidiaries/Complementaries).

Weightage of 10% of marks, scored by the candidate in Part III (Core/Main), shall be added to the total of Part III subjects, for those candidates who have studied B Sc. Biochemistry (Core/Main), after standardizing the marks secured for the same to 600.

The Open course under core group is taken only for reckoning the eligibility for applying for the PG programmes concerned. But a candidate cannot apply for the respective PG programmes solely on the basis of the open course selected under core group.

Relaxation in Marks in the qualifying examination:

(i) **Kerala Scheduled Caste/Scheduled Tribe Category**: The minimum grade in the qualifying examination for admission to the PG Degree programmes is 'C' in the seven point scale for CBCSS and a pass for pre CBCSS applicants.

(ii) **SEBC Category**: A relaxation of 3% marks in the qualifying examination from the prescribed minimum is allowed i.e. CGPA of 4.7 for CBCS (2017),CCPA of 4.7 for CBCSS (2013), CGPA of 1.88 for CBCSS (2009)applicants and 47% marks for pre-CBCSS applicants for admission to M Sc. programmes and CGPA of 4.2 for CBCS (2017), CCPA of 4.2 for CBCSS (2013), CGPA of 1.68 for CBCSS (2009) applicants and 42% marks for pre-CBCSS applicants for admission to M.A/M.Com programmes

(iii) **OEC Category:** A relaxation of 5% marks in the qualifying examination from the prescribed minimum is allowed i.e. CGPA of 4.5 for CBCS (2017), CCPA of 4.5 for CBCSS (2013), CGPA of 1.80 for CBCSS (2009) applicants and 45% marks for pre - CBCSS applicants for admission to M Sc. programmes and CGPA of 4.0 for CBCS (2017), CCPA of 4.0 CBCSS (2013), CGPA of 1.60 for CBCSS (2009)applicants and 40% marks for pre CBCSS applicants for admission to MA/M Com programmes.

(iv) **Persons with Disability category**: A relaxation of 5% marks in the qualifying examination from the prescribed minimum is allowed i.e. CGPA of 4.5 for CBCS (2017), CCPA of 4.5 for CBCSS (2013), CGPA of 1.80 for CBCSS (2009)applicants and 45% marks for pre – CBCSS applicants for admission to M Sc. Programmes and CGPA of 4.0 for CBCS (2017), CCPA of 4.0 for CBCSS (2013), CGPA of 1.60 for CBCSS (2009)applicants and 40% marks for pre CBCSS applicants for admission to for admission to MA/M Com programme.

PROGRAMME OUTCOME FOR PG

At the end of the programme, the students acquire:

Basic understanding about various precepts of the discipline, in synchronic and diachronic manner.

Critical thinking about what they learn, that prompts them to research about its technical and philosophical nuances.

Inter-personal skills enabling them to work in teams, facilitating effective interaction in their respective work places.

Environmental and social consciousness, leading to a sustainable living.

An urge for lifelong learning towards professional advancement and kindle the spirit of entrepreneurship.

A holistic view regarding life and a self-disciplined learning ability for becoming a valuable person to the institution a well as the society.

PROGRAMME SPECIFIC OUTCOMES for M. Sc. BIOCHEMISTRY

Upon completion of the M.Sc. Biochemistry Programme, the students will be able to:

PSO 1	Analyse the Structure function relationships of biomolecules, interaction between macro molecules and cellular processes at the molecular level.	PO.1,2
PSO 2	Apply Tools and techniques used in biological analysis	PO 2

PSO 3	Relate the Metabolic pathways, Clinical aspects, Bioenergetics and Catalysis.	PO 1,2
PSO 4	Understand the concepts of molecular biology and applications in genetic engineering	PO 1,2
PSO 5	Understand the concepts of microbiology and immunology and their application	PO 1,2
PSO 6	Utilize interdisciplinary knowledge in basic biotechnology and microbiology .	PO 2,3
PSO 7	Awareness of Environmental policies, problems and ethical issues related to Bioscience research.	PO2,3 4
PSO 8	Apply Research methodology, Promote scientific discoveries	PO2,3,4

M.Sc BIOCHEMISTRY PROGRAMME STRUCTURE

Course Code	Title of the Course	Type of the Course	Hours per week	Credits
FIRST SEMESTER				
PG20BS101	Biochemistry	Core course	04	04
PG20BS102	Cell Biology and Genetics	Core course	04	04
PG20BS103	Biophysics, Bioinstrumentation and Bioinformatics	Core course	04	04
PG20BS104	Human Physiology and Biostatistics	Core course	03	03
PG20BSP1-BC	Laboratory Course I	Core course	10	04
Total			**25**	**19**
SECOND SEMESTER				
PG20BS205	General Microbiology	Core course	03	03
PG20BS206	Immunology	Core course	04	04

PG20BS207	Molecular Biology and Genetic Engineering	Core course	04	04
PG20BS208-BC	Metabolism and Bioenergetics	Core course	04	04
PG20BSP2-BC	Laboratory Course II	Core course	10	04
Total			**25**	**19**
THIRD SEMESTER				
PG20BS309-BC	Enzymology	Core course	04	04
PG29BS310-BC	Plant Biochemistry	Core course	04	04
PG20BS311-BC	Molecular Endocrinology	Core Course	04	04
PG20BS312-BC	Neurobiology	Elective1	03	03
PG20BS313-BC	Biochemical Toxicology	Elective1	03	03
PG20BS314-BC	Pharmacological Biochemistry	Elective1	03	03
PG19BSP3-BC	Laboratory Course III	Core course	10	04
Total			**25**	**19**
FOURTH SEMESTER				
PG20BS413-BC	Clinical Biochemistry	Core Course	05	04
PG20BS414-BC	Environmental Science	Elective-2	05	03
PG20BS415-BC	Plant and Animal Cell culture	Elective - 3	05	03

PG20BS416-BC	Research Methodology,IPR and Bioethics	Elective-2	05	03
PG20BS417-BC	Genomics and Proteomics	Elective-2	05	03
PG20BS418-BC	Nanobiology	Elective - 3	05	03
PG20BS419-BC	Nutritional Biochemistry	Elective - 3	05	03
PG20BSP4-BC	Laboratory course IV	Core course	10	05
PG20BS4P-BC	Project			05
PG20BS4V-BC	Viva Voce			03
	Total		**25**	**23**
Total Credits				**80**

SYLLABUS

First Semester M.Sc. Biochemistry

PG20BS101	Biochemistry
PG20BS102	Cell Biology and Genetics
PG20BS103	Biophysics, Bioinstrumentation & Bioinformatics
PG20BS104	Human Physiology & Biostatistics
PG20BSP1-BC	Laboratory Course I

PG20BS101 - BIOCHEMISTRY

Hours / Week: 4 **Credits: 4**

Course Objective

- **To gain deep understanding of the structures of biological macromolecules and their structure function relationship**

Course Outcomes

CO No.	Upon completion of this course, the students will be able to:	Knowledge Level
1	IIlustrate the basic concepts of biomolecules	**K2**
2	Analyze the structure – function relationship of biomolecules	**K4**
3	Explain the interactions between macromolecules	**K2**

Knowledge Levels: K1-Remembering; K2-Understanding; K3-Applying; K4-Analyzing; K5-Evaluating; K6-Creating.

UNIT I

Brief Review of Basic Biochemistry (9 Hours)

Role of Water in biological systems; physiological buffers; importance of Carbon, hydrogen, oxygen, nitrogen and phosphorus in biological systems.

Chemical bond and interactions: Covalent bonds; Ionic bonds; Disulfide linkages; Non-covalent interactions: Van der Waals, electrostatic, hydrogen bonding, hydrophobic interaction.

Introduction to Biomolecules: Composition; basic structure and function of biomolecules: carbohydrates, lipids, proteins, nucleic acids and vitamins, hormones. Charge properties of biological molecules; Isoelectric pH.

UNIT II

Complex Carbohydrates (17 Hours)

Oligosaccharides: Glycosidic bonds; Classification: glycoproteins (O-linked and N-linked), glycolipids; Nature of carbohydrate moiety attached; Functions: as cell recognition factors, in intracellular targeting; Purification and Characterization of oligosaccharides from cell membranes

Polysaccharides: Classification: Homopolysaccharides (Cellulose, Starch, Chitin and Glycogen), Heteropolysaccharides (bacterial peptidoglycans, glycosaminoglycans, hyaluronic acid, and heparin); Structural characteristics and functions of above mentioned polyasaccharides; Exopolysaccharides from bacterial systems and their uses; Purification and Characterization of Polysaccharides from biological systems.

UNIT III (16 Hours)

Complex Lipids: Glycerophospholipids: Structure and function of (Phosphatic acid, cardiolipin, Phosphatidyl serine, Phosphatidyl ethanolamine, Phosphatidyl glycerol, Phosphatidyl choline, Phosphatidyl inositol), CDP-diacylglycerol, Lung surfactants.

Glycosphingolipids: Structure and function of Sphingosine, ceramides & sphingomyelins, cerebrosides, globosides, gangliosides, sulfatides .

Eicosanoids: Prostaglandins, Leukotrienes and Thromboxanes: Chemistry, formation and physiological function.

Steroids: Steroids in animal system: Glucocorticoids, mineralocorticoids and Sex hormones (Site of biosynthesis, functions); Sterols in Plant system: Phytohormones: Brassinosterroids (functions); Sterols in microbial system.

UNIT IV (16 Hours)

Protein structure and function: Primary, Secondary, Tertiary and Quaternary structure of Proteins w.r.t: Globular protein (eg: Hemoglobin and Myoglobin), Fibrous protein (Collagen), Membrane Protein (ATP synthetase); Structural implication of the peptide bond: rigid planar peptide unit; cis and trans configuration; conformations of a pair of linked peptide units; torsion angles: phi and psi; steric hindrance; allowed and disallowed conformation – Ramachandran diagram: conformational maps of glycine and other natural amino acids. Protein families, alpha domain, beta domain, Protein structure and molecular approach to medicine: introduction, Sickle cell anaemia. Protein –DNA interaction nhelix turn helix, helix loop helix, zinc fingers, homeo box.

Protein –RNA interaction RNA recognition motif. Protein-protein interaction-leucine zippers, bHLH, bZip motifs, PTB SH2, SH3 domains. Protein lipid interaction – PH domain. Protein drug interaction.

UNIT V (14 Hours)

Nucleic acid structure and function: Discovery of nucleic acid structure, Contribution of Indian Scientists in the elucidation of structure, Types of DNA -A, B and Z. GC content, Denaturation kinetics, cot curve, Supercoiling of the DNA molecule; topoisomers and superhelixes; Higher orders of DNA Structure: Chromatin Structure: Histones and Nucleosomes; histone modifiacation and their importance, Conformation of Chromatin fibers.

Organization of the DNA Sequence: Genes, pseudogenes, extragenic regions (beta globin gene and gene family) duplicated genes; Repetitive DNA sequences:Tandem repeats (Satellites, minisatellites, and microsatellites), Interspersed repeats (LINE,SINEs) Single copy genes; RNA Structure: Types of RNA; structure of mRNA, tRNA, SiRNA, micro RNA with emphasis on importance of structure to its function, non –coding RNAs, Regulatory RNAs.

REFERENCES

1. Biochemistry: A Students survival Guide by Hiram.F.Gilbert(2002) Publishers: McGraw-Hill ISBN 0-07-135657-6
2. Introduction to Biophysics by Pranab Kumar Banerjee(2008) Publishers: S.Chand & Company Ltd ISBN:81-219-3016-2
3. Lehninger, Principles of Biochemistry, Fourth Edition by David L.Nelson Michael. M Cox Publisher: W.H.Freeman; Fourth Edition (April 23,2004) ISBN-10:0716743396 ISBN-13:978-0716743392
4. Biochemistry(2011) by Donald Voet, Judith G Voet Publisher: JohnWiley & SonsInc ISBN: 978-1-1180-25024

5. Principles of Biochemistry,4/e(2006)by Robert Horton H, Laurence A Moran, GrayScrimgeour K Publisher Pearsarson ISBN:0131977369,

6. Biochemistry 6th Edition (2007)by Jeremy M. Berg John L.tymoczko LubertStryer Publisher:B.I Publications Pvt.Ltd ISBN:071676766X ISBN-13:9780716767664, 978716767664

7. Biochemistry (2008) by Rastogi, Publisher: Mcgraw Hill ISBN: 0070527954 ISBN-13:9780070527959, 978-0070527959

8. Molecular Biology of the Cell by Bruce Alberts, Alexander Johnson ,JulianLewis, MartinRaff, KeithRoberts, Peter Walter Publisher: Garland Science; 5 edition ISBN-10: 0815341059 ISBN-13: 978-0815341055

9. Genes IX by Benjamin Lewin(2008)Publisher: J&b ISBN:07637 52223ISBN-13: 9780763752224, 978-0763752224

10. Molecular Biology of the Gene 5/e(s)by James D Watson, Tania A Baker, Stephen P Bell (2008) Publisher: Dorling Kindersley (India) Pvt Ltd ISBN: 8177581813 ISBN-13: 9788177581812, 978-8177581812

11. Cell and Molecular Biology by S. SundaraRajan (2003) Publisher: Anmol Publications ISBN: 8126113553 ISBN-13: 9788126113552, 978-8126113552

12. The Double Helix: A Personal Account of the Discovery of the Structure of DNA byJames Watson (1968) Publisher: Hachette UK ISBN:97817.

PG20BS102 - CELL BIOLOGY AND GENETICS

Hours / week: 4 **Credit: 4**

Course Objective

- **To have an overview of various cellular organelles**
- **To understand the significance of cell signaling pathways**

Course Outcomes

CO No.	Upon completion of this course, the students will be able to:	Knowledge Level
1	Explain and Illustrate the various organelles of a cell and its functions	**K2**
2	Demonstrate the different cellular receptors and signal transduction pathways	**K3**
3	Illustrate the etiology of cancer	**K2**
4	Analyze the genetic aspects of inheritance	**K4**

Knowledge Levels: K1-Remembering; K2-Understanding; K3-Applying; K4-Analyzing; K5-Evaluating; K6-Creating.

UNIT I (12 Hours)

Cell: An Introduction. Membrane proteins, lipids. Fluid mosaic model, membrane fluidity, membrane asymmetry, lipid raft. Functions of the membrane. Membrane transport: Passive transport- Diffusion, facilitated diffusion- glucose porter molecules. Channel proteins- aquaporins. Ionic channels- voltage gated and ligand gated channels. Transmission of electrical impulses- resting and action potential. Active transport: Features, Na^+ K^+ pump. Cell junctions: Adherens junctions, desmosomes, tight junction, gap junction.

UNIT II (16 Hours)

Extracellular matrix: composition and functions. Cell signaling- G protein coupled receptors, Ion channel coupled receptors- synaptic transmission. Enzyme coupled receptors-

ras pathway. cAMP as second messengers- glycogen breakdown by epinephrine.ca ions as second messenger. ER: structure and function, Golgi complex: structure, types, protein sorting and trafficking, exo and endocytosis, coated pits and vesicles. Lysosomes and peroxisomes: enzymatic components and functions, Mechanism of autophagy. Cytoskeleton: Microtubule, assembly and organization, microfilaments: actin structure and assembly, filament based movement in muscle, sliding filament model. Intermediate filaments-types and functions. **17**

UNIT III (16 Hours)

Mitochondrion: structural features and functions, Chemiosmotic coupling, Chloroplast -structural features and functions, LHC, rubisco . Nucleus, nuclear pore complex, structure of chromosomes, chromosome banding, mitosis and meiosis, Model organisms in cell biology. Cell cycle: G1, S,G2, M phases, MPF, cyclins, checkpoints, Role of Rb & p53. Cell cycle inhibitors, Aging- significance of glutathione. Apoptosis and necrosis, apoptotic pathways. Types of tumor, induction of cancer, properties of cancer cells, oncogenes and c onco genes, tumor suppressors, Molecular pathways- PIP3 Akt, JAK STAT .

UNIT IV (18 Hours)

Mendel's laws, dominance, epistasis, pleiotropic interactions, multiple alleles-ABO blood groups, pseudoalleles, atavism, linkage, sex linkage, , linkage groups, two point and three point test crosses, determination of gene order, chromosome mapping, sex influenced genes, sex limited genes, inherited disorders in metabolism-maple syrup urine disease,Lesch Nyhan syndrome, Down's syndrome, polyploidy, aneuploidy , Cytoplasmic inheritance, cytoplasmic male sterility. .

UNIT V (10 Hours)

Behavioral genetics, Hardy Weinberg principle- natural selection, genetic drift, Genetic variation, Allele frequencies and its changes, mutation , gene flow, random mating, inbreeding, outbreeding, assortive mating, hybrid vigour. Mutational analysis using principles of probability-Chi square test.

Reference:

1. Principles of Genetics, Snustad D P, Simmons and Jenkins, John Wiley And Sons Inc ***ISBN***-13: 978-1118129210
2. Genetics, Robert Weaver and Philip Hendricks, WH.C. Brown Publishers, Iowa
3. Fundamentals of Genetics, B D Singh, Kalyani Publishers
4. Introduction to Genetic Analysis, Griffiths, Wessler, Lewontin, Gelbart,Suzuki and Miller, Freeman's and Co, New York
5. Principles of Genetics: M J Gardner, John Wiley and sons.
6. Cell Bilogy, Smith and Wood
7. Cell and Molecular Biology by Gerald Karp, Academic Press
8. Cell and Molecular Biology Cooper, Hausman, ASM Press. ISBN: 9781605351551
9. World of the Cell , Becker, Reece, Poenie, The Benjamin/Cumming's Pub. ***ISBN***-10: 0134145798

10. Cell Biology , Lodish et al, W H Freeman and Co.,NewYork. ISBN-13: 978-1429234139
11. Cell Biology , Thomas D Pollard and W.C.Earnshaw, Saunder's PublishersISBN: 9780323341264.
12. Cell BiologyOrganelle, structure and function: David E Sadava. Jones and Barlette series in Biology. ***ISBN***-10: 9780867202281
13. Cell and Molecular biology: C S Rastogi NEW Age International Pub.. ***ISBN***-13: 978-8122416886

PG20BS103 - BIOPHYSICS, BIOINSTRUMENTATION AND BIOINFORMATICS

Hours / Week: 4 **Credits: 4**

Course Objective

To gain an understanding of the principle and working of various instruments and tools for biological anlaysis

Course Outcomes

CO No.	Upon completion of this course, the students will be able to:	Knowledge Level
1	Illustrate the biochemical techniques used in research and industry	**K2**
2	Practice experiments with various instruments used in laboratories	**K3**
3	Demonstrate the Insilico tools for biological data analysis	**K3**
4	Explain the significance and precautions to be taken during radioactivity experiments	**K2**

Knowledge Levels: K1-Remembering; K2-Understanding; K3-Applying; K4-Analyzing; K5-Evaluating; K6-Creating.

UNIT I (6 Hours)

Thermodynamics: Laws of thermodynamics, the concept of enthalpy, entropy and free energy, thermodynamic equilibrium, redox potential, high energy molecules, examples of redox potential in biological system, Nernst equation.

UNIT II (6 Hours)

Mass Spectrometry: Principle, Applications; Peptide mass finger printing using MALDI-TOF, MASCOT database.

UNIT III (20 Hours)

Microscopy: Light, Scanning and Transmission electron, phase contrast, polarization, confocal, Flourescence and interference microscopy, Application of immunofluorescence in microscopy, Microscopy for detecting chromosomal aberations.

Spectroscopy: Beer-Lamberts law, Principle, Instrument Design, methods and Applications of UV-Visible spectra, IR spectra, Raman Spectra, Fluorescence spectra, NMR and ESR spectra.

UNIT IV (25 Hours)

Chromatographic and eletrophoretic techniques: Principle, methods and Applications of Chromatography, ion exchange, molecular sieve, affinity chromatography, TLC, GC-MS, HPLC, Centrifugation and Ultra centrifugation, PAGE, SDS PAGE, 2D Gel Electrophoresis, Capillary Electrophoresis, isoelectric focusing.

Methods to study the macromolecules :ORD, CD, X-ray diffraction by crystals, Electron diffraction

Application of radioactive and non radioactive methods: GM counter, Liquid scintillation counting, phosphoimager.

UNIT V (15 Hours)

Bioinformatics: Introduction to Bioinformatics, data mining Online databases and search tools, data organization, Biological data bases, structural data bases, derived and specialized data bases , DNA and RNA sequence data bases, genomic sequences, protein sequence data bases, Distance matrix methods and parsimony. Multiple sequence alignments-tree alignments, star alignments, pattern in pair wise alignment, genetic algorithm. Sequence analysis softwares, SS search, BLAST, FASTA, CLUSTAL, Phylogenetic analysis, construction of phylogenetic tree, evolutionary changes in nucleotide and protein sequences, structure prediction, structural alignment tools, homology modeling, drug design, Energy minimization in molecular docking. Applications of Bioinformatics: pharmaceutical industry, immunology, agriculture, forestry, basic research, chemiinformatics in biology, geoinformatics, legal ethical and commercial considerations.

REFERENCES

1. Introduction to Protein structure: Branden and Tooze1.
2. Biophysics-Hoope W etal
3. Molecular Biophysics- Volkenstain M.V
4. Introduction to Thermodynamics Of Irreversible Process-John Wiley
5. Statistical Methods In Biology- Briley N.J.T
6. Introduction to Biophysics-Sokal R.R & Rohl F.J
7. Bioinformatics: Sequence and Genome Analysis- David Mount, Cold Spring Harbour Lab Press, New York.
8. Bionformatics and Molecular Evolution: Paul G Higgs, Teresa K Attwood. Blackwell pub.
9. Introduction to Bioinformatics; Attwood T K and Parry-Smith D J Pearson Education Ltd.
10. Bioinformatics Seqence, structure and database; Des Higins, Willie Taylor.
11. Practical Biochemistry-Principles and Techniques. Keith Wilson and John walker(Eds),University press, Cambridge UK.
12. Introduction to Spectroscopy. DonaldL.Pavia Gary M.Lipman, George S Kriz. Harcourt brace College Publishers, Orlands, Florida
13. An Introduction to Computational Biochemistry; C.StanTsai,Wiley India Pvt.Ltd
14. Basic bioinformatics, S. Ignachimuthu, SJNarosa Publishing House

PG20BS104 – HUMAN PHYSIOLOGY AND BIOSTATISTICS

Hours / week: 3 **Credits: 3**

Course Objective

- **To have a basic knowledge of the structure and functions of various organs and tissues and organs of human body**
- **An brief overview of different statistical tools in biology**

Course Outcomes

CO No.	Upon completion of this course, the students will be able to:	Knowledge Level
1	Illustrate the tissues and organs of the human body	**K2**
2	Demonstrate the ability to differentiate physiology from the cellular and molecular level to the organ system	**K3**
3	Apply physiological and anatomical knowledge to enhance their well-being	**K3**
4	Apply statistics in biological science	**K3**
Knowledge Levels: K1-Remembering; K2-Understanding; K3-Applying; K4-Analyzing; K5-Evaluating; K6-Creating.		

UNIT-1 (8 Hours)

Tissues: Epithelial tissue, connective tissue, muscle and nervous tissue

Nervous system: Organization and function of Central and peripheral nervous system, Parts of Brain - Forebain, Midbrain, Hindbrain. Spinal cord. Neurons –Structure, Properties, Types of neurons. Neuroglial cells. Synapse - Chemical and electrical synapse, Synaptic transmission.

UNIT –II (14 Hours)

Muscle: Muscle classification- skeletal muscle, smooth muscle, cardiac muscle. Muscle contraction, neuromuscular junction.

Blood: Formed elements of blood- RBC, WBC, platelets. Lymph and plasma. Haematopoiesis. Blood groups – ABO blood group, Rh blood group. Blood grouping. Blood transfusion. Blood coagulation.

Heart: Cardiac muscle, cardiac cycle, heart sounds, conducting mechanism of heart. Regulation of heart beat, Cardiac output, ECG, blood pressure.

UNIT-III (9 Hours)

Excretory system: Kidney- structure of nephron, urine formation, GFR, renal circulation. Micturition. Composition of urine. Renal regulation of water and electrolyte balance.

UNIT –IV(9 Hours)

Respiratory system: Structural organization of respiratory system, respiratory membrane, pulmonary ventilation, pulmonary volumes and capacities, alveolar ventilation, pulmonary surfactants, exchange and transport of gases, regulation of respiration. Acid-base balance. Periodic breathing. Artificial respiration.

Abnormal respiratory patterns: Apnea, dyspnea, Hypoxia, cyanosis, hyper capnia, asphyxia. Carbon monoxide poisoning.

UNIT –V (14 Hours)

Biostatistics: Introduction, scope, probability and probability distribution analysis, variables in biology, collection, classification and tabulation of data, graphical and diagrammatic representations-scatter diagrams, histograms, frequency polygon, frequency curve, logarithmic curves, Descriptive statistics, measures of central tendency, Arithmetic mean, median, mode, geometric mean, harmonic means, Measures of dispersion, Standard deviation, standard error, Variance, coefficient of variation, correlation and regression, Principal component analysis test of significance, Basic idea of Significance test , hypothesis testing, students′t test, Chi-square test, statistical packages, use of statistical softwares, Excel, SPSS, Prism, graphed software.

REFERENCES

1. Text book of Medical physiology. Indu Khurana. Elsevier. ISBN: 978-81-8147-850-4.
2. Vander's Human Physiology-The mechanism of Body function, Widmaier, Raff, strang.
3. Text book of Medical Physiology. Arthur.C.Guyton & John.E.Hall
4. Review of Medical Physiology-William F.Ganong
5. Essentials of Medical Physiology K.Sembulingam &Prema Sembulingam
6. Statistical methods in Biology-Briely N.J.T.
7. Introductory Practical Biochemistry, S.K.Sawhney & Randhir Singh (eds), Narosa Publishing House, New Delhi, ISBN 81-7319-302-9, P195-303.
8. Standard Methods of Biochemical Analysis, S.K.Thimmaiah (ed), Kalyani Publishers, Ludhiana ISBN 81-7663-067-5, P12-18.
9. Expeimental Biochemistry, A Student companion, Beedu Sasidhar Rao and Vijay Deshpande(ed), I.K.International Pvt.Ltd, NewDelhi, ISBN 81-88237-41-8, PB13-17, P 49-72.
10. Practical Biochemistry, R.C.Gupta S.Bhargava(eds) CBS Publishers and Distribuors, New Delhi ISBN 81-239-0124-0 P9-27

PG20BSP1-BC - LABORATORY COURSE I

Hours/week: 10 **Credits: 4**

Biochemistry

1. **Preparation of Solutions:**
   - Percentage solutions,
   - Molar solutions,
   - Normal solutions
   - Dilution of Stock solutions
2. **Preparation of buffers using the Henderson Hasselbach equation**
3. **Spectrophotometric Experiments:**
   - Determination of UV-Visible spectrum of compounds
   - Determination of Concentration of molecules from Molar Extinction coefficient values.

Quantitative Analysis-Any five from plant or animal source

- Extraction and Quantitative estimation of reducing sugars by Dinitrosalicylic acid method/ Nelsons Somogyi method/
- Extraction and Quantitative Estimation of fructose by Roe and Papadopaulose method
- Estimation xylose by orcinol method
- Extraction of polysaccharide Anthrone method (starch,glycogen) and quantification.
- Quantitative estimation of tyrosine by Folinscio calteumethod
- Quantitative estimation of Methionine by Nitroprusside method
- Extraction and Quantitative Estimation of protein by biuret method./ Lowry's method/ BCG method
- Estimation of Cholesterol by Zak's method
- Estimation of DNA by Diphenylamine and estimation of RNA by Orcinol method
- Determination of Saponification value, acid value,iodine number of oils or fats.

4. Separation Techniques

- Separation of amino acids by Paper chromatography(Descending or Ascending)
- Separation of Plant pigments/lipids/sugars by Thin layer chromatography
- Separation of any biomolecule by column chromatography (gel filtration/ ion exchange chromatography)
- SDS PAGE

Cell Biology and Genetics

1. Study of various stages of mitosis using cytological preparations of onion root tips.
2. Karyotype study using cytological preparation of dividing root tip cells of onion /photographs /permanent slides
3. Study in the ultra structure of cell organelles using electron microphotographs pics.
4. Solving genetic problems related to monohybrid, dihybrid ratio and interaction of genes

Physiology

1. Determination of haemoglobin concentration
2. Determination of haematocrit value
3. Enumeration of bloodcells: Erythrocytes by haemocytometry, Total leukocyte by haemocyometry
4. Preparation of Blood smears for differential count and cell morphology
5. Determination of Erythrocyte sedimentation rate

Bioinformatics

1. Familiarizing with the different data bank mentioned in the syllabus.
2. Retrieve a document reporting recent work on a genomic analysis of human disease.
3. Retrieve one sequence both DNA and protein from database retrieval systems.
4. Retrieve nucleotide sequences and construct a distance tree.
5. Online sequence analysis, BLAST.

6. Phylogenetic analysis.

Biostatistics

1. Problems on Arithmetic mean, Standard deviation,Correlation,regression, Chi square test
2. Visit a research Institute to familiarize with the Instrumentatin . Submit a report

REFERENCES

1. Introductory Practical Biochemistry, S .K. Sawhney & Randhir Singh (eds) Narosa Publishing House, New Delhi, ISBN 81-7319-302-9, P195-303
2. Standard Methods of Biochemical Analysis, S.K. Thimmaiah (ed), Kalyani Publishers, Ludhiana ISBN 81-7663-067-5, p 12-18
3. Hawk's Physiological Chemistry, Bernard L.Oser(ed) TATA McGraw Hill Publishing Company LTD, New Delhi, p 60-127, 1317-1334
4. Practical Clinical Chemistry, Harold Varley, CBS Publishers and Distributors, New Delhi,
5. Medical Laboratory Technology – A procedure manual for routine diagnostic tests Volume 1, K.L. Mukherjee, Tata McGraw-Hill Publishing company LTD, New Delhi

SYLLABUS

Second Semester M.Sc. Biochemistry

PG20BS205	General Microbiology
PG20BS206	Immunology
PG20BS207	Molecular Biology & Genetic Engineering
PG20BS208-BC	Metabolism & Bioenergetics
PG20BSP2-BC	Laboratory Course II

PG20BS205 - GENERAL MICROBIOLOGY

Hours / Week: 3 **Credits: 3**

Course Objective

- **To gain an understanding of the general properties and identification of bacteria,virus and fungus**

Course Outcomes

CO No.	Upon completion of this course, the students will be able to:	Knowledge Level
1	llustrate the diversity of microbial world and their interactions with the environment	**K2**
2	Explain the genetic materials and mechanisms in bacteria and their role in the transmission of genetic characters	**K2**
3	Illustrate the importance of sterilization and disinfection and the methods used in a microbiology laboratory and premises	**K2**
4	Demonstrate microorganisms based on their characteristics	**K3**
Knowledge Levels: K1-Remembering; K2-Understanding; K3-Applying; K4-Analyzing; K5-Evaluating; K6-Creating.		

UNIT I (12 Hours)

Introduction: The historical foundations and development of microbiology. Outline classification of microorganisms- Haeckel three Kingdom classification, Whittaker five Kingdom classification and Woese three domain classification.

Principles of bacterial taxonomy: Numerical taxonomy, Identification characters- morphological, staining, physiological, biochemical and molecular (mol % G+C, nucleic acid hybridization, 16SrRNA sequencing) characters. Bacterial classification as per latest edition of Bergey's Manual of systematic Bacteriology. Archaebacteria and Bacteria.

UNIT II (16 Hours)

General properties of bacteria: Morphology and structure of bacteria-size, shape and arrangement. Surface structures and inclusions of bacteria-Capsule, pili, fimbriae, flagella, cell wall, cell membrane, cell organelles, genetic material, plasmid, spore, inclusion bodies. Microbial locomotion - flagellar motility, gliding motility and amoeboid motion. Chemotaxis.

General properties of viruses: Morphology and structure of viruses, Bacteriophages, viroids, prions. Genetic modification of viruses. Virus multiplication. Cultivation of viruses.

General properties of fungi: Classification of fungi, Reproduction in fungi. Methods for the study of fungi. Cultivation of fungi.

UNIT III (20 Hours)

Bacterial growth and nutrition: Factors influencing bacterial growth – nutritional and environmental factors. Bacterial growth at different temperature, pH and oxygen level. Nutritional types of bacteria. Binary fission. Bacterial growth curve. Batch, fed-batch and continuous culture. Measurement of bacterial growth.

Cultivation of bacteria: Culture media - Composition and preparation of culture media. Types of culture media – Solid, semi-solid, liquid and bi-phasic media, simple media, differential media, special media, enriched media, enrichment media, auxanographic and anaerobic media. Culture methods- Aerobic and anaerobic.

Identification of bacteria: Staining reactions- Principles of staining. Types of staining- Simple staining, Differential staining, Special staining- capsule, spore, flagella and volutin granule. Cultural, morphological and biochemical properties. Molecular methods for identification - Isolation of bacterial DNA, electrophoresis, amplification of DNA -PCR technique,16SrRNA sequencing, Phylogenetic tree.

UNIT IV (10 Hours)

Sterilization: Principles and methods, physical and chemical methods. Disinfectants - modes of action. Testing of disinfectants.

Antibiotics: Antibacterial, antifungal, antiviral, mechanism of action. Classification of antibiotics based on mechanism of action. Drug resistance in bacteria. Antibiotic sensitivity tests.

UNIT V (14 Hours)

Bacterial genetics: Genetic materials in bacteria. Bacterial chromosome. Extrachromosomal genetic elements. Plasmid- copy number and incompatibility, Replication of plasmid. Episomes. Transposable element-IS element and transposon, Integrons and Antibiotic resistance cassettes, Multiple antibiotic resistant bacteria, Mutation- types of mutations, DNA repair-Photolysis, Excision repair, NER, SOS repair, Mutant selection. Mechanism of gene transfer - transformation, transduction and conjugation. Recombination- types, mechanism and enzyme involved. Gene mapping. Metagenomics.

REFERENCES

1.Prescott LM, Harley JP, & Klein DA (2005) Microbiology (McGraw-Hill, Boston;London) 6th ed.

2.Russell AD, Hugo WB, &Ayliffe GAJ (1999) Principles and practice of disinfection,

3.Preservation, and sterilisation (Blackwell Science, Oxford) 3rd ed

4.Bryan LE (1984) Antimicrobial Drug Resistance (Academic Press, Orlando

5.Topley WWC, Wilson GS, Parker T, & Collier LH (1990) Topley and Wilson's Principles of Bacteriology, Virology and Immunology .Edward Arnold, London. 8th ed.

6.Davis BD (1990) Microbiology (Lippincott, Philadelphia) 4th ed

7.Zinsser H &Joklik WK (1992) ZinsserMicrobiology (Appleton& Lange, Norwalk,CT) 20th Ed

8.Gerhardt P (1994) Methods for General and Molecular Bacteriology.American Society for Microbiology, Washington, D.C.

9.Pelczar MJ, Chan ECS, & Krieg NR (1993) Microbiology: Concepts and Applications McGraw-Hill.5th ed.

PG20BS206 - IMMUNOLOGY

Hours / Week: 4 **Credits: 4**

Course Objective

- **To have an understanding of the immune system and their function**

Course Outcomes

CO No.	Upon completion of this course, the students will be able to:	Knowledge Level
1	Illustrate the cellular and molecular basis of the immune system	**K2**
2	Demonstrate how the innate a and adaptive immune responses coordinate to fight against invading pathogens	**K3**
3	Describe the structure and functions of MHC molecules and Immunoglobulins	**K2**
4	Explain the complement system, its activation and biological consequences of complement activation	**K2**
5	Illustrate the use of vaccines and analyze the strategies to develop future vaccines	**K4**
6	Explain the genetic defects that lead to immunodeficiency diseases and their treatment as well as the current status of gene therapy	**K2**

Knowledge Levels: K1-Remembering; K2-Understanding; K3-Applying; K4-Analyzing; K5-Evaluating; K6-Creating.

UNIT I (10 Hours)

Introduction to the immune system: Organs and cells with immune function. Infection, Source of infection, Methods of transmission. Immunity - Types of immunity. Mechanisms of innate immunity- barriers, inflammation, phagocytosis-mechanisms, Pattern recognition receptors - Scavenger receptors and the Toll-like receptors.

UNIT II (16 Hours)

Antigen, antibody and immunological techniques: Antigens, Antigenicity, Epitopes, Antibodies, Immunoglobulin – structure, classes and functions Fc receptors. Monoclonal antibodies – production and application, Antibody engineering. Antigenic determinants on Ig- Isotype, Allotype, Idiotype. Genetic basis of antibody diversity, Organization and Expression of Immunoglobulin Genes, V(D)J rearrangements; somatic hypermutation and affinity maturation, Class-switching, Antigen-antibody reactions - Agglutination, Precipitation, Complement fixation, Immunodiagnosis: Radioimmuno assay, Immunoflourescence, ELISA, lateral flow assay, Western blotting, Flow cytometry .

UNIT III (16 Hours)

Cell and humoral Immune response: Receptors on T and B cells for antigens, MHC, Antigen processing and presentation, Complement system, Complement activation, regulation, Biological effects of complements, B cell- generation, activation, differentiation, Humoral Immune response- Antibody formation, Primary and secondary immune response, Clonal selection theory. T-cell maturation, activation and differentiation, Cell mediated Immune response, Cytokines, Immune modulation

UNIT IV (14 Hours)

Transplantation and immunotherapy: Immunology of organ and tissue transplantation- Allograft reaction and GVH reaction, Factors influencing allograft survival, Immunology of malignancy- Tumor antigens, Immune response in malignancy, Immunotherapy of cancer, Immunohematology- ABO and Rh blood group system, Immunology of blood transfusion, Hemolytic disease of new born.

UNIT V(16 Hours)

Hypersensitivity, Autoimmunity and vaccines: Immunological Tolerance, Autoimmunity- Mechanisms of autoimmunity, Autoimmune diseases. Inflammation, Hypersensitivity– immediate and delayed reactions, Clinical types of hypersensitivity, Immunodeficiency diseases, Immunoprophylaxis- Vaccines –types of vaccines: 1) Conventional vaccines- Attenuated, live; 2) recombinant vaccines- carbohydrate, protein and DNA based vaccines, Combination vaccines, Edible vaccines. Recent trends in vaccine development. Role of Adjuvants. Immunoregulation

REFERENCES

1. Roitt IM & Delves PJ (2001) *Roitt's essential Immunology*.Blackwell Science, Oxford. 10th ed.
2. Kindt TJ, Goldsby RA, Osborne BA, & Kuby J (2006) *Kuby Immunology*.W.H. Freeman, New York. 6th ed
3. Murphy K, Travers P, Walport M, & Janeway C (2008) *Janeway's Immunobiology*. Garland Science, New York. 7th ed
4. Chapel H (2006) *Essentials of clinical Immunology* .Blackwell, Malden, Mass. ; Oxford. 5th ed
5. Kimball JW (1986) *Introduction to Immunology*.Macmillan, London 2nd ed
6. Paniker CKJ (2006) *Ananthanarayan & Paniker's Textbook of microbiology*. Orient Longaman.

PG20BS207 – MOLECULAR BIOLOGY AND GENETIC ENGINEERING

Hours / Week: 4 **Credits: 4**

Course objective

- **To gain an understanding of molecular biology of the cell**
- **Application of recombinant DNAtechnology**

Course Outcomes

CO No.	Upon completion of this course, the students will be able to:	Knowledge Level
1	Explain the various molecular mechanism underlying the transmission of genetic information	**K2**
2	Illustrate the theoretical aspects of rDNA technology and genetic engineering	**K2**
3	Apply the different molecular tools and strategies explored in rDNA technology	**K3**
4	Analyze the outcome of various molecular biology experiments	**K4**

Knowledge Levels: K1-Remembering; K2-Understanding; K3-Applying; K4-Analyzing; K5-Evaluating; K6-Creating.

UNIT I (17 Hours)

Structural Organisation of genome: chromatin , nucleosome, chromosomes. Functional organization: genes, controlling sequence, split gene concept, exons, introns, intergenic DNA-repetitive sequences-interspersed repeats- SINE,LINE transposons- types(IS elements, replicative transposons, retroposons) &significance, tandem repeats-micro,minisatellites DNA ReplicationModels of DNA Replication, Conservative, Semiconservative and

discontinuous, Messelson and Stahl experiment, Steps in initiation of replication, Enzymatic factors involved, Ori site , Okazaki fragments, Termination of replication, DNA polymerases in eukaryotes and prokaryotes, Klenow fragment, Primosome, SSB, Ligase, modes of replication, theta, rolling circle, d-loop replication, end problem of replication, telomerase-structure and functions, Inhibition of replication. Role of enzymes in proof reading, Repair mechanisms: Photolyase, Excision Repair- BER, NER. Mismatch repair, SOS repair, Recombination repair systems.

UNIT II (17 Hours)

Transcription. -Process of transcription, stages in transcription, RNA polymerases in prokaryotes and enkaryotes, sigma factor in prokaryotes, Rho dependant and Rho independent termination. Enhancers, Transcription factors in Eukaryotes, Differences in transcription between prokaryotes and Eukaryotes, post transcriptional modifications-Polyadenylation, capping, r-RNA processing, Splicing-Spliceosome, lariat structure, Group 1, II and III Introns Ribozyme, Importance of ribozyme, properties, application, RNase P, RNAse III, RNAse H. monocistronic and polycistronic m-RNA, Joint transcript of r-RNA and t-RNA in prokaryotes and their processing, Transplicing, alternate splicing, inhibitors of Transcription.

Molecular mechanism of gene regulation in prokaryotes-Transcriptional regulation in prokaryotes; Inducible & repressible system, positive and negative regulation; Operon concept, structure of operon, Lac, Trp, Ara operon, Catabolic repression, Attenuation. Role of Hormones in gene regulation.

RNA World, RNA based technology- Molecular mechanism of Ribozyme, Antisense RNA, SiRNA, MicroRNA, Riboswitches & their applications; Telomerase structure and function Nucleic acid as therapeutic agent

UNIT III (12 Hours)

Translation

Process of translation. Stages in translation, genetic code, properties, wobble hypothesis, eukaryotes and prokaryotes ribosomes, m-RNAs, t-RNAs, aminoacyl t-RNA synthetases, protein factors initiation complex, peptidyl transferase , releasing factors, differences between prokaryotic and eukaryotic systems, inhibition of translation. Post translation modification by cleavage, self assembly assisted self assembly chaperones, acylation, phosphorylation, acetylation and glycosylation, Histone acetylation and deacetylases, chromosome remodeling complex. Intein splicing.

UNIT IV(16 Hours)

Tools and techniques for Genetic Engineering

History of rDNA Technology, Cohen And Boyer Patents. Enzymes used in genetic engineering with special reference to restriction enzymes, ligases, and other DNA modifying enzymes. modification of restriction fragments, vaccinia topoisomerases, Cloning strategies - Use of linkers, adaptors, TA cloning, and homopolymer tails . Nucleic acid hybridization - Colony hybridization, plaque hybridization; Blotting techniques – Southern, Northern.

Vectors – Plasmid- pSC101, pBR322, pUC their development, features and selection procedures; Bacteriophages- λ and M13, Cosmids- features advantages and cosmid cloning schemes; Phagemids- pEMBL, pBluescript, pGEM3Z, pSP64. Shuttle vectors- YAC. Ti-plasmids. Expression vectors. Construction of genomic librariesand cDNA libraries, procedure for recombinant selection and library screening, Chemical synthesis of DNA, DNA Sequencing- plus and minus sequencing, Sanger's dideoxy sequencing, Maxim and Gilberts method. Advanced sequencing procedures – pyrosequencing, Illumina, ABI/SOLiD and their applications. Principles, techniques and applications- PCR, RFLP, RAPD, AFLP, Foot and Finger printing.

UNIT V (10 Hours)

Applications of Genetic Engineering

DNA chips and microarray, gene screen technology; site directed mutagenesis, gene knockout techniques, Genetic markers, Gene transfer in plants and animals. Applications of transgenic technology. Animal cloning- stem cell technology, somatic cell nuclear transfer, Plant cell culture based techniques. Applications of Molecular Biology in forensic sciences, medical science etc.

REFERENCES

1. M. Fogiel, J. A. Stone, Research and Education Association., (1995) *The genetics problem solver : a complete solution guide to any textbook*. REA's problem solvers (Research and Education Association, Piscataway, N.J.
2. Anthony. J. F. Griffiths (2002), *Modern genetic analysis*. 2nd ed. (W.
   2.1.1. H. Freeman ; Basingstoke : Palgrave, New York.
3. EJ Wood, Chris Smith (1996) Cell biology. 2nd ed. Chapman and Hall, London.
4. Gerald Karp.(2009) *Cell and Molecular Biology: Concepts and experiments*. 6th ed. John Wiley & Sons.
5. Geoffrey M Cooper, Robert E Hausman (2007) *The cell: a molecular approach*. 4th Ed. ASM Press.

6. EDP DeRobertis , EMF DeRobertis. (1995).*Cell and Molecular Biology.* 6th ed. B.I Waverly.
7. Bernard R Glick, Jack J Pasternak (2010) *Molecular Biotechnology. Principles and Applications of recombinant DNA*. 4th ed.
8. Sandy B Primrose , Richard Twyman (2009) *Principles of Gene Manipulation and Genomics.* 7th ed. John Wiley & Sons.
9. Terry A Brown. (2010) *Gene Cloning and DNA Analysis: An Introduction*. 6th ed. John Wiley & Sons.
10. Benjamin Lewin, Jocelyn E. Krebs, Elliott S. Goldstein, Stephen T. Kilpatrick (2009)
11. *Lewin's Genes X.* 10th ed. Jones and Bartlett Publishers International, London.
12. James D Watson. (2008) *Molecular biology of the Gene.* 6th ed. Pearson/ Benjamin Cummings.
13. Harvey F Lodish. (2004) *Molecular Cell Biology*. 5th ed. W.H Freeman.

PG20BS208-BC – METABOLISM AND BIOENERGETICS

Hours/ Week: 4 **Credits: 4**

Course Objective

- **To gain an understanding of the various metabolic pathways in the body and their regulation**

Course Outcomes

CO No.	Upon completion of this course, the students will be able to:	Knowledge Level
1	Explain the metabolism of carbohydrates, proteins, lipids and nucleic acids	**K2**
2	Describe the major pathways of intermediary metabolism , their energetics and regulation	**K2**
3	Relate the metabolic activity of tissues and organs with their function.	**K4**
4	IIlustrate Bioenergetics	**K2**
Knowledge Levels: K1-Remembering; K2-Understanding; K3-Applying; K4-Analyzing; K5-Evaluating; K6-Creating.		

UNIT I (12 Hours)

Metabolism of Carbohydrates-glycolysis-reactions, Metabolism of sugars other than glucose, fructose galactose and mannose-energetics and regulation(hormonal, allosteric and feed back)

Gluconeogenesis-reactions and regulation.Coricycle, glyoxylate pathway, pentose phosphate pathway.Alternative oxidative pathway of glucose.Uronic acid pathway, phosphoketolase pathway.

Metabolism of glycogenGlycogen breakdown, synthesis, regulation.

Citric acid cycle-reactions, enzymes amphibolic nature of the cycle, anaplerotic reactions.Regulation.

UNIT II (10 Hours)

Lipid Metabolism:Fatty acid oxidation- α,β,ω oxidation. Catabolism of unsaturated fatty acids, formation and utilization of ketone bodies.

Fatty acid biosynthesis-regulation: Synthesis and breakdown of traicylglycerols-regulation.Phospholipids and glycolipid metabolism-glycerophospholipids, sphingolipids, sphingoglycolipids.

Cholesterol metabolism Cholesterol biosynthesis and regulation. Transport of cholesterol-LDLreceptor pathway.Cholesterol catabolism-Synthesis of bile acid.Lipoprotein metabolism-Chemical composition, biological functions and metabolic fate of VLDL,LDL and HDL.

Arachidonic acid metabolism-leukotrienes and prostaglandins.

UNIT III (12 Hours)

Metabolism of proteins and amino acids: An overview of Biosynthesis and degradation of aliphatic and aromatic aminoacids . Biosynthesis and catabolism of aromatic amino acids,

Biosynthesis of urea- Conversion of aminoacids to histamine, polyamines, serotonin, epinephrine, and norepinephrine γ aminobutyrate.

Metabolism of purine and pyrimidine nucleotides-biosynthesis and catabolism-inter conversion - uric acid formation, regulation, Heme synthesis and degradation

UNIT IV(10 Hours)

Hormonal regulation of metabolism-Role of Insulin, glucagon, epinephrine-intracellular receptor and cell surface receptors signalling: Cyclic AMP-dependent protein kinase; Cyclic GMP-dependent protein kinase; Protein kinase C; Ca2+-calmodulin-dependent protein kinases; AMP-dependent protein kinases. Receptor tyrosine kinases, Regulation of glycogen synthesis, degradation and glucose transport.

UNIT V(10 Hours)

Bioenergetics: High energy molecules, Functional significance of the mitochondrial respiratory chain and oxidative phosphorylation, Electron transport chain: structural components of the chain, complexes, free elements; Structure and functional properties of cytochrome, ferrosulphurated proteins and CoQ; Generation of the electrochemical proton gradient:Chemiosmosis ATP synthesis: structural and functional properties of ATP synthesis; Inhibitor agents and decoupling agents of the respiratory chain and ATP synthesis; Transport processes across the internal mitochondrial membrane.

Metabolomics

Introduction to the origin of metabolomics, definition of metabolite and metabolome. Applications of metabolomics

REFERENCES

1. Lehninger, Principles of Biochemistry Fourth Edition by David L.Nelson Michael M.CoxPublisher:W.H.Freeman; Fourth Edition (April23,2004)ISBN-10:0716743396ISBN-13:978-0716743392
2. E.S.West,W.RTodd,H.S Mason and T.J van Bruggen, A Text Book of Biochemistry , Oxford and IBH Publishing Co.,New Delhi,1974
3. Biochemistry[with CDrom](2004) by Donald Voet, Judith G. Voet Publisher: John Wiley &Sons Inc ISBN:047119350XISBN-13: 9780471193500, 978-0471193500
4. Principles of Biochemistry (1995) by Geoffrey L Zubay, WilliamW Parson, Dennis E Vance Publisher: Mcgraw-hill Book Company-Koga ISBN: 0697142752 ISBN-13: 97806971142757, 978-0697142757
5. Principles of Biochemistry, 4/e(2006) by Robert Horton H, Laurenence A Moran, GrayScrimgeour K Publisher:Pearsarson ISBN:0131977369, ISBN-13:9780131977365, 978-0131977365
6. Biochemistry 6thEdiion (2007) by JeremyM.berg John L.tymoczko LubertStryer Publisher: B.I publications Pvt.Ltd ISBN:071676766X ISBN-13:9780716767664, 978-716767664

7. Biochemistry (2008) by Rastogi Publisher:Mcgraw Hill ISBN: 0070527954 ISBN-13: 9780070527959, 978-0070527959

PG20BSP2-BC -LABORATORY COURSE -II

Hours / Week: 10 **Credits: 4**

MICROBIOLOGY AND IMMUNOLOGY

- Microscopic examination of bacteria in living conditions - Testing of motility by hanging drop.
- Staining procedures- Gram, Volutin, Spore, Capsule, Negative, Acid Fast, Fungal staining etc.
- Cultivation of bacteria and fungi
- Sterilization methods
- Study of cultural characteristics and biochemical reaction of bacteria
- Testing of disinfectants
- Bacterial growth curve
- Antibiotic sensitivity tests- disc diffusion, MIC
- Serological tests for the diagnosis of microbial infections
- Agglutination and precipitation tests
- Immunodiffusion in gel
- ELISA
- Bacterial identification using software based on morphological and biochemical characters

MOLECULAR BIOLOGY AND GENETIC ENGINEERING

- Genomic DNA, Plasmid DNA and RNA isolation from different microbial sources
- Agarose gel electrophoresis of nucleic acids
- Estimation of DNA and RNA
- Polymerase Chain Reaction
- Restriction enzyme digestion
- Ligation, Bacterial transformation and blue white screening
- Expression and purification of recombinant proteins
- Metagenomics

REFERENCES

1. Cheesbrough M (2006) *District Laboratory Practice in Tropical Countries. Vol.2* Cambridge University Press. 2nd ed.
2. Collee JG & Mackie TJ (1996) *Mackie and McCartney Practical Medical Microbiology* .Churchill Livingstone, Edinburgh. 14th ed
3. Gradwohl RBH, Sonnenwirth AC, & Jarett L (1980) *Gradwohl's Clinical Laboratory Methods and Diagnosis* .Mosby, St Louis, Mo. ; London. 8th ed
4. Dubey RC & Maheshwari DK (2002) *Practical Microbiology* (S. Chand & Company Limited
5. Aneja KR (2003) *Experiments In Microbiology, Plant Pathology And Biotechnology*. New Age International.
6. Sambrook J. and Russell D. 2001. *Molecular Cloning: A Laboratory Manual*, 3rd edition. Cold Spring Harbor Laboratory Press, Cold Spring Harbor, New York.
7. Sambrook J., Fritsch E.F., and Maniatis T. 1989. *Molecular Cloning: A Laboratory Manual*, 2nd edition. Cold Spring Harbor Laboratory Press, Cold Spring Harbor, New York.

SYLLABUS

Third Semester M.Sc. Biochemistry

PG20BS309-BC	Enzymology	Core course
PG20BS310-BC	Plant Biochemistry	Core course
PG20BS311-BC	Molecular Endocrinology	Core course
PG20BS312 - BC	Neurobiology	Elective1
PG20BS313-BC	Biochemical Toxicology	Elective1
PG20BS314-BC	Pharmacological Biochemistry	Elective1
PG20BCP3	Laboratory course III	Core course

PG20BS309-BC - ENZYMOLOGY

Hours / Week: 4 **Credits: 4**

Course Objective

- **To have a indepth knowledge of the properties and functions of enzymes**

Course Outcomes

CO No.	Upon completion of this course, the students will be able to:	Knowledge Level
1	Describe structure, functions and mechanism of action of enzymes	**K2**
2	Classify enzymes based on the reactions catalysed.	**K2**
3	Relate kinetics, inhibition and regulation of enzyme catalysed reactions	**K4**

Knowledge Levels: K1-Remembering; K2-Understanding; K3-Applying; K4-Analyzing; K5-Evaluating; K6-Creating.

UNIT I

Introduction to enzymes: Holoenzyme, apoenzyme, and prosthetic group; Interaction between enzyme and substrate- lock and key model, induced fit model, Features of active site, activation energy, Rate Enchacement through Transition State Stabilization, Chemical Mechanisms for Transition State Stabilization, The Serine Proteases: An Illustrative Example; Enzyme specificity and types; Enzyme Commission system of classification and nomenclature of enzymes (Class and subclass with one example) Ribozymes, Abzymes. Coenzymes and their functions- NAD, NADP+, FAD, FMN, lipoic acid, TPP, Pyridoxal phosphate, biotin and cyanocobalamin.
Measurement and expression of enzyme activity, enzyme assays. Definition of IU, katals, enzyme turnover number and specific activity, Isolation of enzymes and the criteria of purity; Characterization of enzymes.

UNIT II (16 Hours)

Enzyme kinetics: Importance, order of reaction, study of the factors affecting the velocity of enzyme catalyzed reaction-enzyme concentration, temperature,pH, substrate concentration, inhibitors and activators (explanation with graphical representation).

Derivation of MichaelisMenten equation and Km value determination and its significance, Definition of Vmax value of enzyme and its significance, Lineweaver-Burk plot; Bi- substrate reactions: Classification, Reaction mechanisms; Using the king Altman Method to Determine Velocity Equations.

UNIT III (14 Hours)

Enzyme inhibition: Reversible and irreversible-examples. Reversible-competitive, non-competitive and uncompetitive inhibition; Graphical determination of inhibitor type, Dose- response curves of Enzyme inhibition.Mutually Exclusive Binding of Two inhibitors; Structure-Activity Relationships and Inhibitor Design; Application of inhibitors as therapeutic agents for HIV,Cancer.

UNIT IV(16 Hours)

Regulation of Enzyme activity: Covalently modulated enzymes with examples of adenylation and phosphorylation; Zymogen form of enzyme and zymogen activation; Multienzyme complexes and their role in regulation of metabolic pathways; Allosteric enzymes: Examples of Cooperativity and Allostery in Proteins, Models of Allosteric Behavior, Effects of Cooperativity on Velocity Curves, Sigmoidal Kinetics for Nonallosteric Enzymes.

Allosteric regulation: example of Aspartate trascarbamoylase, Isoenzymes- Lactate dehydrogenase and creatine phosphokinase.

UNIT V(6 Hours)

Application of enzymes: Industrial uses of enzymes: production of glucose from starch, cellulose and dextrans, use of lactase in diary industry, production of glucose fructose syrup from sucrose, use of proteases in food, leather and detergent industry. Diagnostic and therapeutic enzymes;Enzymes as antiviral agents; Enzyme engineering

REFERENCES

Fundamentals of Enzymology: The cell and molecular Biology of Catalytic Proteins by Nicholas C. Price, Lewis Stevens, and Lewis stevens (2000) Publisher: Oxford University Press, USA ISBN: 019850229x ISBN-13: 9780198502296, 978-0198502296

Enzyme Kinetics: A modern Approach Book: Enzyme Kinetics: A Modern Approach by Alejandro G. Marangoni (2003) Publisher: Wiley-interscience ISBN: 0471159859 ISBN_13:9780471159858, 978-0471159858

Enzyme Kinetics and Mechanisms by Taylor Publisher: Spring ISBN 8184890478 ISBN-13: 9788184890471, 978-8184890471

Enzyme Mechanism by P.K Sivaraj Kumar (2007) Publisher: RBSA Publishers ISBN: 8176114235 ISBN -13:9788176114233, 978-8176114233

Enzymes and Enzyme Technology by kumar (2009) Anshan Pub ISBN: 1905740875,ISBN-13:9781905740871, 978-1905740871

Enzymes in Industry: Production And Applications by Aehle W (2007) Publisher: John Wiley & Sons Inc ISBN: 3527316892 ISBN -13: 9783527316892, 9783527316892, 9783527316892 Enzymes: Biotechnology, Clinical Chemistry (second Edition)by Trevor Palmer, Philip Bonner (2007) Publisher: Horwood Publishing Limited ISBN: 1904275273 ISBN-13: 978-1904275275

PG20BS310-BC – PLANT BIOCHEMISTRY

Hours/Week:4 **Credits: 4**

Course Objective

To have an understanding of the biochemical pathways in plants

Course Outcomes

CO No.	Upon completion of this course, the students will be able to:	Knowledge Level
1	Outline photosynthesis and photo respiration	**K1**
2	Describe various plant hormones and its applications in agriculture.	**K2**
3	Demonstrate the use of plant lectins in the purification of glycans	**K3**
4	Illustrate how plants survive stress conditions and climate change.	**K2**
5	Evaluate the various phytoconstituents and their application in drug development	**K6**

Knowledge Levels: K1-Remembering; K2-Understanding; K3-Applying; K4-Analyzing; K5-Evaluating; K6-Creating.

UNIT I (16 Hours)

Photosynthesis: Ultra Structure and organization of chloroplast membranes, lipid composition of choloroplast membranes, electron transport chain. Thylakoid membrane protein complexes Calvin cycle: Biochemistry of RuBp Carboxylase or oxygenase, activation of Rubisco, Hatch and slack pathway, CAM plants; productivity of C4 plants, Photorespiration and compensation point, photosynthetic efficiency and plant productivity,

UNIT II (16 Hours)

Nitrogen Metabolism: Nitrogen fixation, nitrogenase complex, electron transport chain and mechanism of action of nitrogenase. Structure of 'NIF'genes and its regulation, Hydrogen uptake and bacterial hydrogenases, Nitrate Metabolism: Enzymes of nitrate metabolism, regulation of their synthesis and activity. Ammonium assimilation enzymes: glutamine synthetase, glutamate synthase and GDH.

UNIT III (12 Hours)

Plant growth regulators: Auxins; gibberellins, cytokines, abscicic acid and ethylene - biosynthesis , synthetic growth hormones, inhibitors. Stress response in Plants.

UNIT IV (16 Hours)

Major chemical classes of secondary metabolites: A brief account of the following classes: Alkaloids, terpenoids, flavonoids, Phenolics and phenolic acids,steroids, coumarins, quinines, acetylenes, cyanogenic glycosides, amines and nonprotein amino acids,gums, mucilages, resins etc. (Structures not necessary). Importance of secondary metabolites: Protection of the producer plant from predators and insects;. Uses of secondary metabolites to man: as drugs, precursors of drugs in pharmaceutical industry, as natural pesticides/insecticides; other uses of secondary metabolites.

General biosynthetic pathways of the following classes of secondary metabolites (structures of intermediates not necessary): Terpenoids: Isoprene as Precursor, hemi , mono, sesqui, di, triterpenes and polyterpenes with examples . Phenols: simple phenols, phenol carboxylic acids, phenylpropanes, flavan derivatives, and phenolic glycosides. Broad outline of their biosynthesis . Alkaloids, definition of true and pseudo alkaloids, Phenyl ethylamines, pyrrolidone alkaloids, Piperidine alkaloids, Pyridine alkaloids ,tropane alkaloids, quinoline and isoquinoline alkaloids,Indole alkaloids, purine alkaloids, isoprenoidal alkaloids, Steroidal alkaloids.

UNIT V (12 Hours)

Transgenic plants ,QTL mapping, Marker Assisted Breeding in transgenics – herbicide resistance; Pest and disease resistance; Quality enhancement ,Bt cotton,Bt Brinjal,Applications of RNAi technology, Gene Editing,CRISPR Cas 9 , Ethics and regulatory issues.

REFERENCES

Plant Metabolism by H.D Kumar and H.N Singh (1980) Publisher. Macmillan (Mar 1980) ISBN-10: 0333256387: ISBN-13:978-0333256381.

Biotechnology: Secondary Metabolites by K.G Ramawat, (2000) Publisher: Science Publishers, U.S. ISBN-10: 1578080576 ISBN-13: 978-1578080571

Plant Biochemistry by P.M Dey and J.B. Harborne (Editors) (1997) Publisher: Academic Press ISBN-10:0122146743, ISBN-13:978-0122146749

Plant Metabolism by Prof David T. Dennis, Prof David H. Turpin, Dr Daniel D. Lefebvre and Dr David B. Layzell(Editors) (1997) publisher: Longman; ISBN-10: 0582259061, ISBN-13:978-582259065

Plant Biochemistry by Hans-Walter Heldt Professor Em (3ed 2004)publisher: Academic ISBN-10: 0120883910 ISBN- 13: 978-0120883912

The Principles of Plant Biochemistry by Murield Wheldale Onslow (1931) Publisher: Cambridge University Press ASIN: BOO2BJMXIM

Plant Physiology and Development-Lincoln Taiz,Edurado Zeiger,Ian M Moller and Angus Murphy

Biochemistry and Molecular Biology of Plants- Bob B Buchanan, Wilhelm Gruissem, Russel L Jones ,

PG20BS311-BC MOLECULAR ENDOCRINOLOGY

Hours / Week: 4 **Credits: 4**

Course Objective

To have an overview of mechanism of action of various hormones and their functions in health and disease

Course Outcomes

CO No.	Upon completion of this course, the students will be able to:	Knowledge Level
1	Outline the various hormones produced by human body	**K1**
2	Describe the different cellular signals and regulation of metabolic activities.	**K2**
3	Explain the mechanism of action of various hormones and discuss different types of hormone receptors	**K2**
4	Discuss the biosynthesis and degradation of hormones	**K2**
5	Analyze the mechanism of hormonal control in various diseases.	**K4**

Knowledge Levels: K1-Remembering; K2-Understanding; K3-Applying; K4-Analyzing; K5-Evaluating; K6-Creating.

UNIT I (10 Hours)

Introduction, History of Endocrinology, Classification of hormones, Overview of circulation, modification and degradation.Target tissue, feed back control.Hormone receptors- general features, structure and regulation. Plasma membrane receptors, Steroid hormone receptors,orphan receptors.

UNIT II (10 Hours)

Hypothalamus and Pituitary hormones- Biochemistry and mechanism of action.Regulation of synthesis and secretion.Hypo and hyper activity of pituitary hormones-gigantism, dwarfism, acromegaly, diabetes insipidus, syndrome of inappropriate ADH secretion.

UNIT III (16 Hours)

Thyroid hormones- synthesis, secretion, transport and mechanism of action.Metabolic fate and biological actions.Antithyroid agents.Thyroid diseases, thyrotoxicosis, goiter, hypothyroidism, Graves' disease, Hashimoto's disease.Thyroid function tests.

Parathyroid Hormone and Calcitonin- Biological actions, regulation of calcium and phosphorus metabolism.Calcitriol.Pathophysiology.

UNIT IV (18 Hours)

Adrenal hormones- Adrenal cortex- glucocorticoids and mineralocorticoids-synthesis, secretion, transport and mechanism of action.Metabolic fate and biological actions.Adrenal androgens- metabolic effect and functions.Adrenal medulla- catecholamines- synthesis, secretion, transport and mechanism of action.Metabolic fate and biological actions. Abnormal secretion of adrenal hormones- Addison's disease, Cushing's syndrome, Congenital adrenal hyperplasia, phaeochromocytoma.

Gonadal hormones- Androgens and estrogens-synthesis, secretion, transport and mechanism of action.Metabolic fate and biological actions. Ovarian cycle, Pregnancy, Biochemical changes in pregnancy,antifertlity agents.

UNIT V (16 Hours)

Pancreatic hormones- Islets of Langerhans and Hormone secretion. Biosynthesis, secretion and mechanism of action.Biological actions.Receptors, intracellular mediators and signaling pathways of insulin and glucagon. Somatostatin, Pancreatic polypeptide and insulin like growth factors.

Gastrointestinal hormones- producing cells, synthesis, structure, secretion and functions, GIP, VIP, gastrin, CCK and other peptides.

Hormones secreted from other organs and tissues like, liver, kidney, heart, thymus and pineal gland

REFERENCES

1. Williams Textbook of Endocrinology Larsen et al,Elsevier
2. Harpers Biochemistry-Murray etal Mc Graw Hill.

3.Lehninger, Principles of Biochemistry David L.Nelson Michael M.Cox, W.H.Freeman.

4. Principles of Biochemistry-Donald J Voet and Judith Voet, John Wiley &Sons Inc

5. Endocrinology-Mac Hadley and Jon E Levin,Pearson

6.Vander's Human Physiology-The mechanism of body function, Widmaier, Raff, Strang. McGraw Hill Newyork.

7.Text book of Medical Physiology.Arthur.C.Guyton and John.E.Hall Elsevier Saunders, Pensylvania

8.Review of Medical Physiology-William F.Ganong,McGraw Hill

PG20SBC312-BC – NEUROBIOLOGY

Elective1

Hours / Week: 3 **Credits: 3**

Course objective

To have an understanding of mechanism of neuronal signaling and basics of neurobiochemistry

Course Outcomes

CO No.	Upon completion of this course, the students will be able to:	Knowledge Level
1	Describe neurons and their functions	**K1**
2	Recognise the role of neurotransmitters in health and disease.	**K2**
3	Illustrate various neurodegenerative diseases	**K2**
4	Discuss different types of learning and memory systems	**K2**

Knowledge Levels: K1-Remembering; K2-Understanding; K3-Applying; K4-Analyzing; K5-Evaluating; K6-Creating.

UNIT I (10 Hours)

Neuron: Neurocellular anatomy, neural membrane, classification of neuron, nerve fibers, axonal transport, neural growth, neuroglia , nervous system, blood brain barrier, cerebrospinal fluid

UNIT II (12 Hours)

Neuronal signaling: Membrane potentials, ion channels, recording neuronal signals, ionic basis of resting potential and action potential, propagation of action potential

UNIT III(14 Hours)

Synaptic transmission: Synapse, Electrical synapse transmission, chemical synaptic transmission, Synaptic transmitter release, synaptic potentials, synaptic delay, synaptic plasticity, molecular mechanism of synaptic transmission, myoneural junction

UNIT IV (6 Hours)

Neurotransmitters: Chemistry, synthesis, storage, release, receptors and function- acetyl choline, catecholamines, serotonin, histamine, glutamate, asparatate, GABA, glycine, neuropeptides, nitric oxide

UNIT V (12 Hours)

Neural processing and neurodegenerative disorders: Learning and memory, Associative and non associative learning and their mechanism, types of memory and their mechanism, , neurodegenerative disorders, Parkinson's disorder, Alzheimer's disorder, Amyotrophic Lateral Sclerosis, Senile Dementia,Diseases associated with signal transmission,Huntington disease,prion disease,Basic aspects of protein folding and its role in development of neurodegenerative diseases.

REFERENCES

1. Basic Neurochemistry. Molecular, Cellular and Medical aspects- George J. Siegel, Bernard W.Agra noff, R. Wayne Albers, Stephen K. Fisher& MichaelD. Uhler, LWW Publishers.

2. Review of Medical Physiology- William F Ganong,McGraw Hill.

3.From Neuron to Brain- John G. Nicholls, A. Robert Martin, Bruce G.Wallance and Paul A. Fuchs, David A Brown,Mathew E Diamond and David A Weisblat, Sinaur Associates.

4. lon channels. Molecules in Action-David J. Aidley and Peter R. Stanfield, Cambridge University Press

5. Neurobiology Molecules, Cells and System- Gary G. Matthews, Wiley Blackwell.

6 The Neurobiology of Memory, Concepts, Findings, Trends- YadinDudai,Oxford University Press

7.The physiology of Excitable Cells- David J Aidley, Cambridge University Press.

8.Fundamental Neuroscience- Larry Squire Darwin Berg Floyd E. Bloom Sascha du Lac Anirvan Ghosh Nicholas C. Spitzer, Elsevier

PG20SBC313-BC – BIOCHEMICAL TOXICOLOGY
Elective1

Hours/Week 3 **Credits 3**

Course Outcomes

CO No.	Upon completion of this course, the students will be able to:	Knowledge Level
1	Describethe basic concepts in toxicology and the mechanisms of drug interaction	**K1**
2	Explain the methods of toxicity studies, symptoms and treatment during poisoning	**K2**

Knowledge Levels: K1-Remembering; K2-Understanding; K3-Applying; K4-Analyzing; K5-Evaluating; K6-Creating.

UNIT I

Fundamentals of Toxicology: Dose-Response Relationships, Toxicity interactions-synergism, antagonism etc. Biomarkers, Dose Response; Measurement of Dose-Response; Relationships Linear Dose Response Hormesis; Hazard and Risk Assessment Duration and Frequency of Exposure and Effects, Acute & Chronic exposures ,ED50 & LD50.

UNIT II

Factors Affecting Toxic Responses: Disposition, Absorption ,Sites of absorption, (description about each site included), distribution, Excretion; Pharmacodynamics, Biotransformation & Metabolism: types of Metabolic change phase I reactions; Phase 2 reactions, Enzymes & proteins involved in metabolism. Toxication vs. Detoxication.

UNIT III

Toxicity testing: Test protocol, Genetic toxicity testing & Mutagenesis assay: *In vitro* test systems: bacterial mutation tests-Reversion test, Ames test, Fluctuation test, and Eukaryotic mutation test. *In vivo* test system Mammalian mutation test-Host mediated assay and Dominant Lethal test. Biochemical basis of toxicity: Mechanism of toxicity: Disturbance of excitable membrane function, Altered Calcium homeostasis, Covalent binding to cellular macromolecules.

UNIT IV

Developmental Toxicology: Teratogenesis, Immunotoxicity, Genetic Toxicity; Chemical Carcinogenesis. Metal Toxicity, Food Toxicology & Food allergies -toxicity of food additives, bacterial toxins, toxins in seafood etc. Environmental Toxicology-air pollution & occupational hazards.

UNIT V

Tissue specific toxicity: kidney Damage, Lung Damage, Liver damage, Cardiac damage; Neurotoxicity; Exaggerated and Unwanted pharmacological effects; Toxic effects of pesticides; effects on ecosystem & health. Multi-Organ Toxicity.

REFERENCES

1. Principles of Toxicology by: Karen E Stine, Thomas M Brown. Crc Press

2. Principles of Biochemical Toxicology by John A. Timbrell, Informa Healthcare

3. Environmental Toxicology by Sigmund F. Zakrzewski, Oxford University Press, USA

4. Casarett & Doull's Toxicology, The Basic Science of Poisons-Curtis .D.Klassen-7th Edition -Mc Graw Hill Medical Publishing Division.

5. Basic Environmental Toxicology by Lorris .G.Cockerham and Barbara S Shane CRC Press Inc.

PG20SBC314-BC PHARMACOLOGICAL BIOCHEMISTRY
(Elective 1)

Hours/Week-03 **Credits-03**

Course Outcomes

CO No.	Upon completion of this course, the students will be able to:	Knowledge Level
1	Describe the scope of pharmacology and the route of administration of drugs: the principles of drug absorption, distribution, metabolism and excretion.	**K2**
2	Explain the pharmacokinetics of drugs with the molecular mechanisms of drug action including drug receptor interactions. methods of toxicity studies, symptoms and treatment during poisoning	**K2**
3	Describe drug designing and development	**K2**
Knowledge Levels: K1-Remembering; K2-Understanding; K3-Applying; K4-Analyzing; K5-Evaluating; K6-Creating.		

UNIT 1

Introduction to pharmacology: Sources of drugs, dosage forms & routes of administration, Mechanism of drug action, synergistic effect of drugs, factors modifying drug action, Drug tolerance & dependence. Therapeutic drug monitoring. Adverse responses and side effects of drugs: allergy, Drug intolerance, Drug addiction, drug abuse and their biological effects.

UNIT II

Classification of drugs based on sources: mode of administration, site of action, andabsorption of drugs, Drugs distribution, Drug metabolism: chemical pathways of drug metabolism, Phase I and Phase II reactions, role of cytochrome P450, drug metabolizing enzymes,Drug elimination: Role of kidney in elimination.

UNIT III

Molecular basis of drug action: a) Receptor: Drug Receptor Interaction: Basic ligand concept, agonist, antagonist, partial agonist, inverse agonist, receptor theories - Occupancy, Rate & Activation Theories, receptor Binding Assays, Dose response curve: LD50, ED50

b) Enzyme Inhibition: enzyme Inhibitors as drugs – Angiotensin converting enzyme, Lipoxygenase, Cycloxygenase, Aromatase, Xanthine oxidase, DNA Polymerase Inhibitors, HIV - Protease / Reverse Transcriptase, Integrase and Cytochrome P-450 Inhibitors.

c) Drugs binding to nucleic acids -- Antimalarial, anti-cancer, antiviral.

UNIT IV

Chemotherapy: General Principles of Chemotherapy, Chemotherapy of Cancer Mode of action, uses, structure-activity relationship of the following classes of drugs:Androgens and Anabolic steroids – Testosterone, Stanazolol; Estrogens and Progestational agents – Progesterone, Estradiol; Adrenocorticoids – Prednisolone, Dexamethasone, Betamethasone; Antibiotics-Penicillins, streptomycin, tetracyclines, Cephalosporins.

UNIT V

Drug development: Phases of drug development, Molecular modification of lead compounds, pharmacophore modelling,Computer aided drug design: Ligand based and Structure basedmethods,QSAR, Prodrugs and soft drugs. General overview of Immunopharmacology and Pharmacogenomics.

REFERENCES

1. Organic Pharmaceutical Chemistry by Harkishan Singh, Kapoor Vk ublisher:
Vallabh Publications/Prakashan
2. Organic Chemistry Vol-1 Finar I, Dorling Kindersley, India.
(India) Pvt Ltd
3. Principles of Organic Medicinal Chemistry by Rama Rao Nadendla New
Age International (p) Limited
4. Basic & Clinical Pharmacology by Bertram G. Katzung Mcgraw-hill
5. Essential of Medical Pharmacology by Tripathi K.D Jaypee Brothers
6. Of Experimental Pharmacology - Kulkarni Vallabh Publications
7. .Drug design :Structure and Ligand Based Approches KM MerzJr, D Ringe, CH Reynolds, Cambridge university press
8. Computer aided drug design and delivery systems Ahindra Nag and Baishakhidey McGraw-Hill.

PG20BSP3-BC - LABORATORY COURSE - III

Hours / Week: 10 **Credits: 4**

1.Isolation of proteins from plant or animal sources.

Purifcation of protein using ion exchange chromatography, gel filtration chromatography,ammonium sulphate precipitation, dialysis

2.Estimation of lipids from plant or animal sources.

Cholesterol by Zaks method,
Triglycerides by Van Handel and Zilversmit method
Phospholipids by Zilversmit and Davis
Seperation of lipids by TLC

3.Determination of enzymatic activity in biological tissues- serum, plasma, liver, plant extracts, etc(Any five)

Alanine transaminase (GPT)
Aspartate transaminase(GOT)
Lactate dehydrogenase
β hexosaminidase
Amylase
Trypsin
Urease

4 Enzyme kinetics (Any four)

Effect of substrate concentration on enzymatic activity
Effect of pH on enzymatic activity
Effect of enzyme concentration on enzymatic activity
Effect of temperature on velocity of enzyme catalysed reaction
Determination of Q 10
Effect of activators on velocity of enzyme catalysed reaction
Determination of type of inhibition using Lineweaver Burk plot-.

5.Extraction of enzymes and assay (Any Three)

1 Acid phosphatase from fresh potato (Solonumtuberosum)

2. β amylase from sweet potato (Ipomoeabatates)

3 Urease from Jackbean (Canavalia ensiformis)

4 Phytase from seeds

5. Polyphenol oxidase

6 Peroxidase

7 Phenyl alanine ammonia lyase

6.Extraction, Isolation and analysis of phytopharmaceuticals; (Any Two)HPLC

1. Different extraction protocols:- Infusion ,Decoction, Maceration, Soxhlet- extraction.

2. Extraction of High molecular weight carbohydrates

3. Extraction of total alkaloids

4. Estimation of total phenols.

5. Estimation of Flavanols.

REFERENCES

1. Introductory Practical Biochemistry SK Sawhnefy and Randhir Singh (eds) Narosa publishing House, New Delhi, ISBN 81-7319-302-9 P, 195-303

2. Standard Methods of Biochemical Analysis, S.K. Thimmaiah (ed), Kalayani Publishers, Ludhiana ISBN 81-7663-067-5, p 12-18.

3. Hawk's physiological Chemistry, Bernad L. Oscer (ed) TATA MC GRAW Hill publishing Company Ltd, New Delhi.

4. Experimental Biochemistry: A student Companion Beedu Sasidhar Rao & Vijay Deshpande (ed), I.K International Pvt Ltd, New Delhi ISBN 81-88237- 41-8.

5. Practical Biochemistry, R.C Gupta and S. Bharghava (eds) CBS Publishers and Distributors, New Delhi, ISBN/81-239-0124-0

6. Practical Clinical Chemistry, Harold Varley, CBS Publishers and Distributors, New Delhi.

7. Enzymes Assays, Jeans-Louis Reymond (ed) Wiley- Vch Publishers, Germany, ISBN-13; 978-3-527-31095-1ISBN-10: 978-3-527-31095-9

SYLLABUS

Fourth Semester M.Sc. Biochemistry

PG20BS413-BC	Clinical Biochemistry	Core Course
PG20BS414-BC	Environmental Science	Elective-2
PG20BS415-BC	Plant and Animal Cell culture	Elective -3
PG20BS416-BC	Research Methodology,IPR and Bioethics	Elective
PG20BS417-BC	Genomics and Proteomics	Elective
PG20BS418-BC	Nanobiology	Elective
PG20BS419-BC	Nutritional Biochemistry	Elective
PG20BSP4-BC	Laboratory course IV	Core course

PG20BS413-BC – Clinical Biochemistry

Hours / Week: 5 **Credit 4**

Course objective: To have an understanding of causes, diagnosis and treatment of various metabolic disorders

Course Outcomes

CO No.	Upon completion of this course, the students will be able to:	Knowledge Level
1	Describe various inborn errors of metabolism	**K2**
2	Illustrate the importance of quality control in clinical laboratories.	**K2**
3	Analyse,and interpret the common result patterns in routine clinical biochemistry.	**K4**
4	Discuss the various molecular markers in the diagnosis of diseases	**K2**

Knowledge Levels: K1-Remembering; K2-Understanding; K3-Applying; K4-Analyzing; K5-Evaluating; K6-Creating.

UNIT I (12 Hours)

Quality control;.Precision, reliability, reproducibility and other factors in quality control. Pre-analytical, analytical post analytical variables in quality analysis . Specimen collection and processing (blood, urine and feaces); Storage of specimens; Automation in clinical biochemistry:- classification of auto analysers-single channel and multi-channel analysers, working principles of continuous flow and discrete analysers

UNIT II (12 Hours)

Kidney, liver and gastric function tests-Renal function tests,osmolarity and free water clearances, acute and chronic renal failure,Liver function tests : clinical features and test based on excretory functions, metabolic capacity of liver, synthetic functions of liver, serum enzymes.Gastric function tests: collection of gastric contents, examination of gastric residium, FTM, stimulation tests, tubeless gastric analysis.

UNIT III (18 Hours)

Disorders of metabolism : Carbohydrate metabolism: Diabetes mellitus, insulin receptors and C-peptide, assay of insulin, proinsulin and insulin antibodies. Hemoglobin AIC, fructosamines, insulin tolerance test, Glycogen storage diseases, galactosemia ,fructosuria, pentosuria; Plasma lipids and lipoprotein abnormalities: hypercholesterolemia- lipidosis and

hypolipoproteinemias, Taysachs and Niemann Picks diseases ,atherosclerosis, coronary heart disease, and fatty liver. Disorders of nucleic acid metabolism-hypo and hyperuricemia, gout; Disorders of erythrocyte metabolism- hemoglobinopathies, thalassemias and anemias,hemophilia. porphyrias Treatment ;gene therapy

UNIT IV (14 Hours)

Inherited disorders of metabolism and its treatment: Newborn screening: PKU, tyrosinemia, aminoacidurias, organic acidurias,. Biochemical monitoring of therapy; prenatal diagnosis of inborn errors of metabolism, amniotic fluid and fetal blood examination; Acetylcholinesterase and other tests on amniotic fluid; chromosomal abnormalities by cytogenetics

UNIT V (16 Hours)

Molecular diagnosis of genetic and infectitious diseases: Diagnosis of genetic diseases by molecular biology techniques (cystic fibrosis,Hemachromatosis, thalassemias, sickle cell diseases,HIV,malaria,tuberculosis) DNA probes; restriction fragment length polymorphism (RFLP); polymerase chain reaction (PCR); amplification of mRNA. AIDS,Clinical diagnosis. Oncogenic enzymology: acid phosphatase, alkaline phosphatase, lactate dehydrogenase. Body fluid constituents of use in oncology

REFERENCES

1.Notes on Clinical Biochemistry by John K. Candlish (1992) publisher: World Scientific Publishing Company ISBN: 9810210663 ISBN-13: 9789810210663, 978-9810210663

2.Clinical Biochemistry: Metabolic And Clinical Aspects by William J. Marshall, Stephan K. Bangert, Elizabeth S.M. Ed. S.M (ed) Marshall (2008) Publisher: Elsevier Science Health Science Div ISBN: 0443101868 ISBN-13: 9780443101861, 978-0443101861

3.Biochemistry by John K. Joseph (2006) Publisher: Campus Books International ISBN: 8180301109 ISBN -13: 9788180301100, 978-8180301100

4.Basic Medical Biochemistry: A Clinical Approach by Dawn B PH.D. Marks, Allam D. Marks colleen M. Smith (1996) Publisher; Lippincott Williams & Wilkins; illustrated edition ISBN -10: 068305595X ISBN-13: 978-0683055955

5.Clinical Chemistry, 6/e William J Marshall, Stephen K Bangert(2008) Publisher: Elsevier ISBN: 0723434603, ISBN-13:978-0723434603

6.Tietz Fundamental of Clinical Chemistry, 6/e by Carl A Burits, Edward R Ashwood (2008) publisher: Else ISBN: 8131213749, ISBN-13: 9788131213742,978-8131213742

PG20BS414-BC – ENVIRONMENTAL SCIENCES

Hours / Week: 5 **Credits: 3**

Course objective: To have an understanding of basic concept of environment and importance of biodiversity

Course Outcomes

CO No.	Upon completion of this course, the students will be able to:	Knowledge Level
1	Describe the ecological homeostasis	**K2**
2	Analyse and examine current threats to the environment by pollution and the technological solutions leading to sustainable environment	**K4**
3	Recognise environmental policies .	**K2**
Knowledge Levels: K1-Remembering; K2-Understanding; K3-Applying; K4-Analyzing; K5-Evaluating; K6-Creating.		

UNIT 1(16 Hours)

Basic Concepts Of Ecology and Environment: Atmosphere; Hydrosphere; Lithosphere- Principles and Concepts of ecosystem- Structure of ecosystem- cybernetics and Homeostasis- Energy transfer in an ecosystem-Food chain. Food web-Ecological efficiencies- Trophic structure and energy pyramids- Principles Pertaining to limiting factors; Biogeochemical cycles(N, C, P cycles)

Biodiversity: Types of diversity; Genetic diversity,Species diversity and Ecosystem diversity-Morphological and molecular characterization of biodiversity-Molecular taxonomy –Methods of biodiversity conservation- Gene banks; Cryopreservation-Assessing, analyzing and documenting biodiversity – Vulnerability and extinction of biodiversity- Introduction to biodiversity database: endangered animals, endemism and Red data books- Global biodiversity information system.

UNIT II (14 Hours)

Chemistry of Environment: Properties of water- water quality parameters- pH, Dissolved Oxygen (DO),Chemical Oxygen demand (COD); Biological Oxygen demand(BOD);

Atmospheric toxicants- CO, NO2, CO2, SO2-; Toxic heavy metals- Radionuclides - Sampling of air and water pollutants-Monitoring techniques and methodology; Chemistry of soil: Constituents and properties of soils; Chemical factors affecting the soil quality; Adsorption of contaminants in soil.

Organic chemicals in the environment; Aliphatic/aromatic hydrocarbons (hydrocarbon decay, environmental effects); Soaps and surfactants (cationic, anionic and nonionic detergents, modified detergents); Pesticide residue – classification, degradation, analysis, pollution due to pesticides; phenols and petrochemicals,Industrial pollutants and their health effects

UNIT III (16 Hours)

Treatment Technologies for Polluted Environment: Biosensors- types and applications in environmental pollution detection and monitoring, Traditional Biological treatment: stabilization pond, aerated lagoon, activated sludge process trickling filter anaerobic treatment.

Environment-friendly use of microbes (bacteria and fungi) in biodegradation and Biotransformation: Bioremediation In situ and Ex situ bioremediation; Constrains and priorities of bioremediation; Evaluating Bioremediation; Bioremediation of VOCs; Biodegradation- Factors affecting process of biodegradation; Methods in determining biodegradability. Microbial transformation; Accumulation and concenteration of metals; Biosorption- Oil field microbiology; Improved oil recovery; Biotechnology and oil spills- Use of plants in biodegradation and environment cleaning- phytoremediation. Xenobiotics; Persistence and biomagnifications of Xenobiotic molecules; Microbial interactions with xenobiotics; Phase I and Phase II reactions; Cyt P 450 mediated reactions- Terratogens and Carcinogens: Assesment of toxicity; Assessment of environmental risks.

UNIT IV (12 Hours)

Technology for Sustainable Agriculture: GM Crops and their impact on environment;Biological nitrogen fixation; Phosphate solubilization; Biofertilizers; Biological control of insect pests; Role of biopesticides/ insecticides; Biocontrol of plant pathogens; Integrated pest management-practical implementation

UNIT V (12 Hours)

Technology for Resource Management and Environment Policies: Role of biotechnology in management of resources- Reclamation of wasteland: Biomass production: Biogas and

biofuel production ; Development of environment-friendly processes such as integrated waste management, Renewable energy sources ;solar energy. Constitutional provisions for Environmental Protection, National Environmental Legislation related to water, air, mining. National Legislation on Forest, Wildlife.

REFERENCES:

1.Fundamentals of Ecology- E.P Odum

2.Applied and Environmental microbiology- Amann, R.I. Stromely .J. Stahl

3.Environmental chemistry, B.K.Sharma

4.Chemicals in the environment, Y. Mido& M. Satake

5.Text book of Environmental Chemistry-O.D. Tyagi and M.Mehra.

6.Biotechnology: A textbook of Industrial Microbiology, Crueger and Crueger

7.Environmental, Biotechnology: Principals and Applications, 2nd Edition –Brace Rittman, Perry L. Mc Carty.

8.Biodegration and Bioremediation, 2nd Edition –Martin Alexander.

9.An Introduction to Environmental Biotechnology-Milton Wainwright.

10. Physiology and Biochemistry of metal Toxicity and tolerance in plants-M.N.V. Prasad Kazimierz strzalka,

11.Environmental Laws in India-Pares Distn.

PG20BS415-BC – PLANT AND ANIMAL TISSUE CULTURE

Hours / Week: 5 **Credits: 3**

Course objective: To have an understanding of basics of plant and Animal Cell culture and its applications

Course Outcomes

CO No.	Upon completion of this course, the students will be able to:	Knowledge Level
1	Describe the basics of Plant and animal cell culture	**K2**
2	Describe the sources, selection, potential and challenges of using stem cells for tissue engineering.	**K2**
3	Identify the key challenges in gene editing technology	**K2**
4	Demonstrate different techniques to produce novel and hybrid plants	**K3**
Knowledge Levels: K1-Remembering; K2-Understanding; K3-Applying; K4-Analyzing; K5-Evaluating; K6-Creating.		

UNIT I (12 Hours)

Animal Cell Culture : Historical Background, Importance and progress in Animal Cell Culture Technology, Laboratory setup and equipments, aseptic technique, different cell culture media and supplements, Importance of Serum and Serum Free Media, preparation and sterilization of cell culture media and supplements

UNIT II (14 Hours)

Different tissue culture techniques; Disaggregation of tissue and primary culture; Types of primary culture; Chicken embryo fibroblast culture; Chicken liver and kidney culture; Secondary culture; Trypsinization; Cell separation ; Continuous cell lines; Passaging number; Anchorage and Anchorage independent cells and cultures; Suspension culture; Organ culture and Histotypic cultures: tissue specific stem cells; embryonic hematopoietic and neural stem cells, classification and sources,uses.

UNIT III (14 Hours)

Conventional plant breeding, tissue culture as a technique to produce novel plants and hybrids, tissue culture media , initiation and maintenance of callus and suspension cultures, single cell clones . Organogenesis, somatic embryogenesis. Transfer and establishment of whole plants in

soil. Shoot tip culture, rapid clonal propagation and production of virus free plants, embryo culture and embryo rescue.

UNIT IV (16 Hours)

Protoplast isolation, culture and fusion; Selection of hybrid cells and regeneration of hybrid plants; Symmetric and asymmetric hybrids, cybrids, anther, pollen and ovary culture for production of haploid plants and homozygouslines. Somaclonal variation.In vitro mutation-sexual incompatibility and male sterility .

UNIT V (16 Hours)

Cell culture reactors; Scale up in suspension and in monolayers with an example each.Gene editing, gene knock out,applications in cell culture. 3 D cell culture,biomaterial and cells used,applications.

REFERENCES

1. Freshney,Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications , Wiley Blackwell
2. Ed. John R.W Masters Animal cell culture-Practical approach 3rd edition, Oxford university press.
3. R. Sasidhara, Animal Biotechnology MJP publishers-Chennai.
4. Plant biotechnology-J Hammond, et.al; Springer Verlag.
5. Biotechnology in crop improvement –H S Chawla.
6. Practical application of plant molecular biology-R J Henry, Chapman and Hall.
7. An introduction to plant tissue culture-M K Razdan, Oxford &IBH
8. Cell culture and somatic cell genetics of plants (Vols.1to3)-A K Vasil, Academic Press.
9. Principles of plant biotechnology: An introduction to genetic engineering in plants SH Mantell, Blackwell Scientific Publications.
10. Advances in biochemical engineering/ Biotechnology-Anderson, et.al, Springer.
11. Plant cell and tissue culture-S Narayanswamy, Tata McGraw Hill Education India

PG20BS416-BC
RESEARCH METHODOLOGY, IPR AND BIOETHICS
(Elective 2)

Hours/Week 5 **Credit 3**

Course Outcome:

 Be familiar with the different types and methods of research and how to present scientific data.

 Be aware of legal rights of intellectual activity in the industrial, scientific, literary and artistic fields.

 To realise the problems and ethical issues related to Bioscience research.

UNIT -I

Research Methodology: Definition, objectives and motivation in research. Research methods *vs* Methodology. Various types of research, multidisciplinary research, methods of research. Research problem. Goals of Research – Characteristics and purpose of research, essential qualities of a researcher. Criteria of Good Research. Difference between hypothesis, theory and scientific law.

UNIT -II

Data and Methods of Data Collection: primary data, secondary data. Methods of data collection-observation method, interview, questionnaire, schedules etc., selection of appropriate method of data collection, limitations and precautions in data collections. Steps in doing research, Review of literature, primary and secondary sources, Research process: formulation of research problem, hypothesis, research design, data collection, analysis and interpretation etc. National institutions useful in search of literature –NISCAIR-Library resourses, searching of web resources- electronic databases-critical review of literature.

UNIT –III

Scientific Writing and Presentation of Scientific Data. Guidelines for scientific writing - Article, Essay, Research Paper, Research Project, Thesis or Dissertation, Book, Reviews, Research proposals, Research reports. Presentation of tables and figures. Peer review and manuscript submission. Presentation tool, oral and poster presentation. Microsoft power point and pdf slides, open office or similar tool.

UNIT IV

Intellectual Property Rights (IPR): Introduction and the need for intellectual property right (IPR), IPR in India and abroad, IPR infringement. Patent system: Objectives, basic principles and general requirements of patent law, Criteria for patentability and non-patentable inventions.

Procedure for registration, term of patent, rights of patentee. Patent document, granting of patent, rights of a patent. Patentable subjects and protection in biotechnology, International convention for the protection of new varieties, Strasbourg convention, UPOV Convention. Patent office practice, trade secrets, harmonization of patent law. Copyrights and trademark-meaning and scope.

The patentability of microorganisms-claims, Characterization and repeatability disposition in the culture collections, legal protection for plants and other higher organisms, new plant varieties by rights, tissue culture protocols, transfer of technology, patentability of inanimate products of nature vectors, FDA, FPA, Patent office practice, trade secrets, copy right infringement problems, harmonization of patent law. IPR and plant genetic resources

UNIT V

Ethics in Research: Research output- Honesty and integrity of a good researcher. Proper interpretation of results and proper scientific presentation. Bioethics: Bioethical issues- bio-safety environmental impacts, ecological ethics, Ethics related to research on human subjects and animal samples. Plagiarism, fabrication and falsification. Software to check plagiarism in publications.

REFERENCES

1. Brody, B.A. The Ethics of Biomedical Research: An International Perspective. Oxford University Press: NY. 1998.

2. Hart, L.A. (Ed.) Responsible Conduct with Animals in Research. Oxford University Press: NY. 1998.

3. Kothari C.R., Research Methodology: Methods and Techniques. New Age International, 2004.

4. Paul D. Leedy, Jeanne Ellis Ormrod, Practical Research: Planning and Design. Prentice Hall Publications. 2004.

5. Panneerselvam R Research Methodology, Prentice Hall of India, New Delhi.2001

6. Jerrord HZ Biostatistical analysis (5th edition), Prentice Hall International, London. 2014.

7. Imre Lakatos, Falsification and the Methodology of Scientific Research Programme. In Imre Lakatos and Alan Musgrave (eds), Criticism and the Growth of Knowledge, Cambridge University Press. 1970.

8. Booth W C, Colomb G G, and Williams J M. The Craft of Research (2nd edition), Chicago University Press. 2003.

9. Marshall C and Rossman GB. Designing Qualitative Research. Sage Publications, London. 1989.

10. Montgomery, Douglas C. Design and Analysis of Experiments (9th edition), Wiley India. 2017

11. Carlos CM. Intellectual Property Rights, the WTO and Developing countries; The TRIPS agreement and policy options, Zed Books, New York. 2000.

12. Day RA, How to write and publish a scientific paper (4th edition), Cambridge University Press, London. 1995.

13. Golafshani N, Understanding reliability and validity in qualitative research. The Qualitative Report, 8(4) 597-607. 2003

14. Leedy PD and Ormrod JE, Practical Research: Planning and design (11th edition), Prentice Hall India, New Delhi. 2016.

Graziano AM, Raulin ML.. Research Methods: A process of Inquiry (8th edition), Allyn

PG20BS417-BC GENOMICS and PROTEOMICS

(Elective 2)

Hours/Week-5 **Credits-3**

Course outcome

 To get an overview of genome variation in population and technologies to detect these variations.

 Understand how High-throughput DNA sequencing (HTS) can be used to identify disease causing genetic variants in monogenic diseases.

 Understand the application of various Omics technologies in disease diagnosis.

 Understand the importance of bioinformatics tools in proteomics and genomic studies.

UNITI

Overview: Genomes of Bacteria, Archaea, and Eucarya; Genome and topology; chromatin, supercoiling and packaging; Genome Organization (intron, exon, promoter, intergenic region, ORF; Genome Sequencing: Maxum-Gilbert Method, Sanger Methods, Pyro-sequencing. Next Generation sequencing methods (NGS).

UNIT II

Study of genomes- Mapping; Genetic and Physical mapping, Single Nucleotide Polymorphism and RFLP's. The nature of SNPs, mining of SNPs, distribution of SNPs, Applications of SNP technology; Role of SNPs in Pharmacogenomics. Metagenomics; The Human Genome Project, Ethical issues in human Genome Research

UNIT III

Gene finding and annotation: Sequence annotation and bioinformatics tools for genomics and genome comparison; analyzing gene expression-DNA microarray-design, analysis and visualization of data. Types of microarray - expression arrays, protein arrays, Comparative Genomic Hybridization (CGH) arrays, Resequencing arrays. Applications of Microarray technology

UNIT IV

Overview of protein structure: Primary, secondary, tertiary and quarternary structure; Protein structure and function-; two dimensional gel electrophoresis, mass spectrometry - ESI, Chemical Ionisation, Hybrid MS. Prediction of protein secondary structure: Chou-fasman/GOR method, Nearest Neighbour method, Homology modeling, Active site mapping and prediction.

UNIT V

Post translational Modifications: Quantitative proteomics, clinical proteomics and disease biomarkers, mass spectral tissue imaging and profiling; Protein-protein interactions: Surfaceomes and Secretomes, Solid phase ELISA, pull-down assays (using GST-tagged protein) tandem affinity purification, far western analysis, by surface plasmon resonance technique; Protein microarray.

References

1. Brown TA *Genomes*, Garland Science
2. Mount David W. Bioinformatics Sequence and Genome Analysis. Cold Spring Harbor Lab Press, CSH New York.
3. Stephen Misener and S. A. Krawetz. Bioinformatics Methods and Protocols. Humana Press.
4. Rastogi, S.C, N. Mendiratta, P. Rastogi. Bioinformatics Methods and Applications. Prentice Hall of India.
5. Campbell AM and Heyer LJ *Discovering Genomics, Proteomics and Bioinformatics.* Benjamin Cummings.
6. Primrose S and Twyman R *Principles of Gene Manipulation and Genomics*, 7th Edition, Blackwell.
7. Rehm H *Protein Biochemistry and Proteomics*, 4th Edition, Academic Press.
8. Twyman RM. *Principles of Proteomics*, Second Edition by Garland Science Taylor & Francis Group New York and London.
9. Liebler DC *Introduction to Proteomics: Tools for the New Biology*, Humana Press, Totowa NJ. USA.
10. Griffiths WJ, *Metabolomics, Metabonomics and Metabolite Profiling*, The Royal Society of Chemistry UK. PROGRAM

PG20BS418BC-NANOBIOLOGY

Hours/Week-5 **Credits-3**

Course Outcome

 Analyse cutting edge concepts and technologies that are emerging by using nanotechnology in the field of Biology

 Discuss different tools and techniques that are being used in the field, and where these technologies are heading to.

 Understand about the applications of nanobiology in the emerging areas such as Nano-medicine, Bio-mimicry to create Nano-materials, and Nano-biotechnology

 Gain an insight into the ethical issues that are associated with the study of nanoscience, its role in law and policy making.

UNIT I

Introduction to nanomaterials: Dimension of nanomaterials, Top-down and Bottom-up approach, Nano-Biomimicry and applications, Synthesis of nanomaterials by physical and chemical methods, Nucleation and growth, Synthesis of nanomaterials by biological methods, Mechanism of synthesis, Characterisation of nanoparticles, UV-Visible Spectroscopy Dynamic Light scattering (DLS), Electron microscopy (TEM & SM), Atomic force microscopy (AFM),

UNIT II

DNA nanotechnology: Self-assembly, DNA origami, Application of DNA nanotechnology Drawbacks of DNA origami, Protein & glyco nanotechnology and applications, Bio-nanomachines, Carbon nanotube, Functionalization of carbon nanotubes, Application of CNT.

UNIT III

Nanomaterials for diagnosis and therapy: Nanomaterials for cancer diagnosis, Nanomaterials for cancer therapy, Nanotechnology in tissue engineering- Nanofibrous scaffolds - relevance and role in vascular, neural and cardiac tissue engineering, nanocomposites and applications in tissue engineering, Nano artificial cells, Nanotechnology in organ printing.

UNIT IV

Nanopharmacology & drug targeting: Nano-Biosensors, Cellular uptake mechanisms of nanomaterials, development of nanostructures for drug delivery applications - polymeric

nanoparticles - nanofibres- dendrimers -liposome and lipid nanoparticles - nanotubes and fullerenes – nanogels - nanocrystals – protein nanoparticles.

UNIT V

Nanotoxicology: Physiological and biochemical effects, Modes of exposure, effect of environmental exposure, effects on human health, blood-brain barrier effects, ethical issues related to nanoparticles, Methodology for toxicity studies of nanoparticles.

Reference :

1. Poole Jr, C. P., & Owens, F. J. *Introduction to nanotechnology*. John Wiley & Sons.

2. Malsch, N. H. (Ed.). *Biomedical nanotechnology*. Crc Press.

3. Bhushan, B. (Ed.) *Springer handbook of nanotechnology*. Springer.

4.

5. Greco, R. S., Prinz, F. B., & Smith, R. L. (Eds.) *Nanoscale technology in biological systems*. CRC press.

6. Wolf, E. L. *Nanophysics and nanotechnology: an introduction to modern concepts in nanoscience*. John Wiley & Sons.

7. Cancer Nanotechnology, eds. H. S. Nalwa and Thomas Webster, American Scientific Publishers.

8. Introduction to Nanotechnology, Charles P. Poole, Jr., Frank J. Owens; John Wiley & Sons.

9. L.E.Foster, Nanotechnology-Science, Innovation and opportunity, Pearson eduction inc,.

10. Bionanotechnology: Lessons from Nature Author: David S. Goodsell Wiley- Liss

PG20BS419-BC –Nutritional Biochemistry

Hours/Week 5 **Credits 3**

Course outcome :

 Understand the concept of 'nutrition' and the important nutrients.

 Describe the causes symptoms and management of lifestyle diseases.

UNIT 1

An overview of nutrition & Dietetics: Introduction to nutrients, nutrition assessment, diet & health, planning a healthy diet, digestion, functions, absorption & transport of nutrients.
The carbohydrates – sugars, starch, & fibre, Alternatives to sugars
Lipids- Triglycerides, phospholipids & sterols-its role in diet &nutrition
Health effects of protein, Protein energy malnutrition
Recommended intake of carbohydrates, lipids & proteins

UNIT II

Energy balance and weight management: Energy balance and body composition, Energy values of carbohydrates , protein and fats, Body weight and health - weight management, overweight, obesity and underweight, nutritional treatment for obesity.
Nutritional importance of vitamins, Major minerals and trace minerals, Role of calcium, iron and zinc in the body, consequences of calcium deficiency, osteoporosis, consequences of iron and zinc deficiency and toxicity.
Functional foods.

UNIT III

Life cycle nutrition: Nutrition during pregnancy and lactation. Fetal alcoholic syndrome,factors incompatible with pregnancy, Nutrition in childhood, adulthood and later years. Nutritional intervention, Medical nutrition therapy, Regular hospital diets, enteral and parenteral nutrition.

UNIT IV

Nutrition for disorders I: Nutrition for GI tract disorders, stress nutrition, Medical nutrition therapy for diabetes mellitus. Diet in cardiovascular diseases - atherosclerosis, coronary heart diseases and hypertension.

UNIT V

Nutrition for disorders II: Nutrition and renal disorders - kidney stones, nephrotic syndrome, renal failure. Nutrition during kidney transplant, dialysis. Nutrition and liver disorders - fatty liver, hepatitis, cirrhosis and gall stones. Nutrition for Cancer and HIV infection.

REFERENCES

1. Understanding normal and Clinical nutrition, Sharon Rady Rolfes, Kathryn Pinna &Ellie Whitney, Cataldo, Cengage Learning, Stanford.
2. Nutritional Biochemistry- Tom Brody, Elsevier.
3. A text Book of Medical Biochemistry- M.N Chatterje and R. Shindea, Jaypee publishers.
4. Harpers Illustrated Biochemistry- R.K murray, D.K Garnnes. and V.V Rodwell, McGraw Hill.
5. Medical Physiology- A.C. Guyton and J.E Hall, Saunders publishers.
6. Human Physiology. C.C. Chatterjee, C B S Publishers and Distributors.
7. Nutritional Biochemistry- Swaminathan M, Ganesh & Co., Madras
8. Normal and Therapeutic nutrition CH Robinson, Wads worth Publishing Co Inc

PG20BSP4-BC - LABORATORY COURSE - IV

Hours / Week: 10 **Credits: 5**

Clinical Biochemistry Experiments

1. Liver function tests

Estimation of total proteins in serum

Estimation of serum albumin by BCG method

Estimation of albumin – globulin ratio in Serum

Estimation of serum bilirubin

Assay of SGOT& SGPT-DNPH method

Assay of alkaline phosphatase-King &Amstrong method, Acid phosphatase

2. Renal Function tests

Estimation of blood urea by diacetyl monoxime method

Urea clearance test

Estimation of creatinine by Jaff ‘s method

Creatinine clearance test

Estimation of uric acid-caraway method

Estimation of plasma bicarbonate

3. Glucose tolerance test
4. Estimation of glucose by glucose strip
5. Analysis of normal and abnormal urine.
6. Check the reliability of various methods using Levy Jenning plot

ENVIRONMENTAL SCIENCE

Field study

- Analysis of water quality parameters: pH,,BOD,COD,MPN
- Analysis of soil parameters: Analysis of heavy metals

Plant and Animal cell culture

Isolation, preparation, sterilization and inoculation of different explants shoot tip, ,anther,embryo

REFFERENCES

1. Introductory Practical biochemistry, S.K sawhney&Randhir Singh (eds) Narosa Publishing House, New Delhi, ISBN 81-7319-302-9, p 195-303
2. Standard Methods of Biochemical Analysis, S.K Thimmaiah (ed), Kalayani Publishers, Ludhiana ISBN 81-7663-067-5,p12-18
3. Experimental Biochemistry: A Student companion, BeeduSasidharRao& Vijay Deshpande (ed), I.K International Pvt. LTD, New Delhi ISBN 81-88237-41-8, p 13-17, p 49-72
4. Practical Biochemistry, R.C Gupta &Bhargava (eds) CBS Publishers and distributors, New Delhi, ISBN 81-239-0124-0 p 9-27
5. Practical Clinical Chemistry, Harold Varley, CBS Publishers and distributors, New Delhi.
6. Gradwhols Clinical Laboratory Techniques. Stanley & Raphael. W.E. company, London, UK

MODEL QUESTION PAPERS

MAR ATHANASIUS COLLEGE (AUTONOMOUS)
KOTHAMANGALAM, KERALA - 686666
First Semester M.Sc. Biochemistry Examination
PG20BS101 BIOCHEMISTRY

Time 3 hours **Model question paper** **Total weight: 30**

SECTION A

Answer any **eight** of the following. Each question carries a weight of 1

1. Give examples and functions of any 2 homopolysaccharides?
2. What are epimers? Give Examples
3. Explain histone acetylation. What is its importance in DNA activation and inactivation?
4. Briefly explain siRNA
5. What are physiological buffers?Give an example
6. Explain glycosidic bond.
7. What are the functions of topoisomerases?
8. Describe the sterols in microbes
9. What are modified aminoacids? Give an example
10. How is peptide bond formed?

(**8x1=10**)

SECTION B

Answer any **six** of the following. Each question carries a weight of 2

11. Describe the structure of t-RNA.what are its functions?
12. Explain lung surfactant and its role in prevention of pulmonary infection.
13. Differentiate between glucocorticoids and mineralocorticoids
14. What are the structural characteristics of glycosaminoglycans?
15. Describe Ramachandran diagram
16. Explain the different forms of DNA
17. What are fat soluble vitamins? Write a note on the structure and functions of any two of them.
18. Explain cot curve **(6x2=12)**

SECTION C

Answer any **two** of the following. Each question carries a weight of 5

19. Describe the various bonds stabilizing biomolecules.
20. Briefly explain the methods you will adopt for the purification and subsequent characterization of a polysaccharide.
21. Describe the chemistry and physiological functions of eicosanoids.
22. Describe the various protein DNA interaction motifs (**2x5=10)**

M. Sc. BIOCHEMISTRY DEGREE C.S.S EXAMINATION

MAR ATHANASIUS COLLEGE, KOTHAMANGALAM (AUTONOMOUS)

FIRST SEMESTER - MODEL QUESTION PAPER

PG20BS102 - CELL BIOLOGY AND GENETICS

Time: 3 Hours Maximum Weight: 30

SECTION A

Answer any **eight** of the following. Each question carries a weight of 1

1. Lipid raft
2. ERAD
3.Desmosomes
4. MPF
5. Cyclins
6. Tubulins
7. Tumor suppressor genes
8. MSUD
9. Genetic drift
10. Down's Syndrome **(8x1=8)**

SECTION B

Answer any **six** of the following. Each question carries a weight of 2

11. Ionic Channels.
12. Facilitated diffusion.
13. Lysosomal Trafficking.
14.Sex linked Inheritance.
15. Cytoplasmic Inheritance.
16. Endo/Exo cytosis.
17. Role of Rb and p53
18. Chromosome Mapping. **(6x2=12)**

SECTION C

Answer any **two** of the following. Each question carries a weight of 5

19. Explain in detail on cell cycle and check points involved in cell cycle.
20. Give a detail amount on protein trafficking.
21. Illustrate with diagrams on various transport mechanisms in a cell.
22. Explain Hardy Weinberg equilibrium principle.

(**2x5=10)**

M. Sc. BIOCHEMISTRY DEGREE C.S.S EXAMINATION

MAR ATHANASIUS COLLEGE, KOTHAMANGALAM (AUTONOMOUS)

FIRST SEMESTER - MODEL QUESTION PAPER

PG20BS103 - BIOPHYSICS, BIOINSTRUMENTATION AND BIOINFORMATICS

Time: 3 Hours Maximum Weight: 30

SECTION A

Answer any **eight** of the following. Each question carries a weight of 1

1. Give examples and functions of any 2 homopolysaccharides?
2. What are epimers? Give Examples
3. Explain histone acetylation. What is its importance in DNA activation and inactivation?
4. Briefly explain siRNA
5. What are physiological buffers?Give an example
6. Explain glycosidic bond.
7. What are the functions of topoisomerases?
8. Describe the sterols in microbes
9. What are modified aminoacids? Give an example
10. How is peptide bond formed? **(8x1=8)**

SECTION B

Answer any **six** of the following. Each question carries a weight of 2

11. Describe the structure of t-RNA.what are its functions?
12. Explain lung surfactant and its role in prevention of pulmonary infection.
13. Differentiate between glucocorticoids and mineralocorticoids
14. What are the structural characteristics of glycosaminoglycans?
15. Describe Ramachandran diagram
16. Explain the different forms of DNA
17. What are fat soluble vitamins? Write a note on the structure and functions of any two of them.
18. Explain cot curve **(6x2=12)**

SECTION C

Answer any **two** of the following. Each question carries a weight of 5

19. Describe the various bonds stabilizing biomolecules.
20. Briefly explain the methods you will adopt for the purification and subsequent characterization of a polysaccharide.
21. Describe the chemistry and physiological functions of eicosanoids.
22. Describe the various protein DNA interaction motifs

(**2x5=10)**

M. Sc. BIOCHEMISTRY DEGREE C.S.S EXAMINATION

MAR ATHANASIUS COLLEGE, KOTHAMANGALAM (AUTONOMOUS)

FIRST SEMESTER - MODEL QUESTION PAPER

PG20BS104 - PHYSIOLOGY AND BIOSTATISTICS

Time: 3 Hours Maximum Weight: 30

SECTION A

Answer any **eight** of the following. Each question carries a weight of 1

1. ABO blood group
2. Neuroglial cells
3. Platelets
4. JG apparatus
5. Renal circulation
6. Chloride shift
7. Hypoxia
8. Standard error
9. Scatter diagrams
10. WBC **(8x1=8)**

SECTION B

Answer any **six** of the following. Each question carries a weight of 2

11. GFR
12. Respiratory membrane
13. Acclimatization
14. Alveolar ventilation
15. Structure & function of neuron
16. Measures of dispersion
17. Cardiac cycle
18. Chi-square test & goodness of fit **(6x2=12)**

SECTION C

Answer any **two** of the following. Each question carries a weight of 5

19. Explain transport and exchange of gases
20. Explain the structure and function of nephron
21. Discuss the types of tissues of the body
22. Explain muscle contraction (**2x5=10)**

M. Sc. BIOCHMISTRY DEGREE C.S.S EXAMINATION

MAR ATHANASIUS COLLEGE, KOTHAMANGALAM (AUTONOMOUS)

SECOND SEMESTER - MODEL QUESTION PAPER

PG20BS205 - GENERAL MICROBIOLOGY

Time: 3 Hours Maximum Weight: 30

SECTION A

Answer any **eight** of the following. Each question carries a weight of 1

1. Write notes on Archaea.
2. Differentiate positive & negative staining
3. What are Integrons?
4. Explain Bacterial Plasmids
5. Bacterial peptidoglycan
6. Chemotaxis
7. Write about Gene mapping
8. Bacterial endospore?
9. Describe about Whittaker five Kingdom classifications.
10. What is Transposon? **(8x1=8)**

SECTION B

Answer any **six** of the following. Each question carries a weight of 2

11. Testing of disinfectants
12. Explain the Mechanism of multiplication of virus and its morphology.
13. Write a notes on drug resistance in bacteria.
14. Classify fungi, and its economic importance and reproduction.
15. Give details about culture media used for aerobic bacterial cultivation.
16. Write a note on Site Directed Mutagenesis.
17. Give details on Gram negative Bacterial Flagella.
18. Explain bacterial growth curve **(6x2=12)**

SECTION C

Answer any **two** of the following. Each question carries a weight of 5

19. Elaborate the sterilization techniques.
20. Explain DNA repair systems.
21. Write Elaborate essay on Generalized & Specialized transduction
22. Describe in detail the types of antibiotics, mechanism of action & antibiotic sensitivity tests**.**

(**2x5=10)**

M. Sc. BIOCHEMISTRY DEGREE C.S.S EXAMINATION

MAR ATHANASIUS COLLEGE, KOTHAMANGALAM (AUTONOMOUS)

SECOND SEMESTER - MODEL QUESTION PAPER

PG20BS206 - IMMUNOLOGY

Time: 3 Hours Maximum Weight: 30

SECTION A

Answer any **eight** of the following. Each question carries a weight of 1

1. What are Haptens?
2. Write about Thymus.
3. What are the properties of cytokines?
4. Describe tumour antigen.
5. What are Inflammatory Barriers?
6. What is SLE?
7. Explain indirect ELISA.
8. What does a positive Coombs Test mean?
9. Local immunity
10. What is MALT? **(8x1=8)**

SECTION B

Answer any **six** of the following. Each question carries a weight of 2

11. Give an account of the mechanism of autoimmune diseases.
12. Briefly explain the structure of Class II MHC.
13. Describe in detail the Cell-mediated immunity.
14. Describe the structure, properties, and functions of IgG.
15. Write short notes on GVH reaction.
16. Explain the role of Toll-Like Receptors in the pathogen associated pattern recognition.
17. Describe the endogenous and exogenous pathways of antigen processing.
18. Explain different types of vaccines

(6x2=12)

SECTION C

Answer any **two** of the following. Each question carries a weight of 5

19. Describe different pathways of complement activation.
20. Explain monoclonal antibody production and its applications.
21. Discuss the genetic basis of antibody diversity.
22. Give an account of the immediate and delayed hypersensitivity (**2x5=10)**

M. Sc. BIOCHEMISTRY DEGREE C.S.S EXAMINATION

MAR ATHANASIUS COLLEGE, KOTHAMANGALAM (AUTONOMOUS)

SECOND SEMESTER - MODEL QUESTION PAPER

PG20BS207 - MOLECULAR BIOLOGY AND GENETIC ENGINEERING

Time: 3 Hours Maximum Weight: 30

SECTION A

Answer any **eight** of the following. Each question carries a weight of 1

1. Rolling circle replication
2. Okazaki fragments
3. Ori site
4. Split gene concept
5. LINE
6. Peptidyl transeferase
7. Sigma factor
8. Cosmids
9. Vaccinia topoisomerase
10. Enhancers

(8x1=8)

SECTION B

Answer any **six** of the following. Each question carries a weight of 2

11. Write note on hybridization techniques
12. Blue white screening
13. Blotting techniques
14. Explain DNA modification during transcription
15. Attenuation control of TRP operon
16. Write note on Antisense technique
17. Messelson and Stahl experiment
18. Explain the process of Ligation with examples (**6x2=12)**

SECTION C

Answer any **two** of the following. Each question carries a weight of 5

19. Discuss the hormonal regulation of gene expression taking any two hormones as examples.
20. Explain in detail on the various steps in Replication of prokaryotes.
21. Elaborate on the various enzymes used in recombinant DNA technology. Also add a note on various cloning modifications.
22. Briefly explain in detail on the translational events. (**2x5=10)**

M. Sc. BIOCHEMISTRYY DEGREE C.S.S EXAMINATION

MAR ATHANASIUS COLLEGE, KOTHAMANGALAM (AUTONOMOUS)

SECOND SEMESTER - MODEL QUESTION PAPER

PG20BS208 - BCMETABOLISM AND BIOENERGTICS

Time: 3 Hours Maximum Weight: 30

SECTION A

Answer any **eight** of the following. Each question carries a weight of 1

1. Cori cycle
2. What is entropy? Give its importance
3. What is the importanceofmetabolomics
4. Beta oxidation of Palmitate
5. Glycogen synthase
6. Explain the biosynthesis of gamma amino butyrate
7. What is trans deamination
8. Zymogens
9. Functional properties of coenzyme Q
10. Transcriptional regulation of Cholesterol metabolism

(**8x1=8)**

SECTION B

Answer any **six** of the following. Each question carries a weight of 2

11. Uncouplers and inhibitors of ETC
12. Bisubstrate Reactions
13. Gluconeogenesis and its significance
14. Isoenzymes
15. Theraputic enzymes
16. Formation of uricacid
17. Urea cycle
18. Allosteric regulation of Aspartate Trans Cabomoylase (**6x2=12)**

SECTION C

Answer any **two** of the following. Each question carries a weight of 5

19. Ellaborate different types of enzyme inhibition detail?
20. Illustrate eukaryotic electon transport chain and oxidative phosphorylation
21. Biosynthesis of aromatic aminoacids.
22. Write an essay on isolation and purification of enzyme and add note on characterization of enzymes? (**2x5=10)**

IIIrd Semester

MAR ATHANASIUS COLLEGE (AUTONOMOUS)
KOTHAMANGALAM, KERALA - 686666
Third Semester M.Sc. Biochemistry Examination - 2019
PG19BC309 ENZYMOLOGY

Time: 3 hrs **Model question paper** Total credits: 30

Part A

Short answer questions; Answer any eight of the following Weight: 1 each

1. Define Katal and International Unit
2. Induced fit hypothesis
3. Ribozymes
4. What are coenzymes? Give the structure and functions of any one example
5. Order of a reaction
6. Line weaver Burk plot
7. What is Dose response Curve?
8. Study of structure activity relationship in inhibitor design
9. What are multienzyme complexes? Write their advantages?
10. Enzyme specificity

Part B

Short essay/Problem solving type. Answer any six of the following Weight: 2 each

11. Derive Michaelis Menten equation. What is the significance of km.
12. Describe the reaction mechanisms of bisubstrate reactions.
13. Short note on isoenzymes with an example
14. What are abzymes? Write down their applications
15. Write a note on diagnostic application of enzymes
16. Write down the mechanism of transition state stabilization of Serine proteases
17. Explain regulation of enzyme activity by covalent modification
18. Write a short note on enzymes used in therapy?

Part C

Long essay type. Answer any two of the following Weight: 5 each

19. Distinguish between various types of enzyme inhibition?
20. Write an essay on the systematic classification and nomenclature of enzymes
21. Explain regulation of metabolic pathways by allosteric modification using Aspartate Trans Carbomoylase as an example.
22. Outline various applications of enzymes in industry.

MAR ATHANASIUS COLLEGE (AUTONOMOUS)

KOTHAMANGALAM, KERALA - 686666

Third Semester M.Sc. Biochemistry Examination - 2019

PG19BC310 PLANT BIOCHEMISTRY

Time:3 hours **Model question paper** Total weight: 30

Part A

Short answer questions; Answer any eight of the following Weight: 1 each

1. Write the reaction catalysed by Ribulose biphosphate carboxylase/oxygenase.
2. Describe the term‘CAM’.
3. Distinguish between auxins andgibberellins.
4. What is the importance of nif genes?
5. What are the major functions ofalkaloids?
6. What do you mean by photosyntheticefficiency?
7. What is the importance of Jasmonic acid in plant defence?
8. Point out the importance of glyoxysomes and peroxysomes.
9. What are transgenic plants? Give examples.
10. Which are the enzymes involved in ammonium

Part B

Short essay/Problem solving type. Answer any six of the following Weight: 2 each

11. Give the significance of photorespiration
12. Explain the mechanism of action of abscissicacid.
13. Distinguish between cyclic and non-cyclic photophosphorylation..
14. What are the major functions ofalkaloids?
15. List out the enzymes important in nitratemetabolism
16. What are nonprotein aminoacids. Explain its significance.
17. Describe the importance and application of synthetichormones.
18. How do plants defend against microbial infection?

Part C

Long essay type. Answer any two of the following Weight: 5 each

19. Detail the chemical reactions involved in the dark phase of photosynthesis.

20.Classify alkaloids and discuss their important role inplants.

21. Explain the mechanism of action of nitrogenase enzyme.

22. Discuss the biosynthesis of cytokinins

MAR ATHANASIUS COLLEGE (AUTONOMOUS)
KOTHAMANGALAM, KERALA - 686666

Third Semester M.Sc. Biochemistry Examination - 2019

PG19BC311 MOLECULAR ENDOCRINOLOGY

Time3hrs **Model question paper** **Total weight 30**

Part A

Short Answers (Write any 8 out of 10) Weight 1each

1. Differentiate between water soluble and lipid soluble hormones?
2. Describe the hormones of posterior pituitary and their functions
3. Heart is an endocrine gland. Explain
4. How are thyroid hormonestransported?
5. What is diabetes insipidus?
6. Name the hormone whose second messenger is cGMP and indicate how cGMP is formed.
7. What are goitrogenic compounds?
8. What are the structural differences between proinsulin andinsulin?
9. What is Cushings syndrome
10. What are the hormones involved in maintain pregnancy

Part B

Short Essay (Write any 6 out of 8) Weight: 2 each

11.Explain feedback control of hormones.Describe positive and negative feed back control

12.Describe the biosynthesis of catcholamines

13. How is blood sugar regulated in our body

14.What are gastro intestinalhormones.Briefly describe their functions

15.Describe the hormonal control of calciumhomeostasis.

16.What are steroid hormone .Explain the biosynthesis of estrogen

17.Describe the hormones secreted by posterior pituitary.

18.How are hormones classified.

Part C

Long Essay (Write any 2 out of 4) Weight: 5each

19.Explain the biosynthesis of thyroid hormone.

20.Describe the biosynthesis of insulin and explain its mechanism of action

21.Describe the mechanism of action of steroid hormones.

22..Expain briefly Gigantism and dwarfism.

MAR ATHANASIUS COLLEGE (AUTONOMOUS)
KOTHAMANGALAM, KERALA - 686666

Third Semester M.Sc. Biochemistry Examination - 2019

PG19BC312 NEUROBIOLOGY
MODEL QUESTION PAPER

Time 3hrs Total weight 30

Part- A Answer any eight (weight-1)

1. Discuss the different types of neuron
2. Neuroglia and their functions
3. Which are the different types of Synapse
4. Mention the name and role of protein involved in the docking of neurotransmitter vesicles.
5. Write down the site of action of any two neurotoxins?
6. What is Myoneural junction
7. Describe patch-clamp technique
8. Differentiate between Short –term memory and long-term memory
9. Give an account on the neurotransmitter derived from tryptophan and its function
10. Briefly describe Senile Dementia

Part B Answer any six (weight-2)

11Give detailed description of structure of neuron with diagram
12Explain in detail voltage dependent ion channels
13.Write a short note on cerebrospinal fluid
14Explain the mechanism of synaptic transmission
15.Neuropathology of Alzheimer's disease
16.Describe synaptic plasticity
17.What is the structure and importance of blood brain barrier.
18.Discuss the chemistry, synthesis, degradation and functions of acetylcholine

Part C Answer any two (weight-5)

17. Describe the organization of central nervous system and peripheral nervous system
18. What is an action potential? Write an essay on various stages in generation and propagation of action potential through neuron
19. Explain in detail the biosynthesis, mechanism of action and functions GABA and NO
20. Outline the symptoms, etiology, neuropathology, and treatment of Parkinson's disease

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IV Semester

MAR ATHANASIUS COLLEGE (AUTONOMOUS)
KOTHAMANGALAM, KERALA - 686666

Fourth Semester M.Sc. Biochemistry Examination - 2019

Time 3hrs Total weight 30

PG20BS413-BC CLINICAL BIOCHEMISTRY

Part A Answer any eight (weight 1)

1. Write a note on Post-analytical variables in quality control

2. What you mean by osmolarity of water and free water clearance

3. Write about any one stimulation test used in the gastric function tests

4. Describe insulin tolerance test

5. Write about clinical diagnosis of AIDS

6. Explain DNA probes

7. Explain any one disorder of erythrocyte metabolism

8. What is Glycosylated Hemoglobin? How it is used in the diagnosis of Diabetes Mellitus.

9.List out the constituents of cerebrospinal fluid.

10.Give 5 examples of radioisotopes used for diagnosing diseases

Part B Answer any six (weight-2)

11. Write briefly on the method of collection, storage and processing of blood specimen for biochemical analysis?

12. Write an account on Gastric function tests.

13. What is PKU ?How is newborn screening done to diagnose PKU.

14. Write down the deficient enzymes, symptoms, clinical diagnosis and treatment of Niemann Pick disease.

15. Describe Cystic fibrosis.

16. Explain the functions of kidney.

17. Describe the types of Glycogen storage diseases.

18. Describe Restriction Fragment Length Polymorphism.

Part C Answer any two (weight-5)

19. Explain polymerase chain reaction .

20. Mention and explain the disorders associated with nucleic acid metabolism

21. Explain the abnormalities in lipoprotein metabolism.

22. Which are the tests to be done to find out the proper functioning of liver? Describe in detail.

MAR ATHANASIUS COLLEGE (AUTONOMOUS)
KOTHAMANGALAM, KERALA - 686666

Fourth Semester M.Sc. Biochemistry Examination - 2019

PG20BS414 -BC Elective

ENVIRONMENTAL SCIENCES

Time -3 hrs Total Weight -30

Part A

(Short Answer Questions; Weight -1 each, Answer any eight)

1. Mention the crucial atmospheric factors that determine the climate of a place. Explain
2. Explain the major environment factor that determines the balance of the hydrosphere
3. What do you mean by the structure of an ecosystem?
4. Explain cybernetics of an ecosystem
5. Why is dissolved oxygen highly significant to aquatic systems?
6. Distinguish between BOD and COD
7. Distinguish between α- diversity and ϒ-diversity
8. What is the basic criterion to declare a species endangered?
9. What are primary air pollutants
10. Explain CITES

Part B

(Short Essay/ Problem Solving type; Weight -2 each, Answer any six)

11. Mention the major water quality parameters and their standard limits as per any national or international norms
12. Explain the major kinds and sources of terratogens and carcinogens in the environment
13. Explain radiation fallout. Mention the sources and the major environment impacts of radiation fallout
14. What are the major soil physical properties? Mention the significance of soil structure in fertility
15. Why is tertiary treatment of water difficult to achieve and remains costly? Explain
16. What are xenobiotics? Explain the major environment impacts of xenobiotics
17. Explain how significant biofertilizers to sustainable agriculture? Give examples of biofertilizers mentioning their mode of action
18. Explain the various applications of microbes in environment cleaning

Part C

(Long Essay type – Weight 5 each, Answer any two)

19. Explain Phytoremediation. Mention the different kinds of phytoremediations and the applications of each kind.
20. Compare and contrast Activated Sludge Process and Trickling Filter Treatment of waste water
21. on the emerging of global environment policies

22. Explain the details of the 1992 National Environment Policy of India. Mention how this policy document reflects constitutional provisions of environment protection in the country?

MAR ATHANASIUS COLLEGE (AUTONOMOUS)
KOTHAMANGALAM, KERALA - 686666

Fourth Semester M.Sc. Biochemistry Examination - 2019

PG20BS415-BC PLANT AND ANIMAL CELL CULTURE

Time 3 hours **Total weight 30**

Part A

(Short answer questions- weight 1 each Answer any *eight*)

1. Explain the importance of serum in media?

2. What are micro carriers?How are they used in cell culture?

3 How are plant and animal cell culture media sterlized?

4. Differentiate between embryo culture and embryo rescue

5. How are stem cells classified?

6. What is cybrid?

7. Explain gene editing?

8 What is passage number, Explain its importance in cell culture

9. Define somatic embryogenesis

10. What is protoplast fusion. Give an example of an agent used for protoplast fusion.

(8x1=8)

Part B

(Short essay/ Problem solving type - weight 2 each, Answer any *six*)

11. Describe a method for the preparation of chick embryo culture. What are its applications?.

12. Explain stem cell therapy with an example

13. What is somoclonal variation? What is its importance?

14. Explain the concept gene knock out

15. Differentiate between symmetric and asymmetric hybrids? How are they produced?

16. What are the different methods of sterilizing glassware?

17. What is callus culture? Explain

18. Write a note on the advantages of plant tissue culture.

(6x2=12)

Part C

(Long Essay Type- weight 5 each Answer any *two*)

19. Distinguish between organ culture and histiotypic culture? What are their applications?

20. Explain the different methods for preparation of virus free plants?

21. Give any two methods for the preparation of haploid plants. What are the uses of haploid plants?

22. Describe the different methods for scale up of cell culture?

(2x5=10)

studies?