MAHATMA GANDHI UNIVERSITY
School of Biosciences

Priyadarsini hills PO
Kottayam – 686560

Revised Syllabus for

POST-GRADUATE PROGRAMME IN BIOPHYSICS

Under the CSS scheme for University Schools/Departments/Centres

(EFFECTIVE FROM 2017 ADMISSIONS)

Syllabus revised by

Post graduate board of studies in Biosciences (2014-17)

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Preface

Mahatma Gandhi University has always been committed to deliver the best quality education that is relevant to what our nation need from time to time. Our commitment to quality education is visible in our efforts to update curriculum and syllabus for all programmes periodically. This is the second revision of the Syllabus of our M Sc programmes in School of Biosciences since the Credit and Semester System is introduced in the University from the 2012-2013 academic years. This revised curriculum document is a comprehensive plan (CSS) of the M Sc programmes in Biosciences of MG University at School of Biosciences with effect from 2017 admissions.

In the current revision, we have focused on constructing new course plans to meet the changing needs of our student community and our society. This is prepared with the view of adapting the curriculum to the power of new technologies, new and creative ways of thinking about Bioscience education at the postgraduate level. We hope that this revision has established a proper direction to Biosciences and it will motivate our postgraduate students in learning the subjects with enthusiasm and they will achieve high competence in modern areas of the subject through the specialization offered in the 2nd, 3rd and 4th semester. While working out the detailed course contents and study and evaluation scheme, the following important elements have been kept in mind:

1) Core areas of Bioscience need proper weightage in the postgraduate programme
2) Competency profile of the students needs to be improved with a view to meet the recent research trends
3) Systematic approach to the subject learning is ensured so that the students enjoy their learning
4) Strictly adhere to the revised CSS regulations for postgraduate programmes in the MG University

This curriculum document is an outcome of the active discussions in several academic meetings of the Board of Studies in Biosciences as well as inputs of experts and teachers from different academic circles. Faculties from all of our specialities participated in the revision process.

We hope that this revision will prove useful in grooming more competent postgraduates of Biosciences in our University. The success of this curriculum depends upon its effective implementation and it is expected that all the teachers in Biosciecnes will make all efforts to create better facilities, develop linkages with research institutions and foster favourable academic environment in their disciplines as per recommendations made in the curriculum document.

Biology is a very fascinating subject. New developments in Biology is the ultimate hope for pertinent solution to all the pressing problems related to food, health, energy and environment that threaten survival of humans on our green planet. However, the pathetic side of biology education is that the best brains are not always attracted to the programme. In the present revision, we have given special efforts to make the programme more attractive to the academically bright student community.

The Board of Studies acknowledges the academic contributions of all our teacher colleagues who by their advice, thoughtful reviews, and comments have helped in the preparation of this revised syllabus. In my final words of closing, I would like to express my greatest gratitude to all the esteemed members of the Board of Studies in PG Botany who were sincerely involved in the preparation and finalization of this syllabus.

Dr. J. G. Ray (Chairman)

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Revised CSS Regulations

Preamble

Credit and semester system (CSS) of Mahatma Gandhi University aims at flexibility in curriculum development, objectivity and critical approach in examination patterns, use of continuous evaluation for assessment in all educational programmes in the university campus. This is to ensure a de-stressed learning environment for students in their overall academic development. The CSS is also meant to provide meaningful common criteria as per the national pattern to transfer credits when students move from one institution to another within or outside the country.

Mahatma Gandhi University follows the guidelines of UGC for the implementation of the CSS, which became operational since 2002-03. The MGU-CSS is applicable to all academic programmes of the statutory Departments/Schools/Centres/Institutes of the University with flexibility to introduce new generation programmes such as integrated graduate-postgraduate and postgraduate-research programmes.

The CSS Regulation has been revised from time to time in accordance with the requirements of changing curricular pattern. Revisions are carried out with a view to ensuring accountability, transparency and flexibility.

Revised Regulations

Revision to the existing comprehensive regulation of the credit and semester system (CSS) has been carried out to ensure functional autonomy of statutory Schools/Centers/Institutes. Functional autonomy implies academic flexibility in matters like curriculum development, course designing, course teaching, conduct of examinations, planning and organization of research activities as well as administrative and financial powers to the extent the university Statute/Act/Regulations/Orders permit towards providing maximum of benefits in terms of academic growth and development.

Functional autonomy envisaged in the CSS is also meant to provide teachers and students with a clear understanding of the principles to be followed in the framing of curriculum/ teaching/learning/ evaluation, preparation of mark lists/certificates, and in the transfer of credits towards achieving maximum academic benefits out of the system of postgraduate,

MPhil and PhD programmes in all the statutory Departments/Schools/Centers/Institutes of the University.

CSS seeks to ensure a uniform pattern of course design, course teaching, evaluation system, academic calendar and examination time-table for all MA., M Sc., MEd., LLM, MTM, MBA., MPEd, M Tech, integrated BSc-MSc, M Phil., integrated MSc-Ph D and course-work of the conventional PhD programmes. CSS also ensures that while all its autonomous Schools/Centre/Institutes enjoy academic flexibility in the conduct of diverse academic programmes, they shall not conflict with the rules and regulations stipulated by the University as well as by the UGC in the issue of degrees/diplomas/certificates. This revised regulation shall be applicable with effect from 2016 admissions.

Programmes of all the existing statutory Schools/Centre/Institutes and, any other similar, ones that may be started in the future shall also be covered by this Revised CSS scheme with effect from 2016 admissions.

Major components of Credit and Semester System (CSS)

CSS of Mahatma Gandhi University is designed as a comprehensive package of curriculum management that enables faculties in Schools/Centre/Institutes to enjoy autonomy and flexibility in the design of diverse programmes in a pattern as per national/international norms or rules prescribed by UGC, which are mandatory. Major components of the CSS are as follows:

1. Admission to programmes
2. Common Academic Calendar
3. Basic principles of curriculum design
4. Principles of course design
5. Course teaching patterns
6. Student assessment patterns
7. Examinations and evaluations
8. Grading of students
9. Course improvement, readmission and repetition
10. Grievance recording and redressal
11. Inter-school academic collaboration
12. Principles of stakeholder involvement

Instead of the conventional system of postgraduate courses designed with several papers and award of marks indicating status of student achievement, CSS envisages well designed academic programmes in a universal pattern with definite number of courses, which are rated in terms of the credits they are worth (number of hours of theory/practical/seminar/project training received) and grading of students according to their continuous and overall performance.

Definitions of terms

'Semester' means a term consisting of a minimum of 90 working days including examination days distributed over a minimum of 18 weeks with 5 working days in each week.

Programme refers to the previous concept of degree (MA, M Sc, MBA, MTTM, M Tech, LLM, M Ed, MP Ed, BSc-MSc, M Phil, M Sc-PhD or Ph D and the like) carried out in a time-bound academic period.

Course means the curricular content for teaching and learning or seminar in a specific area or theme of knowledge.

Core course means a compulsory course in a subject related to a particular programme

Elective course means an optional course, which can be selected from among a group of electives in a programme

Open Course means a course conducted by a School/Centre/Institute other than the parent department. Every regular postgraduate student is required to choose an open course of 4 credits in the third semester.

Repeat course is a course that is repeated by a student in a semester for want of sufficient attendance. ***Improvement course*** is a course registered by a student for improving his/ her performance in the end semester component of that particular course.

Credit is the unit by which a course is measured. It is the measure of total number of hours of training received in a course during a semester; the credit number indicates the total curricular content in terms of number of hours of teaching/learning in a course during a semester.

Grade indicates the student's performance level – the level of achievement of a student in terms of the score obtained evaluations and examinations in a course.

Grade Letter is an index of performance of a student in a particular course. It is the transformation of actual marks secured by a student in a course to percentage and then to grade; Grade letters are: O, A plus, A only, B plus, B only, C, P and F

Grade Point is the weightage allotted to Grade Letter

Credit Point refers to the product of number of credits of a course and grade point obtained by a student for a given course

Semester Grade Point Average (S**GPA)** refers to the performance of the student in a given semester. SGPA is a weighted average based on the total credit points earned by a student in all the courses in the semester divided by the total number of credits offered in the semester. SGPA will be computed as and when a student completes all the required courses of a semester with a minimum required grade as per the respective curriculum.

Cumulative Grade Point Average (CGPA) refers to the performance of the student for all semesters of the programme. **CGPA** is a weighted average based on the SGPA earned by a student in all semesters of the programme and the total number of credits required in the programme.

CGPA calculated on the basis of SGPAs with the minimum required SGPAs of all semesters may not be sufficient to obtain the minimum fixed CGPA for pass in the programme. Students need to overcome the low SGPA of certain semesters due to low grades in courses in which they are weak, by obtaining better grade in courses of other semesters in which they are strong, so that the better SGPA scores of such semesters will enable the candidate to attain the minimum CGPA fixed for a pass in the programme.

Course Code: Each course shall have a unique code number with five abbreviated components - 1. Department/school/centre/institute; 2. Programme (DC – for doctoral course work/ PD – for Pre-Doctoral or M Phil programmes/ M – for all Master programmes / G- for all Graduate programmes / IM – for all Integrated master programmes/ IG – for all integrated graduate programmes); 3. Semester number in Roman Letter and course type (C- for core course; E- for elective course; O- for open course; no separate designation may be required for practical, project and core as these courses also come under the head of core or elective) 4. Year of formulation/revision of syllabus; 5. Course number in Arabic numerals – two digit number.

Important objectives of CSS

A post graduate student has a choice of selecting courses across various disciplines in different semesters of the programme.

Students get the choice of selecting courses offered by a School/Centre/Institute other than their parent School/Centre/Institute, depending on his/her interest, needs and long term goals.

Each School/Centre/Institute designs, offers and teaches a minimum of one course during Semester-III for the students admitted in other departments; such courses are designated as open courses, each of which carries minimum 4 credits.

Continuous evaluation of the students in all the semesters is done through Internal Assessment as per certain common norms.

The student shall do a project work during the 4^{th} semester as a part of the regular programme.

Course content of each programme is designed to meet the ever changing requirements of the individual/industry/job market/ needs of the society.

Each course, seminar and project work is assigned a specific number of credits and the percentage of marks secured by a student is converted into grade points and credit points. The performance of a student in a semester is expressed as semester grade point average (SGPA) and the combined performance of a student in all the four semesters of the programme is expressed as cumulative grade point average (CGPA)

Common Academic Calendar:

The first Semester of all programmes shall begin by 15 July with End Semester Examination to be completed before 31 December; The second Semester shall begin by 1 January and the End Semester Examination to be completed before 14 July; The third Semester shall begin by 15 July and the End Semester Examination to be completed before 31 December; The fourth Semester programme shall begin by 1 January and the End Semester Examination to be completed before 14 July. Completion of a semester includes publication of end semester examination result as well.

Final results of the fourth semester examinations of all the postgraduate programmes shall be published before 15 July every year. Summer vacation period for all Schools/Centres/Institutes shall be from 16 April to 15 June. However, students in university Schools/Centres/Institutes are to continue theory or practical classes or research work or other assignments during the summer vacation as per the direction of heads of Schools/Center/Institute in accordance with the availability of teachers during the vacation period.

CSS Rules and Regulations

1. Duration of programme:

1.1. PG Programme: The duration of the PG programmes shall be minimum of two years consisting of four semesters except for M.Ed. and M. Phil. Minimum duration of the M Ed and M Phil Programmes shall be one year consisting of two semesters. Part-time M Phil programme shall not exceed two years for completion.

1.2. Ph D Programme: Ph D programmes in all subjects will include an initial full semester Course work with minimum of three courses of 4 credits each. Research Methodology will be a compulsory course for all Ph D programmes. A student will be given confirmation of registration to Ph D programme only if he/she attains a minimum CGPA of 5 in the course work examinations.

Those who join Ph D Programme after M Phil degree will be required to take only one special course relating to the specific area of research of the candidate. However, in cases where Research Methodology was not part of the M Phil course, such candidates need to take the course in Research Methodology as well (refer to 3.11). The minimum duration of the Ph D Programme shall be three years; and for MPhil degree holders, it shall be two and half years.

1.3. Integrated Programmes

1.3.1. Integrated B Sc – M Sc Programme: These will also follow 3 year + 2 year pattern of courses with initial six semesters of graduate courses followed by four semesters of postgraduate courses. However, the integrated programmes will have more inter/multidisciplinary curricular content; it also enables students to complete both graduate and postgraduate programmes in a continuous stream and to attain a high level competency in

postgraduate programmes of their specialization. Students who successfully complete six semesters of integrated B Sc – M Sc shall be eligible for graduate degree as per the rules and regulations of the respective curriculum.

1.3.2. Integrated M Sc-Ph D Programmes: These will follow a 2 year + 3year system of courses with a full semester doctoral course immediately after the four semesters of postgraduate courses followed by research work. However, in integrated programmes, apart from interdisciplinary/multidisciplinary curricular content, students will have the opportunity to focus on research from the early semesters of their postgraduate period and thereby equip themselves for higher level achievements. Students who successfully complete four semesters of integrated M Sc-PhD shall be eligible for a postgraduate degree as per the rules and regulations of the respective curriculum.

Minimum CGPA and credit requirements for the B Sc (6 Semesters) and M Sc (4 Semesters) are similar to B Sc and M Sc programmes or as per the specific instructions in the regulations/curriculum of the respective programmes. In the case of M Sc-PhD programmes, the minimum CGPA and credit requirements for M Sc Part of the programme or the first semester Ph D course Work may not be similar to conventional M Sc courses/Ph D courses, but they also need to follow the general norms specified in this regulation.

In the B Sc-M Sc integrated interdisciplinary programme, specification of the degree in a particular stream such as one of the life sciences/chemistry/physics/others and equivalency, for (a) B Sc degree in a specific subject can be given only if 75% of syllabus content of the first six semesters matches with the core courses and allied subjects respectively of the usual BSc programme in the said subject and (b) M Sc degree in a specific subject can be given only if 75 % of course content in the last four semesters falls within the concerned subject.

2. Courses and Credits:

2.1 In all the programmes, three kinds of courses are offered**;** Core Courses (3-4 credits), Elective Courses (2-4 credits) and Open elective courses (4 credits). Core courses are offered by the Schools/Department/Centre/Institute conducting the programme. Elective Courses shall be selected either from the same School/Department or from some other School/Centres/Institutes. Any course chosen generally from an unrelated discipline/subject, from Schools/ Centres/Institutes by a student other than own School/Department/Center, with

an intention to seek broad exposure, is called an **Open** course. Students are required to take one open course in the Third semester.

2.2. Project work/dissertation work is a special course involving application of knowledge in solving/ analyzing /exploring a real life situation / problem. A project/dissertation work up to 4 credits is called minor project/dissertation and that of 6 to 8 credits are called major project/dissertation. Project/dissertation work of a programme can be up to 10/20 credits and for an integrated programme or exceptional postgraduate programmes with project work equivalent to two full semester the credit can be up to 40.

2.3. There shall be a faculty adviser for each batch of students admitted to a programme. Apart from the general student support activities, the faculty advisor shall help students in selecting electives that are relevant to the programme for which they are admitted.

2.4. A course offered may have different components associated with the teaching-learning process of the course, namely (i) Lecture (ii) Tutorial (iii) Practicals, where: **L** stands for Lecture session. **T** stands for Tutorial session consisting participatory discussion/ self study/ desk work/ brief seminar presentations by students. **P** stands for Practical session and it consists of hands on experience/ laboratory experiments/ field studies/ case studies that equip students to acquire the much required skill of applying the theoretically learnt concepts.

2.5. In terms of credits, every one hour session per week of a semester of L amounts to 1 credit and a minimum of two hour session of T or P amounts to 1 credit per semester; maximum hours allotted for 1 credit practical course/tutorial course/seminar course shall not exceed 4 hours. One full semester is equivalent to 15- 20 weeks of teaching-learning – evaluation process.

2.6. The maximum duration of a semester is 90 working days. A course may have lecture component (L) or practical component (P) or tutorial component (P) or combination of any two or all the three components. The total credits earned by a student at the end of a semester

upon successful completion of a course are L + T + P or as the case may be. The credit pattern of a course is indicated as L: T: P.

2.7. If a course is of 4 credits then the different credit distribution patterns in L: T: P format can be:

4 : 0 : 0,	1 : 2 : 1,	1 : 1 : 2,	1 : 0 : 3,	1 : 3 : 0,
2 : 1 : 1,	2 : 2 : 0,	2 : 0 : 2,	3 : 1 : 0,	3 : 0 : 1,
0 : 2 : 2,	0 : 4 : 0,	0 : 0 : 4,	0 : 1 : 3,	0 : 3 : 1,

3. Credit Requirements:

3.1 For the successful completion of four-semester PG programmes, there shall be a minimum of 80 and a maximum of 88 credits. Syllabi and curricula of specific programmes should be framed with specific fixed credit requirements taking into account the flexibility (80-88) offered by this general regulation for the same. For M Ed and M Phil (part time or full time) two-semester programmes, the minimum credits required are 36 and the maximum is 42. The minimum credit requirement of the B Sc part of integrated BSc-MSc conducted in Schools/Centres/Institutes shall be 120.

3.2 The 80 - 88 credits stipulated in a postgraduate programme shall be spread across core courses, electives, open courses, a compulsory project/dissertation. In all postgraduate programmes a student has to secure a minimum of 48 credits for Core courses, a minimum of 8 for Electives and 4 for Open elective courses**.** Minimum credits for Core/Elective courses in integrated programmes/courses with full semester or two semester dissertaion can have a different pattern as stipulated by specific curricula for the same.

3.3. In the Integrated programmes, open courses may be substituted by field works/ industrial exposures/ special training in so far as the inter/cross disciplinary courses are part of such integrated programmes

3.4. The maximum credits for core courses, electives and open courses in postgraduate programmes shall be 64, 20 and 4 respectively**.** Four (4) credits shall be set apart for open courses to be offered in the third semester in all University Teaching Departments/Centers/Institutes except those offering integrated programmes with cross

disciplinary courses. *Open Courses are not mandatory for LLM, MBA, M Ed, MTTM, MP Ed, M Tech and integrated B Sc-MSc or M Sc-Ph D programmes.*

A minimum of 4 credits and maximum of 20 credits shall be set apart for the project work/dissertation. In all major projects/dissertations that constitute full-semester work, as in the case of M Phil and certain postgraduate programmes, the maximum admissible credits shall be 20 and for an integrated programme or exceptional postgraduate programmes with project work equivalent to two full semesters, the credit can be up to 40. The M.B.A. course shall have compulsory projects in the third and fourth semesters based respectively on the core and elective subjects.

Schools/Centres will have the option to continue 'Viva-Voce' with definite credits if the Board of Studies of a School decides the same as quite appropriate in a specific programme. In other cases, credit assigned to *viva voce* must be transferred to the credit requirement of projects or seminar courses. Accordingly *viva voce* shall be part of project/seminar evaluation in such programmes.

3.5. In excess to the minimum credits for a Masters programme in the concerned discipline / subject of study as per the specific curriculum for a programme, a candidate can opt to complete during off hours 4-10 extra credits from courses (which may include self study courses) conducted by any university Schools/Institutes/Centres to acquire **add on proficiency diploma** in that particular discipline/subject besides their masters degree; the diploma shall be awarded by the university as per the recommendation of the concerned directors. However, such courses offered in a School/Institute/Centre shall be approved by the Faculty Council and ratified by the Vice-Chancellor.

3.6. A semester shall, except in the case of M Phil second semester (where a major project/dissertation constitute the full-semester work) and M Sc programmes with full semester research project work in a semester, consist of 4 - 8 courses and shall be worth a minimum of 16 credits and maximum of 22 credits.

3.7. Ph D Programme shall begin with a Course Work of one full semester duration having a minimum of three courses of 4 credits each; one shall be **Research Methodology** and one will be a **special course** related to the specific area of research of the candidate; the third course shall be decided by the Faculty Council of the concerned School/Department/Center/Institute. For Ph D Course-Work, the minimum course requirement is 3 of 4 credits each (for those without M Phil); for MPhil degree holders: 1 to 2

courses of 4 credits each depending on whether Research Methodology is already studied in the M Phil Programme.

3.8. A student must register for the required number of courses as per specific curriculum of a programme at the beginning of each semester. No student shall register for more than 22 credits and less than 16 credits in a semester except for MBA, M Phil, MP Ed, M Tech, Ph D Course work programme. The total credits for electives registered for one semester shall not exceed 8 except in the case of MBA programme. However, this clause will not be applicable to students who apply for course improvement or repeat or reappearance of certain courses as per the norms prescribed for the same. The minimum and maximum credits specified for a semester in the PG and doctoral course work in this regulation shall be binding on all programmes.

3.9. The compulsory project/dissertation to be completed in the 4^{th} semester of a postgraduate programme shall be prepared by the student under the guidance of a member of the faculty or, in the case of subjects, which so demand, an external guide, to be decided by the school's faculty council. The project shall generally be offered in the last semester, though the Faculty Council can decide to have it in one of the earlier semesters (The MBA course shall have projects in the third and fourth semesters; In the M Tech Programme the project shall spread over 3^{rd} and 4^{th} semesters). The topic for the project shall be selected by the student in consultation with the research guide.

3.10. The credit requirement for M Phil will be a minimum of 36 credits and maximum of 42 credits. There shall be courses worth 12-16 credits in the first semester. In the second semester, there can be elective courses and compulsory dissertation worth a maximum of 20 credits (in any case the total credits of this semester shall not exceed the maximum limit of 22 credits). The concerned BoS shall be competent to suggest the modalities of the M Phil programme within the above credit limits.

3.11. A student in the M Phil programme will be permitted to appear for the second semester examinations only if he/she attains the minimum grade (C) prescribed for all courses in the first semester.

4. Programme/Course design:

The broad framework of the programme and the courses - core courses, electives and open courses/project field work/industrial exposure/training, constituting the programme shall be designed by the Boards of Studies of the respective Schools or Curriculum Committees in the case of Centres/Institutes, based on these regulations as well as on the specific recommendations of the Faculty Council/Expert Committee/Curriculum Committee of the Schools/Centres/Institutes.

The number of courses to be taught in a programme and the course titles shall be decided by the respective Boards of Studies in the case of schools and Curriculum Committee in the case of centers/institutes. The Faculty Council of the Schools/Centres/Institutes shall decide the content of each course, the text-books to be prescribed and the like; periodic, even semester-wise, updating of the courses can thus be ensured.

5. Student Admission:

5.1. Admission for all the courses (PG, M Phil and Ph D) will be made by a common admission procedure (CAP) by the University on the basis of a common admission test (CAT) or a special test conducted for specific programmes by the University School/Centres/Institute, as the case may be, decided by the Faculty Council of Schools/Centres/Institutes from time to time.

5.2. Admission may be based on the written test alone or written test and interview or on the basis of the marks obtained in the qualifying examinations as well as the marks obtained in the written test, the interview and/or the group discussion conducted by the respective Schools as decided by the Faculty Council of Schools/Centres/Institutes from time to time.

5.3. In the absence of regular Faculty Council, the Director/Coordinator along with the adjunct/approved faculties for the Centre/Institute shall constitute the council, which will be competent to recommend to the University for deciding the criteria of selection and to suggest specific regulations for admission to specific programmes conducted by such centers/institutes

5.4. The Faculty Council has to decide on the relative weightage to be given for each of the components – entrance examination, interview and percentage of marks at the qualifying degree programme - for the preparation of rank list for conventional PG, M Phil and Ph D programmes by the CAP after the CAT. Each year, the director of a

School/Department/Centre, after consulting the Faculty Council has to inform the university its specific criteria for admission to a programme prior to public announcement of the notification for the CAT/ for specific programmes in the institute.

6. Faculty Council:

The Faculty Council shall consist of all the regular and permanent teachers of the Department/School. The Director/head of the School shall be the chairman of the Faculty Council. He/she shall preside over all the meetings of the Council, and in his/her absence, the next senior teacher shall preside over the meetings. The Faculty Council shall have a secretary, elected from among the teachers of the Schools/Centre/Institute. The teachers shall as a matter of duty attend the meetings of the Council. The Council shall meet at least once every month. In the case of Centres/Institutes the director and the adjunct/guest/invited faculties shall constitute the Faculty Council.

6.1 **Faculty Advisor:** Each student admitted to a course will be affiliated to a faculty advisor, who shall advise the student on the elective and other courses in the parent department as well as in other departments that he/she might choose.

7. Course Teaching:

Courses shall generally be taught by the faculty member who designed the course, though it is possible for the Faculty Council to assign the teaching of a course to more than one faculty member.

8. Evaluation:

8.1. ***External & Internal Evaluation:*** *Evaluation of the post graduate courses for the first and third semester examinations shall be done by the faculty members themselves on the basis of continuous internal assessment and end semester examinations. Evaluation for all the courses of the second and the fourth semester examinations of the post graduate programmes, except for practical examinations in science subjects, shall be conducted both externally and internally. In the Centres/Institutes, the evaluation of answer books are carried out by external examiners and* evaluation pattern for all the semesters *of Institutes/Centres* shall be decided by the concerned Faculty Council of the Centre/Institutes. The performance of a student in each course is evaluated in terms of percentage of marks with a provision for conversion to grade points.

Students who secure a minimum attendance of 75% and above in a semester, and who pass the internal examinations of all the courses of the semester, alone, will be allowed to appear for the end semester examination and continue in the programme to the next higher semester.

However, failed students can approach the grievance redressal committee (the Faculty Council) in case of failure in internal examinations, and the decision of the Faculty Council in this regard will be final. Faculty Council may permit students to repeat the course in appropriate cases, but only once in a programme.

8.2. *Question paper setting*: The Faculty Council of each School shall prepare the panel of question paper setters for each programme and get it approved by the Vice Chancellor. The Director/head of the Schools/ Centre/Institute will make arrangements for getting the question papers set by external experts who shall be selected from the panel approved by the Vice-Chancellor

The Faculty Council shall as far as possible recommend teachers of other Universities as external examiners. Only in emergencies, senior Associate Professors of colleges may be recommended as external examiners of a University Programme.

8.3. Process of Evaluation: The double valuation of answer scripts in the second and the fourth semester courses shall be done by external examiners and the concerned faculty respectively as decided by the Director.

The Director/head of the School/Department/Centres/Institutes will make arrangements for the evaluation of the answer scripts. The project/dissertation shall be evaluated by two examiners, one of them the faculty member who supervised the project and the other an external examiner to be decided by the Director from a panel approved by the Vice Chancellor. The comprehensive *viva-voce*, if any, must be carried out along with project evaluation in the fourth semester.

8.4. Internal Assessment: The student's attendance and classroom performance as well as the feedback received from tests, tutorials, assignments and term papers shall form the basis for internal assessment. The internal assessment will be a continuous assessment (CA) that accounts for 50% of the evaluation in both theory and practical.

8.4.1. Continuous Assessment (CA): This assessment shall be based on a predetermined transparent system involving periodic written tests, assignments and seminars in respect of theory courses and based on tests, lab skill, records/viva and attendance in respect of practical courses.

8.4.2. The percentage of marks assigned to various components for internal evaluation is as follows:

(a) Theory

Components % of internal marks

i)	Two test papers	60%
ii)	Assignments/Book review/debates	20%
iii)	Seminars/Presentation of case study	20%

(b) Practicals

Components % of internal marks

i)	Two test papers	40%
ii)	Lab skill	25%
iii)	Records/viva	25%
iv)	Attendance	10%

Tests: For each course there shall be at least two class tests during a semester. Best of the marks obtained in the two tests will be counted as the internal test component of CAS. The probable dates of the tests shall be announced at the beginning of each semester. Marks should be displayed on the notice board. Valued answer scripts shall be made available to the students for perusal within 10 working days from the date of the tests.

Assignments: Each student shall be required to do 2 assignments/book reviews for each course. Assignments/book review after valuation must be returned to the students. The teacher shall define the expected quality of the above in terms of structure, content, presentation and the like, and inform the same to the students. Punctuality in submission of assignments/records is to be given a weightage in the internal evaluation.

Seminar: Every student shall deliver one seminar as an internal component of every course and must be evaluated by the respective course teacher in terms of structure, content, presentation and interaction. The soft and hard copies of the seminar report are to be submitted to the teacher in charge.

Practical Records: All the records of continuous assessment (CA) must be kept in the department and that must be made available for verification.

Results of Internal Assessment: The results of the CA shall be displayed on the notice board within 5 working days from the last day of a semester. It should be counter signed by the candidates. The marks awarded for various components of the CA shall not be rounded off, if it has a decimal part. The total marks of the CA shall be rounded off to the nearest whole number.

Once the Score-Sheet for CA duly attested by the Director is forwarded to the CSS office for issue of mark lists, no further change in the grades entered in the same will be entertained. Improvement in the internal assessment grade will not be possible in any circumstance for a student after the completion of a semester programme.

8.5. End-Semester Examination: The end semester examination will account for the remaining 50% of the evaluation which will be done by the School/Department/ Center/Institute in accordance with the provisions in Section 8.1.

The evaluation of the end-semester examination of the first and third semesters shall generally be done by the faculty who taught the course, though a School/Department/Center/Institute can opt to have the examiner from outside the university, if the faculty council so decides. Evaluation of the 2^{nd} and 4^{th} semester courses based on questions set by external question paper setters shall be evaluated by two examiners; one, the external (as far as possible the question paper setter shall evaluate the examination paper as well) and the other, internal examiners.

8.5.1. Project Work: There shall be a project/dissertation to be undertaken by all students. The dissertation entails field work, lab work, report writing, presentation and viva voce. The class hours allotted for project work may be clustered into a single slot so that students can do their work at a centre /location for a continuous period of time. However, appropriate changes can be made by the faculty council in this regard. **Project/dissertation** shall be carried out under the supervision of a teacher in the parent School/Centre/Institute or other research institutes or industrial establishment or university departments if they permit the students to do so, after getting permission from the department head.

In such cases, one of the teachers from the schools/centres/institutes would be the co-supervisor/internal guide and an expert from the industry/ research organization concerned shall act as supervisor/ external guide. Project/dissertation shall be submitted to the head of the department two weeks before the commencement of the end semester examination of the final semester.

In the case of M Phil programme while forwarding the mark lists of the second semester to the CSS, director of the school/centre/institute shall ensure that both the hard and soft copies of the project /dissertation of all students will be handed over to the University Library immediately after the publication of the results.

8.5.2. External Evaluation of Theory Answer Scripts: The external evaluation shall be done after the examination at the earliest, preferably in a centralized valuation. As far as possible bar coded Answer Books shall be used to ensure confidentiality. The evaluation of the answer scripts shall be done by examiners based on a well-defined scheme of valuation. There shall be double valuation system of answer books in the 2^{nd} and 4^{th} Semester evaluations. The final marks awarded will be the average of two. If there is a variation of more than 10 % of the maximum marks, the answer books shall be valued by a third external examiner appointed by the director. The final marks to be awarded shall be the **average of the nearest two** out of three awarded by the examiners.

8.5.3. External Evaluation of Practical Courses: End semester evaluation in **practical courses** shall be conducted and evaluated by two examiners; one internal and one external or both internal as may be decided by the faculty council. Duration of practical external examinations shall be decided by the concerned faculty council.

8.5.4. Evaluation of the project work shall be carried out at the end of the programme. The title and the credit with marks awarded for the project work should be entered in the grade/mark sheet approved by the university

Process of evaluation of project work:

1. The end semester evaluation of the project/dissertation shall be done both internally and externally; external evaluation shall be conducted by external examiner as per clause 8.3, paragraph-2.

2. Evaluation of the project report shall also be done under numerical mark system.

The evaluation of the project will be done at two stages:

1. Continuous Assessment (CA) (supervising teacher/s will assess the project and award internal Marks).

2. External evaluation (by external examiner).

3. Marks secured for the project will be awarded to candidates, combining the internal and external Marks.

4. The internal to external component is to be taken in the ratio 1:1.

Internal Assessment of project work shall be completed within 2 weeks before the last working day of a semester. Internal Assessment marks should be published in the department/centre notice board.

Conditions of Pass in the Project:

1. Submission of the project/dissertation and viva are compulsory for internal evaluation.
2. A student shall be declared to have passed in the project/dissertation only if she/he secures minimum P grade (40 % marks of the aggregate and 40% separately for external).

8.6. Grading System:

The grading system followed is that of relative grading on a ten-point scale. The following table indicates the performance range and the relative value of the grades (grade points) on the scale.

Letter grade	Performance	Grade point
O	Outstanding	10
A plus	Excellent	9
A only	Very good	8
B plus	Good	7
B only	Above Average	6
C	Average	5
P	Pass	4
F	Fail	0
Ab	Absent	0

8.7. Minimum grade for passing in a course or programme: For all kinds of programmes except that of M P Ed**,** the minimum for a pass in a course is 'P' grade. **In M P Ed programme the minimum for pass in a course is 'C'.** The minimum CGPA for a specific programme and the minimum credit point requirement for each programme are as per the table given below:

Programmes	**Minimum CGPA**
MA/M Sc	4
MEd/MPhil and Master Diploma	5
MTTM//MBA/M Tech	5
M Ed/ MP Ed	5
Master Diploma	5
M Phil/Ph D Course Work	5
M Sc part of integrated MSc-Ph D in NIPST	5
IIRBS B Sc (part of Integrated BSc-M Sc) IIRBS MSc (M Sc part of integrated B Sc-MSc) IIRBS M Sc (M Sc part of integrated M Sc-PhD)	5 4 4
LLM	5

Programmes	**Credit Flexibility**
MA/M Sc	80-88
M Ed/M Phil	36-42
M P Ed	80-88
M Tech	80-88
MBA/MTM	80-88
M Sc of Integrated M Sc-PhD or Integrated B Sc- MSc	80-88
LLM	80-88
IIRBS- B Sc (part of Integrated BSc-MSc)	120-130
IIRBS M Sc (part of both integrated B Sc-M Sc and M Sc-PhD)	80-88
Ph D Course Work of all Schools/Centres/Institutes	4 to 14 as per specific curriculum

8.8. The Director/HOD shall ensure the regular student feedback of courses, teachers and programme in the prescribed format towards the end of all semesters and the same shall be made available to teachers concerned.

8.9. Publication of Results: The results of the End Semester Examination (ESE) shall be published within 30 days from the date of the last examination.

8.10. Conferment of the Degree: A candidate shall be eligible for the conferment of the degree only after he/she has earned the minimum CGPA as specified in the regulations of the prescribed programme.

8.11. Revaluation: The answer scripts of examinations under CSS shall have provisions for revaluation. The application for scrutiny and revaluation of answer scripts shall be submitted to the Director of the concerned School within 15 days from the date of publication of the results.

8.12. However, there is no provision for revaluation or scrutiny of answer scripts in the end semester examinations of 2nd and 4th Semesters as these have already been valued twice

9. Reappearance and improvement Examinations

9.1. Candidates in the 1st and 2nd semesters, who have secured the SGPA letter grade of 'C' or 'P' in the end-semester examination can improve their grade by reappearing for all the semester courses together along with the next immediate batch provided the candidate has applied for the same and paid the required fee; in such cases a candidate will be awarded a new grade only if there is an improvement in grade in the new examination; otherwise, the candidate is eligible to retain the grade obtained in the previous examination before improvement.

9.2. Candidates in the 1st or 2nd semesters who have secured a letter grade of 'P', 'F' or 'Ab' in any of the courses can reappear for exams course-wise along with the next immediate batch provided the candidate has applied for the same and paid the required fee.

9.3. Candidates in the 3rd semester, who have secured the SGPA letter grade of 'C' or 'P' in the end-semester examination can improve their grade by reappearing for all the semester courses together, along with the next immediate batch provided the candidate has applied for the same and paid the required fee; in such cases a candidate will be awarded a new grade only if there is an improvement in grade in the new examination; otherwise, the candidate is eligible to retain the grade obtained in the previous examination before improvement.

9.4. Candidates in the 3rd semester who has obtained letter grade of 'P', 'F' or 'Ab' in any of the courses can reappear for exams course-wise in a supplementary examination along with the 4th semester examinations provided the candidate has applied for the same and paid

the required fee (fee for supplementary examination of any course shall be full semester examination fee irrespective of number of courses involved).

9.4. After completing a semester programme (all courses with 'P' or above grade) students will not have the facility of course-wise improvement and they will now have to reappear for all the courses constituting the entire semester. 1st and 2nd semester SGPA cannot be improved after the completion of the 4th semester. Only 3rd and 4th semester SGPA can be improved after the completion of a programme. The marks/grades awarded for internal assessment and that for the project/dissertation cannot be improved

9.5. Improvement of the 3rd or 4th semester must be done within a period of one year, that is, by reappearing for the third semester examinations at the following semester and the fourth semester examinations along with the immediate lower batch. If the improvement is meant to obtain minimum CGPA requirement, a candidate has the option to decide which semester (3rd or 4th) is to be improved; however, the grade given to the candidate shall be that obtained for the entire semester improvement examination.

9.6. Candidates who could secure the grade of only 'F' or 'Ab' in a course in the 3rd /4th semester examinations will be given two additional chances for course-wise reappearance even after the completion of the programme; but it has to be done within a period of two years after the completion. In such cases a candidate has to apply for the same as a supplementary exam and pay the required fee (Fee for supplementary examination of any course shall be full semester examination fee irrespective of number of courses involved).

9.7. In the case of students who discontinued studies during a semester or on completion of a semester of the programme for genuine reasons, with the prior permission of the director of the School, he/she can be permitted to complete the programme by taking the required number of courses within a maximum period of eight continuous semesters including the period of his/her programme, provided an amount equivalent to the semester fees for all the intervening semesters have been regularly paid and provided he/she has not been removed from the rolls by issuing a Transfer Certificate.

In all cases of discontinuation and readmissions, candidates must submit applications countersigned by the HOD to the CSS section and obtain the required statutory order for the same. Candidates who are readmitted to repeat a course must follow the then existing syllabus for the said programme and will have no assurance to do the repeat course in the same syllabus which he/she had attempted initially for the course. They need to attend classes along with new batch of students and should obtain the required percentage of attendance as usual.

10. Issue of Grade Card: Grade card will be given to the student at the end of each semester that will indicate the grades he/she has obtained as well as the semester grade point average (SGPA) which is the weighted average of the numerical value (grade point) obtained by him/her in the semester. Weighted average is calculated by dividing the sum of the product of the grade point or numerical value obtained for each course and the credits that it carries by the total number of credits earned. The Cumulative Grade Point Average (CGPA) for the whole programme will be calculated in the same way, which will also be indicated in the Grade Card. M**inimum SGPA in all semesters is not an assurance to minimum CGPA for the entire programme**.

11. 1. Percentage Equivalence of Grade:

Range of % of Marks	Grade Letter	Grade Point
95 - ≤100	O	10
85 - <95	A plus	9
75 - <85	A only	8
65 - <75	B plus	7
55 - <65	B only	6
45 - <55	C	5
40 - <45	P	4
<40	F	0
Absent	Ab	0

11.2: Calculation of Semester Grade Point Average (SGPA) :

Credit Points for the Course = No. of Credits assigned for the course x Grade Point secured for that course.

SGPA indicates the performance of a student in a given Semester. SGPA is based on the total **credit points** earned by a student in all the courses divided by the total number of credits assigned to the courses required in a Semester. **Note: SGPA is computed only if the candidate passes in all the required courses (gets a minimum required grade for a pass in all the required courses as per the specific curriculum). Securing of SGPA in all semesters may not enable students to have minimum required CGPA for a pass in the programme.**

SGPA = Total **credit points** earned by the student from all the required courses of a Semester

Total credits of all courses required in a semester

11.3. Calculation of Cumulative Grade Point Average (CGPA)

CGPA refers to the Cumulative Grade Point Average weighted across all the semesters (4 Semesters). CGPA is obtained by dividing the total number of credit points earned by the student in all the semesters by the total number of required credits of all the Semesters as per curriculum.

CGPA = Total CPts of Semester- S1 + 2 + 3 + 4 ...

Total Credits of Semester- S1 + 2 + 3 + 4..

OR

SGPA of I Semester x Total Credits of I Sem] + [SGPA of II Semester x Total Credits of II Sem] + [SGPA of III Semester x Total Credits of III Sem] + [SGPA of IV Semester x Total Credits of IV Sem]

Total Credits of I Semester + Total credits of II Semester + Total credits of III Semester + Total credits of IV Semester

This formula shall be printed on the Grade Card issued to the student with a note that it could be used to convert the grades into mark-percentages. (The details of the grading system as indicated in section 11.1 & 11.2 above shall also be printed on the Grade Card).

Conversion of SGPA/CGPA to Grade

10	O
9.0 - <10	A plus
8.0 - <9	A only
7.0 - <8	B plus
6.0 - <7	B only
5.0 - <6	C
4.0 - <5	P
<4	F
Absent	Ab

Conversion of CGPA to percentage

Equivalent Percentage = (CGPA obtained) X 100

Maximum CGPA (=10)

12. **Position Certificate**: The position certificate shall be given for the 1st five positions. Students who have completed the course by availing of the improvement examinations for a course or reappearance for a course will not be eligible for position certificate.

If Rank certificate in a prescribed format is demanded by institutions for awarding a specific fellowship/scholarship such as for DST Inspire Fellowship etc, the rank certificate may be given for such students as a special case in the prescribed format.

13. Registration of student enrolment with the CSS: The list of students registered for each semester programme should be forwarded to the CSS along with original certificates (Degree Certificate + SSLC) immediately after closing the admission of first semester programme.

14. Consolidation and Declaration of Results:

All work pertaining to the examinations shall be held in the Schools/ Centres/Institute of study and research under the direct control and supervision of the directors/heads of the departments. The director of each School/Center/Institute will, in consultation with the Faculty Council directly control the internal/external examinations and evaluations or nominate a teacher as the chief examiner who will assist him/her in the matter. The marks awarded for internal assessment will be displayed in the School's notice board at the end of each semester.

If a student has any complaint regarding the marks received in internal assessment, he/she should report it to the concerned faculty member within 3 working days from the date of publication of the same on the notice board. Thereafter, complaints against internal marks will not be entertained under any circumstance. The pass board of a School/ Centre/Institute will consist of selected teachers/ the entire faculty of the School/Department/Centre/Institute concerned and will be constituted by the Director in consultation with the Faculty Council.

The tabulated grade sheets will be forwarded after each end-semester examination to the office of the controller of examinations. The CSS section in the Controller's office will check

the Grade card forwarded from the Department/School/Centre/Institute and notify the results after consolidating them and issue statement of credits. On completion of the final semester a consolidated Grade Card showing the details of all the courses taken will be prepared. The consolidated Grade Card containing the details of all the courses with their titles, credits, grades obtained, the total credits earned, the SGPA and the CGPA will be issued to students.

15. CSS Academic Advisory Committee

There will be a separate section in the Controller of Examination's office with an Academic Advisory Committee consisting of representative Directors/Teachers from the University Departments to oversee and coordinate the conduct of the CSS work. The following will be the composition of the

CSS Academic Advisory Committee:

Pro-Vice-Chancellor (Chairperson)

Deans of various Faculties of the University Departments (2 selected deans)

Directors/Professors of University Departments (4 persons), one of them has to act as the Convenor

University Teachers (4 teachers)

Syndicate Member (1 member)

Registrar

Controller of Examinations

Joint/Deputy/Assistant Registrar of CSS

Section Officer CSS

The nomination of the members of the CSS Academic Advisory Committee will be made by the Vice Chancellor. The committee will be reconstituted every three years. The Academic Advisory committee, apart from coordinating and sorting out inter-school matters pertaining to the CSS, will handle student grievances relating to semester examinations that cannot be resolved at the School/Department/Centre/Institute. Only student grievances that cannot be settled by the faculty council of the school need be forwarded to the CSS Academic Advisory

Committee and the Vice Chancellor. Student grievances that cannot be settled by the CSS Academic Advisory Committee and the Vice Chancellor shall be dealt with by the Syndicate.

The CSS Committee will also prepare a uniform examination schedule for all the programmes in the university. A common admission schedule for all the Departments in the University will also be prepared by the Academic Advisory Committee. All other work pertaining to the CSS will be conducted at the University Departments/Schools of Teaching and Research.

16. Issue of Certificates:

On completion of a semester (when results are ready) the Director/Coordinators of all programmes shall forward tabulated grade sheets along with the minutes of the pass board meeting showing details to the CSS Section; in the case of final semester, consolidated details of all semesters showing total number of candidates registered, appeared and passed in the prescribed format shall also be furnished.

Grade cards to all students who have undergone the courses under the CSS are issued by the office of the Controller of Examinations through the Departments/Schools concerned. Consolidated grade cards are also issued. Fee for the issue of grade cards will be announced by the University from time to time.

17. Financial Provision:

Adequate budgetary provision shall be made for each Department to meet the TA/DA of invited External Examiners and other examination-related costs.

FIRST SEMESTER PROGRAMME IN BIOPHYSICS

SCHEME OF FIRST SEMESTER PROGRAMME

Sl No	Course Code	Course Title	Credits
1	SBS M I C 1701	Biochemistry	3
2	SBS M I C 1702	Microbiology	3
3	SBS M I C 1703	Cell Biology, Genetics & Evolution	3
4	SBS M I C 1704	Biophysics & Biostatistics	3
5	SBS M I C 1705	Physiology	3
6	SBS M I C 1706	Laboratory Course - 1	3
7	SBS M I C 1707	Laboratory Course - 2	3
		Total Credits of the First Semester Programme	21

SBS M I C 17 01 BIOCHEMISTRY

Course Objectives:

1. To have a fundamental understanding about Biomolecules and their function in Biological systems

Module No	Module Content	Credits
1	**Carbohydrates:** Classification of Carbohydrates with examples; Detailed study on Polysaccharides - occurrence, structure, isolation, properties and functions of homoglycans- starch, glycogen, cellulose, dextrin, inulin, chitins, xylans, arabinans, galactans. Occurrence, structure, properties, and functions of heteroglycans – bacterial cell wall polysaccharides, glycoaminoglycans, agar, alginic acid, pectins, amino sugars and deoxv sugars, blood group substances and sialic acids. Glycoprotein and their biological applications. Lectins structure and functions.	
2	**Vitamins and Porphyrins:** Vitamins -water soluble -thiamine, riboflavin, niacin, pyridoxine, folic acid, ascorbic acid-source, structure, biochemical functions, deficiency diseases, daily requirements; fat soluble -vitamin A, vitamin D2, vitamin E and vitamin K -sources, structure, biochemical functions, deficiency diseases, daily requirements. Porphyrins the porphyrin ring system, chlorophyll, hemoglobin, myoglobin and cytochrome.	

3.	**Lipids:** Classification -saturated and unsaturated fatty acids, phospholipids - classification, structure and functions. Ceramides and sphingomyelins. Eicosanoids, structure and functions of prostaglandins, thromboxanes, leukotrienes Types and functions of plasma lipoproteins. Amphipathic lipids -membranes, micelles, emulsions and liposomes. Steroids -cholesterol structure and biological role -bile acids, bile salts. Sterols in Plant system: Phytohormones: Brassinosterroids (functions); Sterols in microbial system: mycosterols	
4	**Protein structure and function:** Classification of proteins on the basis of solubility and shape, structure, and biological functions. Isolation, fractionation and purification of proteins. Denaturation and renaturation of proteins. Primary structure -determination of amino acid sequence of proteins. Detailed study on structure and function with an example: Membrane protein (ATP synthase), Fibrous Protein (Collagen) Globular protein (Hemoglobin)	
5	**Nucleic Acid Structure:** Watson -Crick model of DNA structure. A, B and Z DNA Cruciform structure in DNA, miscellaneous alternative conformation of DNA, Methods for nucleic acid sequence determination, isolation and purification of DNA, molecular hybridization, Cot value curve, ; Organization of the DNA Sequence: Genes, pseudogenes, extragenic regions (beta globin gene and gene family) duplicated genes; Reassociation kinetics, 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 and rRNA ,Si RNA, micro RNA with emphasis on importance of structure to its function	
	Total Credits of the Course	3

Books for Reference

Compulsory Reading:

1. Principles Of Biochemistry, 4/e (2006) by Robert Horton H , Laurence A Moran, Gray Scrimgeour K **Publisher:** Pearsarson **ISBN:** 0131977369, **ISBN-13:**9780131977365, 978-0131977365
2. Biochemistry 6th Edition (2007) by Jeremy M.berg John L.tymoczko Lubert Stryer **Publisher:** B.i.publicationsPvt.Ltd **ISBN:**071676766X **ISBN-13:** 9780716767664, 978-716767664

Further Reading:

- Biochemistry: A Students survival Guide by Hiram. F. Gilbert (2002) Publishers: McGraw-Hill ISBN 0-07-135657-6
- Introduction to Biophysics by Pranab Kumar Banerjee (2008) Publishers: S. Chand & Company ltd ISBN: 81-219-3016-2
- Lehninger Principles of Biochemistry, Fourth Edition by David L. Nelson Michael M. Cox Publisher: W. H. Freeman; Fourth Edition edition (April 23, 2004) ISBN-10: 0716743396 ISBN-13: 978-0716743392
- **E.S. West**, **W.R. Todd**, **H.S. Mason and J.T. van Bruggen**, A **Text Book of Biochemistry**, Oxford and IBH Publishing Co., New Delhi, 1974
- Biochemistry [with Cdrom] (2004) by Donald Voet, Judith G. Voet **Publisher:** John

Wiley & Sons Inc **ISBN:** 047119350X **ISBN-13:** 9780471193500, 978-0471193500

- Principles Of Biochemistry (1995) by Geoffrey L Zubay, William W Parson, Dennis E Vance **Publisher:** Mcgraw-hill Book Company – Koga **ISBN:**0697142752 **ISBN-13:** 9780697142757, 978-0697142757
- Molecular Biology of the Cell by Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter Publisher: Garland Science; 5 edition ISBN-10: 0815341059 ISBN-13: 978-0815341055
- Genes IX by Benjamin Lewin (2008) Publisher: J&b ISBN:0763752223 ISBN-13: 9780763752224, 978-0763752224
- 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
- Cell and Molecular Biology, 3e (2003) by Karp Publisher: Jw ISBN: 0471268909 ISBN-13: 9780471268901, 978-0471268901
- Molecular Cell Biology (2002) by H.S. Bhamrah Publisher: Anmol Publications ISBN: 8126111429 ISBN-13: 9788126111428, 978-8126111428

SBS M I C 17 02: MICROBIOLOGY

Course Objectives:

1. To introduce the scope of microbiology

2. To familiarize students the microbial diversity and its taxonomy

3. To introduce physiology of microbes and to acquaints with the basic principles of sterilization.

Module No	Module Content	
1	**History and scope of microbiology:** The historical foundations and development of microbiology. An overview of microbial world. .The bacteria and the archae. Principles of bacterial taxonomy, Molecular methods in taxonomy. Intraspecies classification of bacteria.	
2	**Microbial Diversity:** Microbial diversity - Prokaryotic and eukaryotic microbial diversity. Morphology and structure of bacteria. Surface structures and inclusions of bacteria; Viruses unique properties, morphology, structure and cultivation. Viroids and Prions. Viral replication.Viral diversity– bacterial, plant and animal viruses. Fungi - properties and classification. Microorganism in extreme environments.	
3.	**Microbial physiology:** Factors influencing microbial growth. Environmental and nutritional factors. Nutritional types of bacteria. Microbial growth curve. Mathematical expression of growth- continuous and batch cultures. Diauxic and synchronous growth. Measurement of bacterial growth.Cultivation of bacteria- culture media and methods. . Aerobic and Anaerobic culture methods. Culture preservation techniques and Culture collection centers.. Microbial locomotion – flagellar motility, gliding motility and amoeboid	

	motion. Chemotaxis, Phototaxis and other taxes. . Microbial photosynthesis	
4	**Identification of bacteria and Sterilisation methods:** Identification of bacteria. Staining reactions. Cultural, physiological and biochemical properties. Molecular methods for identification. Sterilisation – Principles and methods, physical and chemical methods. Disinfectants – modes of action. Testing of disinfectants. Antibiotics – mechanism of action. Drug resistance in bacteria. Antibiotic sensitivity tests	
	Total Credits of the Course	3

Books for Reference

Compulsory Reading:

1. Prescott, L. M., Harley, J. P. and Klein, D. A.2014. *Microbiology*. 9th Edition. Edition, McGraw Hill Higher Education.
2. Pelczar, M. J. Jr., Chan, E. C. S. and Krieg, N. R. 1993. *Microbiology*, 5th Edition, Tata MacGraw Hill Press.

Further Reading:

1. Jeffrey C.Pommerville.2016.Alcamos fundamentals of microbiology. Tenth Edition. Jones and Bartlett Learning.
2. Tortora G. J., Funke B. R. and Case C. L. 2015. *Microbiology: An Introduction*. 12th Edition. Pearson Education Inc.
3. Madigan, M. T. and Martinko, J. M. 2015. *Brock's Biology of Microorganisms*. 14th Edition. Pearson Education Inc.
4. Pelczar, M. J. Jr., Chan, E. C. S. and Krieg, N. R. 1993. *Microbiology*, 5th Edition, Tata MacGraw Hill Press.
5. Prescott, L. M., Harley, J. P. and Klein, D. A.2014. *Microbiology*. 9th Edition. Edition, McGraw Hill Higher Education.
6. Willey, J. M., Sherwood, L. M. and Woolverton, C. J. 2013. *Prescott's Microbiology*. 8th Edition, McGraw-Hill Higher Education.
7. Stanier, R. Y., Adelberg, E. A. and Ingraham, J. L. 1987. *General Microbiology*, 5th Edition. Macmillan Press Ltd.
8. Russell, A. D., Hugo, W. B., and Ayliffe, G. A. J. 2013. *Principles and practice of disinfection, preservation and sterilization*, 5th Edition. Blackwell Science, Oxford.
9. Black, J. G. 2013. *Microbiology: Principles and Explorations*. 6th Edition, John Wiley and Sons, Inc.

SBS M I C 1703: CELL BIOLOGY, GENETICS & EVOLUTION

Course Objectives:

1. To acquaint students with the frontier areas of Cell Biology and Genetics
2. To explain the current developments in different fields of cell biology, genetics and evolution

3. To keep our course in parity with CSIR/UGC syllabus content in these subjects		
Module No	**Module Content**	
1	**Cell and its constituents: Cell constituents -** Mitochondria , Chloroplast, Endoplasmic Reticulum Golgi complex, Peroxisomes, Lysosome, Ribosome, Nucleus, Nucleolus, Chromosomes, Nucleosomes, Histones, Genome, Genomics ,Proteomics. **Cell cycle and Cancer: Cell cycle -** Different stages, variations, checkpoints, regulations of cell cycle, maturation Promoting factor, cells, cyclins , ubiquitin, protein ligases, Anaphase Promoting complex, inhibitors of CdK, growth factors and D cyclins. Rb protein and E2F transcription factors. **Cancer -** Stages in cancer development, causes, properties of cancerous cells, tumor Viruses, oncogenes, functions of oncogene products, oncogene and signal Transduction , oncogene and G proteins, oncogene and cell survival, Tumor Suppressor gene, functions of tumor suppressor gene products, Diagnosis ,prevention and treatment of cancer	
2	**Cell Differentiation**-Stages of development, regulation of development, cascade control/ Differentiation in Drosophila, maternal, Segmentation and homeotic Genes, Genetic control of embryonic development, Bi thorax mutant, Antennapediac mutant ,Hemeobox **Aging** Process of aging, theories of aging, Arking's contribution Oxidative stress, Telomere problem, DNA repair defects. **Cell Death** Necrosis and Apoptosis, Differences between necrosis and Apoptosis, stages in Apoptosis, mitochondrial damage DNA ladders, transglutaminase activity, programmed cell death in *Ceanorhabdtis elegans* CED 3, CED 4, CED 9 and their roles in Apoptosis Bax, Bid, Bcl2 protein	
3.	**Classical Genetics:** Genetics, the evolution of the subject through pre mendelian, Mendelian and post Mendelian Peroids. Mendelism – the basis principles of inheritance, gene interactions – allelic and no allelic. Environment and gene expression, penetrance and expressivity. Multiple alleles and polygenic inheritance, Heritability and genetic advance **Evolution:** Origin of the universe and origin of life; concept of Oparin, Miller-Urey Experiments; Evolution of Prokaryotes - origin of eukaryotic cells - Margulis Endosymbiotic theory; **Geological Timescale:** Tools and techniques in estimating evolutionary time scale; **Theories of evolution of life**: Pre-Darwinian concepts – Lamarkism, Darwinism – major concepts - variation, adaptation, struggle, fitness and natural selection, Neo-Darwinian theories – theories of speciation – allopatric and sympatric speciation - Rose Mary and Peter Grant (Molecular evolution in Darwinian finches) - Neutral Theory of Molecular Evolution.	

4	**Chromasome genetic mapping ,Organelle Genetics and Population Genetics:** Linkage and linked genes with special reference to inheritance, Chromosome mapping with three - point test crosses. Organelle Genetics and cytoplasmic inheritance. Population Genetics – types of gene variations, Measuring genetic variations, Hardy Weinberg principle and its deviations. Medical genetics - an introduction	
5	**Microbial Genetics**:Genetic System in Microbe, Plasmids & bacterial sex. Types of plasmids. Plasmids copy number and incompatibility, Replication of plasmid. Plasmid a cloning vector. Episomes. Transposable element-IS element and transposon, Integrons and Antibiotic resistance cassettes, Multiple antibiotic resistant bacteria, Mu-virus. Gene mapping in Bacteria. Bacteriophage genetics-Plaque formation & phage mutants, genetic recombination in lytic cycle. Genetic system in Yeast & Neurospora.	
	Total Credits of the Course	3

Books for Reference

Compulsory Reading:

1. Jonathan B (2016) Principles of Evolution, Garland Science, Taylor and Francis

2. Strickberger M W (2015) Genetics 3rd Edition, Pearson

Further Reading:

1. Principles of Genetics, Snustad, Simmons and Jenkins, John Wiley And Sons Inc
2. Genetics, Robert Weaver and Philip Hendricks, WH.C. Brown Publishers, Iowa
3. Introduction to Genetic Analysis, Griffiths, Wessler, Lewontin, Gelbart,Suzuki and Miller, Freeman's and Co, New York
4. REA's Problem Solvers in Genetics, Research Education Association,61, Ethel Roadwest, New Jersey
5. Cell and Molecular Biology by Cooper
6. Cell Biology by De Robertis

SBS M I C 1704: BIOPHYSICS AND BIOSTATISTICS

Course Objectives:

1. To introduce interdisciplinary Biophysics area, its scope and its importance
2. To give an insight into the basic concepts of thermodynamics, importance of basic biophysical phenomena, conformation and conformational changes, interaction of protein with other molecules and basic knowledge about radiation, its interaction with matter and its applications.
3. To familiarize the basic concepts of biostatistics and its importance in research area of Life sciences

Module No	Module Content	
1	Scope and definition of Biophysics. Laws of thermodynamics, enthalpy, entropy and free energy, thermodynamic equilibrium. Redos reactions, Redox potential and its calculation by Nernst equation, examples of redox reactions in biological system.Biological importance or redox reactions. Principle and biological importance of physical phenomena- osmosis,osmotic pressure, osmotic equilibrium diffusion, Fick's law, sedimentation, filtration, surface tension, dialysis, adsorption, Colloids- classification, properties and importances of colloids, Osmosis, Osmotic pressure, Osmotic equilibrium, Donnan equilibrium, Electroosmosis	
2	DNA- protein interaction and RNA- protein interactions. DNA-binding proteins: prokaryotic transcription factors, Helix-turn-Helix motif in DNA binding, Trp repressor, Eukaryotic transcription factors, Zn fingers, helix-turn helix motifs in homeodomain, Leucine zippers. Electromagnetic spectrum Ionizing and nonionizing radiation. Properties and biological effects of ultraviolet radiation, lasers, microwave radiations and ultrasonic waves. Radioactivity, Interaction of radiation with matter. Units of Radiation. Biological effects of radiation. Applications of ionizing and non-ionising radiations in industry, agriculture and research. Radiation Hazards. Introduction to proteomics and Bioinformatics	
3.	Introduction to Biostatistics. Scope of Biostatistics, probability and probability distribution analysis. Variables in biology- collection, classification and tabulation of data- graphical and diagrammatic representation- scatter diagrams, histograms- frequency polygon- frequency curve-logarithmic curves. Descriptive statistics- measures of central tendency, Arithmetic mean, median, mode, geometric mean, harmonic mean. Measures of dispersion, standard deviation, standard error, variance, coefficient of variation. Correlation and Regression	
4	Test of significance. Basic idea of significance test- hypothesis testing, levels of significance. Testing of single mean, double mean, single proportion, double proportion in large sample. Testing of single mean, double mean and Paired- t in small sample. ANOVA- One way and Two way; Chi-square test of goodness of fit and Chi-square test of independence, comparison of means of two samples, three or more samples. Fundamentals of field experiments-randomization, replication and local control. CRD and RBD. Statistical packages	
	Total Credits of the Course	3

Books for Reference

Compulsory Reading:

1. Proteins, Structure and molecular properties, Thomas E Creighton
2. Fundamentals of Biostatistics: Irfan.A. khan, Atiya Khanum, Ukaaz publications
3. Principles of Biostatistics: Marcello Pagano, Kimberlee Gauvreau, Duxbury Press
4. Biochemistry: Donald Voet and Judith G Voet, Wiley Publications

Further Reading:

5. Biophysics-Hoope W etal
6. Biophysics-Volkenstain M.V
7. Molecular Biophysics- Volkenstain M.V
8. Introduction to thermodynamics of irreversible process-John Wiley
9. Statistical methods in Biology- Briley N.J.T
10. Introduction to Biophysics-Sokal R.R & Rohl F.J
11. Biostatistics: Pardeep.K.Jasra, Gurdeep Raj, Krishna prakashan Media.(P) Ltd

SBS M I C 1705: PHYSIOLOGY: TOTAL CREDITS

Course Objectives:

1. To provide students with an understanding of the function & regulation of the human body and physiological integration of the organ systems to maintain homeostasis.
2. Course content will include study of the musculoskeletal, cardiovascular, respiratory, digestive, excretory, and endocrine organ systems.

Module No	Module Content	
1	Body organization, chemical composition of the body, body fluid compartments, homeostasis, characteristics of homeostasis control systems, process related to homeostasis, movement of molecules across cell membranes, intercellular chemical messengers, control of cells by chemical messengers. Physiology of excitable cells- transmembrane potentials, passive and active properties of membranes, action potentials and ion channels, ions and excitability, nerve trunk and tracts, neuromuscular junction, post synaptic potentials, types of muscles, properties of muscle, motor unit, contractile force, principles of excitation and contraction of muscles	
2	Cardiovascular physiology- design of the circulatory system, importance of pressure, flow and resistance, heart beat coordination, cardiac cycle, cardiac output, vascular system, blood pressure, integration of cardiovascular function, blood, hemostasis Respiratory physiology- organization of respiratory system, ventilation and lung mechanics, exchange of gases in alveoli and tissues, transport of oxygen in blood, transport of carbon dioxide in blood, transport of hydrogen ions between tissues and lungs, control of respiration, hypoxia, non respiratory functions of lungs	
3.	Renal physiology- Structure of kidney and urinary system, renal processes, renal clearance, micturition, regulation of sodium, water and potassium balance, calcium ion regulation, hydrogen ion regulation, acid-base balance, diuretics, hemodialysis	

	Gastrointestinal physiology- structure and functions of astrointestinal organs, digestion and absorption of food, regulation of gastrointestinal processes, endocrine and neural control of the absorptive and post absorptive state, diabetes mellitus, hypoglycemia, increased plasma cholesterol	
4	Endocrine physiology- principles of hormonal control systems- hormone structure and synthesis, hormone transport in blood, hormone metabolism and excretion, mechanism of hormone action, hyposecretion, hypersecretion hyporesponsiveness and hyperresponsiveness, hormones in brief- pituitary and hypothalamus hormones, nuerohypophysial hormones, melanotropic hormones, hormonal control of calcium homeostasis, gastrointestinal hormones, pancreatic hormones, growth hormones, thyroid hormones, adrenal hormones, sex hormones, neurohormones	
	Total Credits of the Course	3

Books for Reference

Compulsory Reading:

1. Vander's Human Physiology- The mechanism of body function. Widmaier, Raff & Strang
2. Text Book of Medical Physiology. Arthur.C.Guyton & John.E.Hall

Further Reading:

1. Physiological basis of Medical Practice. John.B.West
2. Endocrinology- Mac E Hadley

SBS M I C 17 06 LABORATORY COURSE 1:BIOCHEMISTRY

Course Objectives:

1. To enable development of Practical skill and develop analytical abilities and writing experimental reports

Module No	Module Content	Credits
1	Preparation of solutions: • Percentage solutions, • Molar solutions, • Normal solutions • Dilution of Stock solutions Preparation of buffers using the Henderson Hasselbach equation	

2	Spectrophotometric experiments: • Verification of Beer Lambert's law • Determination of UV-Visible spectrum of compounds • Determination of Concentration of molecules from Molar Extinction Coefficient values Chromatographic techniques • Separation of amino acids by Paper chromatography (Descending or Ascending) Separation of Plant pigments by Thin layer chromatography	
3.	Extraction of Polysaccharides (Starch, Glycogen), Proteins, and Lipids from appropriate source: • Quantification of isolated polysaccharide (anthrone method), protein (Lowry's method) Estimations • Quantitative estimation of reducing sugars by Dinitrosalicylic acid method • Quantitative estimation of Methionine by Nitroprusside method • Saponification value, iodine value, of fat sample • Estimation of Cholesterol by Zak's method	
4	Qualitative analysis of Carbohydrate mixtures (a combination of polysaccharide, disaccharide and monosaccharide) following systematic scheme for analysis. (Starch, dextrin, glycogen, glucose, fructose, xylose, galactose, sucrose, maltose, lactose)	
	Total Credits of the Course	3

Books for Reference

Compulsory Reading:

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), Kalyani Publishers, Ludhiana ISBN 81-7663-067-5, p 12 - 182.

Further Reading:

3. Hawk's Physiological Chemistry, Bernard L. Oser (ed) TATA McGRAW Hill Publishing Company LTD, New Delhi, p 60 – 127, 1317- 1334

4. Experimental Biochemistry: A Student Companion, Beedu Sasidhar Rao & Vijay Deshpande (ed), I.K International Pvt. LTD, New Delhi ISBN 81-88237-41-8, p 13- 17, p 49 - 72

5. Practical Biochemistry, R.C. Gupta & S. Bhargava (eds) CBS Publishers and Distributors, New Delhi, ISBN 81-239-0124-0 p 9 – 27

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

SBS M I C 1707 LABORATORY COURSE-2 – PHYSIOLOGY

Course Objectives:

1. The purpose of this laboratory course is to provide the student with the opportunity to observe many of the physiological principles that are essential to human function.
2. This laboratory course is designed to introduce students to physiology-related skills and techniques used in both research and clinical settings.

Module No	Module Content	Credits
1	**Haematology** i) Determination of haemoglobin concentration ii) Enumeration of formed elements- red blood cells & white blood cells iii) Study of blood smear for differential count and cell morphology iv) Erythrocyte sedimentation rate v) Determination of bleeding time vi) Determination of clotting time	
2	**Respiratory physiology- Pulmonary function testing** i) Demonstration on recording of tidal volume ii) Demonstration on recording of vital capacities iii) Demonstration on recording of inspiratory & expiratory flow rates	
3.	**Cardiovascular physiology- Electrocardiography** i) Demonstration on ECG recording- human or animal model ii) Identification of ECG waves Calculation of heart rate from ECG	
	Total Credits of the Course	3

Books for Reference

Compulsory Reading:

1. Medical Laboratory Technology-A procedure Manual for Routine Diagnostic Tests- Kanai L Mukherjee
2. Pocket Guide to Spirometry- David P Johns and Rob Pierce

Further Reading:

3. Spirometry in Practice- A practical guide to using spirometry in primary care- Dr. David Bellamy, British Thoracic Society COPD consortium
4. ECGs made easy- Barbara J Aehlert

SECOND SEMESTER PROGRAMME IN BIOPHYSICS

SCHEME OF SECOND SEMESTER (Total 21 Credits)			
8	SBS M II C 1708	Immunology	3
9	SBS M II C 1709	Molecular Biology and Genetic Engineering	3
10	SBS M II C 1710	Metabolism and Bioenergetics	3
11	SBS M II C 1711	Biophysical Techniques and Bioinstrumentation	3
12	SBS M II C 1712	Laboratory Course - 3	3
13	SBS M II C 1713	Laboratory Course - 4	3
		Elective Course to be selected from the options given below	3
		Total Credits of the 2nd Semester Programme	21
Elective Courses Offered by Different Teachers in the 2nd Semester			
14	SBS M II E 1714	Microbial Technology	3
15	SBS M II E 1715	Ecology and Environment	3
16	SBS M II E 1716	Neurobiology	3
17	SBS M II E 1717	Environment Science	3
18	SBS M II E 1718	Molecular Microbiology	3
19	SBS M II E 1719	Developmental Biology	3

SBS M II C 1708 IMMUNOLOGY

Course Objectives:

1. To introduce the importance and mechanisms involved in immunological reactions

2.To introduce techniques based on immunological reactions

3.To introduce applications of immunology

Module No	Module Content	Credits

1	Infection, Source and methods of transmission, Immunity, Types of immunity. Mechanisms of innate immunity, PAMP pattern recognition receptors, types, scavenger receptors and toll – like receptors, Phagocytes and Phagocytosis, Organs and cells with immune functions. Lymphocytes and lymphocyte maturation.	
2	Antigens, Epitopes and paratopes, B-cell and T-cell epitope, Antigenicity and Immunogenicity, Antibodies, Immunoglobulin – structure, classes and functions. Genetic basis of antibody diversity, Organization and Expression of Immunoglobulin Genes, V(D)J rearrangements; recombination signal sequences and their role, somatic hypermutation and affinity maturation Antigen-antibody reactions, Agglutination, Precipitation, Immunoflourescence, Complement fixation, Radioimmuno assay, ELISA, Western blotting	
3.	Immune response- Humoral and cell mediated, Receptors on T and B cells for antigens, MHC, TCR- mediated signaling, Signal transduction pathways associated with T-cell activation, Signal transduction by activated B- cell receptor, Antibody production, Primary and secondary immune response, Factors influencing antibody production, Clonal selection theory, Monoclonal antibodies – production and application, Antibody engineering. Complement system, Complement activation, Biological effects of complements, Antigen processing and presentation, Activation of T-cells, T-cell function, Cytokines.	
4	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	
5	Immunological Tolerance, Autoimmunity, Mechanisms of autoimmunization, Autoimmune diseases. Inflammation, Hypersensitivity – immediate and delayed reactions, Clinical types of hypersensitivity, Immunodeficiency diseases, Immunoprophylaxis, Vaccines –types of vaccines, DNA vaccine, recent trends in vaccine development.	
	Total Credits of the Course	**3**

Books for Reference

Compulsory Reading:

1. Immunology - Thomas J. Kindt, Barbara A. Osborne, Richard A. Goldsby, and Janis Kuby, W H Freeman and Co., 2013
2. Immunobiology - Charles A. Janeway Jr.,Paul Travers, Mark Walport and Mark J. Shlomchik, Garland Publishing., 2016

Further Reading:

3. Essential Immunology - Ivan M. Roitt and Peter J delves, Blackwell Publishing, 2016
4. Essential Clinical Immunology – Helen Chappel and Mansel Haeney, ELBS/Blackwell Scientific Publications, 2014

5. Introduction to Immunology – John W, Kimball Maxwell, Mac Millan International Edition, 1990
6. Text book of Microbiology – R. Ananthanarayanan and C K Jayaram Panicker. Orient Longman,2013

SBS M II C 1709 MOLECULAR BIOLOGY AND GENETIC ENGINEERING

Course Objectives:

1. To introduce Molecular Biology and Genetic Engineering as the most dynamic and attractive courses in all branches of applied life sciences
2. To train the students in both theoretical and practical aspects of the subject
3. To get an idea about the latest developments taking place in this subject

Module No	Module Content	Credits
1	**DNA Replication –** Process of DNA replication, Semiconservative, discontinuous uni and bidirectional , Okazaki fragments, DNA polymerases in eukaryotes and prokaryotes , Klenov fragment, modes of replication, theta, rolling circle, d-loop replication, Primasome, SSB, Helicase, Ligase, methylation and control, repetitive DNA sequences, minisatellite, microsatellite, DNA protein interation DNA Linking number and topoisomerase, Inhibition of replication.	
2	**Transcription**. Process of transcription, stages in transcription, RNA polymerases in prokaryotes and enkaryotes, sigmafactor 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 Rihozyme, Importance of ribozyme, properties, application, RNase P, RNAse III, RNAse H. monocistonic and polysistronic 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,+ & -ve regulation; Operon concept, structure of operon, Lac, Trp, Arc operon, Catabolic repression, Atteunation. Role of Hormones in gene regulation. RNA World, RNA based technology- Molecular mechanism of Ribozyme, Antisense RNA, SiRNA, MicroRNA, Ribozwitches & their applications; Telomerase structure and function .Nucleic acid as therapeutic agent	

3.	**Translation:** Process of translation. Stages in translation, genetic code, properties, wobble hypothesis, eukaryotes and prokaryotes ribosomes, m-RNAs, t-RNAs, aminoacyl t-RNA synthatases, 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. Protein targeting, cotranslational import, post translational import, SRP- structure and function, Blobel's concept, Lysosome targeting, M6P address Glycosylation core glycosylation terminal glycosylation, Dolichol phosphate.	
4	**Tools and techniques for genetic Engineering:** History of rDNA Technology ,Cohen And Boyer Patents, Isolation of DNA and RNA from different sources, enzymes used in genetic engineering with special reference to restriction enzymes, ligases, and other DNA modifying enzymes. End modification of restriction fragments, vaccinia topoisomerases mediated ligation of DNA, TA cloning, and homopolymer tailing Vectors for E coli with special reference to plasmid vectors (pSC101, pBR322,pUC,their development, features and selection procedures),direct selection plasmid vectors, low copy number plasmid vectors, runaway plasmid vectors, Bacteriophages (λ and M13) with special reference to Charon phages, λEMBL, λWES λB', λ ZAP- their development, features, selection procedures, *in vitro* packaging mechanisms for phage vectors, cosmids, features, advantages and cosmid cloning schemes, phagemids with special reference to pEMBL, pBluescript, pGEM3Z , pSP64, pcDNA, pLITMUS Construction of genomic libraries and cDNA libraries, procedures for recombinant selection and library screening, PCR enzymes, types of PCR, primer design, real time PCR, RTPCR, Nested PCR, Inverse PCR, Assymmetric PCR, applications of PCR Cloning, Chemical synthesis of DNA, DNA sequencing:- plus and minus sequencing, Sangers dideoxy sequencing, Maxam and Gilberts method. Advanced sequencing procedures: – pyrosequencing, Illumina, ABI / SOLiD and their applications	
5	**Appications of Genetic Engineering:** Applications of transgenic Technology Improving quality, quantity and storage life of fruits and vegetables. Plants with novel features, Engineering metabolic pathways, Pharming. Animal cloning, Ethics of cloning. Applications of Molecular Biology in forensic sciences, medical science, archeology and paleontology	
	Total Credits of the Course	3

Books for Reference

Compulsory Reading:

1. Principles of gene manipulation – Old and Primrose, Blackwell Scientific publishers, Edn.5th
2. Genes-Benjamin Lewin, Jones and Barlett Publishers, 9 th edition, New York ISBN: 9780763752224, 0763752223

Further Reading:

3. Principles of gene manipulation – Old and Primrose, Blackwell Scientific publishers, Edn.5th
4. Principles of gene manipulation – Old, Primrose, and Twyman, Blackwell Scientific publishers, Edn. 6th
5. Principles of gene manipulation – Old, Primrose, and Twyman Blackwell Scientific publishers, Edn 7th
6. Molecular biotechnology, Principles and Applications of Recombinant DNA, Glick Pasternak and Patten, 4th edition ISBN 978-1-55581-498-4 Wiley International Publishers
7. From gene to genomes – Concepts and applications of DNA technology Jeromy W Dale and Malcom von Shantz , John Wiley and sons
8. Principles of plant biotechnology: An introduction to genetic engineering in plants – SH Mantell
9. Cell and Molecular Biology by Gerald Karp, Academic Press, seventh Edition, Wiley publishers

SBS M II C 1710: METABOLISM AND BIOENERGETICS

Course Objectives:

1. To have a deep understanding on metabolic process in biologic system and their regulation

Module No	Module Content	Credits
1	**Metabolic Pathways:** Carbohydrate, Protein, Amino acid and Nucleic acid Metabolic pathways (Catabolic pathways & Anabolic Pathways)	
2	**Bioenergetics:** 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 cytochromes, ferro-sulphurated 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	
3.	**Regulation of metabolism:** Hormonal and Allosteric regulation of pathways in carbohydrate, fat, nucleotide and protein metabolism; Coordinated regulation of opposing metabolic pathways; Regulation of mitochondrial electron transport and oxidative phosphorylation; Regulation of enzymes of carbon dioxide fixation by light; Regulation of light capture process in photosystems	

4	**Signal Transduction:** intracellular receptor and cell surface receptors signaling: Cyclic AMP-dependent protein kinase; Cyclic GMP-dependent protein kinase; Protein kinase C; Ca^{2+} -calmodulin-dependent protein kinases ; AMP-dependent protein kinase ; Receptor tyrosine kinases; Protein kinase B; Cytokine activation of the JAK'/STAT pathway; Cell cycle control; Receptor serine/threonine kinases; Other protein kinases ; Phosphoprotein phosphatases; Cancer Pathways: MAPK, P13K, TP53 network, NF*k*B pathways; Signalling by TGF β factor , STAT factor	
5	**Metabolomics:** Introduction to origins of metabolomics; define terms: Metabolite, Metabolome, Metabonomics; Analytical techniques in study of Metabolomics (Principle & Methodolgy): Separation methods: Gas Chromatography, HPLC, Capillary Electrophoresis; Detection Methods: Mass spectroscopy, NMR. Applications of Metabolomics in: Toxicity assessment/ toxicology, Nutrigenomics, Diagnostics and Health Screening	
	Total Credits of the Course	3

Books for Reference

Compulsory Reading:

1. Compulsory Reading: Principles Of Biochemistry, 4/e (2006) by Robert Horton H , Laurence A Moran, Gray Scrimgeour K **Publisher:** Pearsarson **ISBN:** 0131977369, **ISBN-13:**9780131977365, 978-0131977365
2. Biochemistry 6th Edition (2007) by Jeremy M.berg John L.tymoczko Lubert Stryer **Publisher:** B.i.publicationsPvt.Ltd **ISBN:**071676766X **ISBN-13:** 9780716767664, 978-716767664.

Further Reading:

3. Lehninger Principles of Biochemistry, Fourth Edition by David L. Nelson Michael M., Cox,Publisher: W. H. Freeman; Fourth Edition edition (April 23, 2004) ISBN-10: 0716743396 ISBN-13: 978-0716743392
4. **E.S. West, W.R. Todd, H.S. Mason and J.T. van Bruggen,** A **Text Book of Biochemistry**, Oxford and IBH Publishing Co., New Delhi, 1974
5. Biochemistry [with Cdrom] (2004) by Donald Voet, Judith G. Voet **Publisher:** John Wiley & Sons Inc **ISBN:** 047119350X **ISBN-13:** 9780471193500, 978-0471193500
6. Principles Of Biochemistry (1995) by Geoffrey L Zubay, William W Parson, Dennis E Vance **Publisher:** Mcgraw-hill Book Company – Koga **ISBN:**0697142752 **ISBN-13:** 9780697142757, 978-0697142757
7. Biochemistry (2008) by Rastogi **Publisher:** Mcgraw Hill **ISBN:**0070527954 **ISBN-13:** 9780070527959, 978-0070527959

SBS M II C 17 11 BIOPHYSICAL TECHNIQUES AND INSTRUMENTATION

Course Objectives:

1. To introduce the student to various basic and advanced biophysical techniques and its applications
2. To familiarize various instrumentation techniques used in biological sciences.

Module No	Module Content	
1	Spectroscopic techniques: Principle, Instrument Design, methods and Applications of UV-Visible spectroscopy, Infrared spectroscopy, Raman Spectra, Fluorescence spectra, Nuclear magnetic Resonance Spectroscopy.	
2	Hydrodynamic techniques: Principle, Instrument Design, methods and Applications of all types of Adsorption and Partition Chromatography- Paper chromatography, Thin layer chromatography, Gel filtration chromatography, Affinity chromatography, Ion-exchange chromatography and HPLC. Reversed phase chromatography, hydrophobic interaction chromatography, chiral chromatography, counter current chromatography, Fast protein liquid chromatography, two dimensional chromatography Centrifugation – Principle, methods and application, Ultra centrifugation, Viscometry	
3.	Electro analytical techniques & Optical techniques: Principle, Instrument Design, methods and Applications of Free and zone Electrophoresis – Paper electrophoresis, Gel electrophoresis, Poly Acrylamide gel electrophoresis, SDS PAGE, Capillary electrophoresis, Isoelectric focusing, Potentiometry, pH meter, conductometry. Principle, Instrument Design, methods and Applications of Polarimetry, ORD, CD, Light scattering, Refractometry, Flowcytometry, Cytometry	
4	Microscopic techniques: Principle and working of Compound microscope, Phase contrast microscope, Interference microscope , Fluorescence microscope , Polarizing microscope , Scanning and Transmission Electron Microscopy, CCD camera, Introduction to Atomic force microscopy, Confocal microscopy	
	Total Credits of the Course	3

Books for Reference

Compulsory Reading:

1. Principles and techniques of practical biochemistry: Keith Wilson and John walker, Cambridge
2. Modern Experimental Biochemistry. Rodney F Boyer. Nenjamin/ Cummings publishing company Inc. Redwood city, California

Further Reading:

1. Practical Biochemistry- Principles and techniques. Keith Wilson and John walker (Eds), University press, Cambridge UK.
2. Principles and Techniques of electron microscopy- Biological applications. M.A Hayat., Mac Millan Press, London UK.
3. Biophysical Chemistry: Upadhyay Upadhyay and Nath, Himalaya Publishing House
4. Chromatographic methods. A Braithwate and F J Smith. Chapman and hall, NewYork.
5. Gel Electrophoresis of Nucleic acids- A Practical approach. Rickwood D and BD Hames. IRL Press, New York.

6. Spectrophotometry and Spectrofluorimetry: A Practical Approach. Harris DA and CL Bashford (Ed.) IRL Press, Oxford.
7. Introduction to Spectroscopy. Donald L. Pavia Gary M Lipman, George S Kriz. Harcourt brace College Publishers, Orlands, Florida
8. Gradwohls Clinical Laboratory Techniques. Stanley s. Raphael. W.E. Company, London, UK
9. Fundamentals of molecular Spectroscopy: C N Banwell, Tata Mc Graw hill publishing Company Ltd.
10. Spectroscopic methods and analyses: Christopher Jones, Barbara Mulloy Adrian H.Thomas.
11. Methods in Modern Biophysics: Bengt Nolting, Springer.
12. Bioseparations Science and Engineering: Roger G Harrison, Paul Todd, Scott .R. Rudge, Oxford University Press.

SBS M I C 1712: LABORATORY COURSE-3: MICROBIOLOGY AND IMMUNOLOGY

Course Objectives:

1. To introduce basic techniques in microbiology

2.To introduce basic techniques in immunology

3. To introduce bacterial identification methods

Module No	Module Content	
1	• Microscopic examination of bacteria in living conditions • Testing of motility • Staining procedures • Sterilisation methods • Cultivation of bacteria and fungi • Study of cultural characteristics and biochemical reaction of bacteria	
2	• Testing of disinfectants • Antibiotic sensitivity tests • Agglutination and precipitation tests • Immunodiffusion in gel • ELISA	
	Total Credits of the Course	3

Books for Reference

Compulsory Reading:

1. Medical Laboratory Manual for Tropical Countries Vol.2 Monica Cheesbrough ELBS, 2009
2.Mackie& McCartney Practical Medical Microbiology Churchil Livingstone, 1996

Further Reading:

1.Clinical Laboratory Methods Vol.2 Gradwohl The C.V.Mosby Company, 1981

2.London Practical Microbiology Dubey R.C.and Mahaswari D.K. S.Chand & Company Ltd. New Delhi, 2002
3.Experiments in Microbiology, Plant pathology and Biotechnology, K.R.Aneja,, New Age International (P) Limited, New Delhi, 2003

SBS M II C 1713: LABORATORY COURSE – 4: MOLECULAR BIOLOGY AND GENETIC ENGINEERING

Course Objectives:

1. To familiarize students with protein and DNA electrophoresis, isolation and estimation
2. To introduce PCR technology

Module No	Module Content	
1	• PAGE- Protein separation • Agarose gel electrophoresis of nucleic acids	
2	• DNA isolation • Estimation of DNA	
3.	• RNA isolation • Estimation of RNA	
4	• Selective PCR amplification of a desired fragment	
	Total Credits of the Course	3

Books for Reference

Compulsory Reading:

1. Molecular cloning by Sambrook , Fritsch and Maniatis, Cold Spring harbour laboratories
2. Gel electrophoresis of proteins: A practical approach (second edition); Edited by B D Hames and D Rickwood. pp 383. IRL press at Oxford University Press, Oxford. 1990

SECOND SEMESTER ELECTIVE COURSES
(Students need to select one course from among the options given below)

Elective Courses Offered by Different Teachers in the 2nd Semester			
14	SBS M II E 1714	Microbial Technology	3
15	SBS M II E 1715	Ecology and Environment	3
16	SBS M II E 1716	Neurobiology	3
17	SBS M II E 1717	Environment Science	3
18	SBS M II E 1718	Molecular Microbiology	3
19	SBS M II E 1719	Developmental Biology	3

SBS M II E 1714: MICROBIAL TECHNOLOGY

Course offered by: Dr Keerthi TR

Course Objectives:

1. To introduce relation between microbe and man

2. To understand the microbe as a factory for the production of various useful products.

Module No	Module Content	
1	**Microbial Genomics:** Introduction to Microbial genomics, Structural Genomics, Functional genomics, Comparative Genomics, Meta Genomics - Genome analysis of extremophiles, Metabolic engineering and protein engineering for analysis and optimization of microbial products	
2	**Microbes in food & dairy industry:** Fermented foods-Introduction, Role & Advantages of fermented foods. Production of cheese, yoghurt, koji & Idli. Knowledge of other fermented dairy products. Single cell proteins-algae, bacteria, fungi, yeast & actinomycetes. Alcoholic beverages-Distilled and non distilled, Production of beer, wine & ethanol. Microbe as animal feed additives. Probiotics, Prebiotic & Synbiotics	

3.	**Microbes in Agriculture**:Nitrogen fixation; Symbiotic & Non symbiotic Mechanism; Biofertilizers- Rhizobium, Azolla, Azospirillum, Algal Biofertilizers; Phosphate solubilizing microorganisms; Microbial biopesticide, biofungicide and herbicide; Micorrhiza; Plant –Microbe Interactions. Mushroom cultivation	
4	**Microbes & Environment**: Biotechnology and pollution control; Use of immobilized microbial cell & enzyme in waste water treatment. Microbial biotransformation-Steroid, Microbial degradation of Herbicides, Insecticides & Pesticides; Bioremediation & Bioleaching	
5	**Industrial &Pharmaceutical Applications**: Methanogens & Biogas Production; Microbial Hydrogen production; Microbes in plastic industry - Bioplastics; Microbial biosensors- Micro oxygen electrode. Biochips; Biofilm; Bioactive compounds from microbes. Bioethanol & biodieseal production. Microorganism for Bioassay & as Bio weapon	
	Total Credits of the Course	3

Books for Reference

Compulsory Reading:

1. Biotechnology Fundamentals and Applications, S.S. Purohit and S.S. Mathur; Agro Botanical Publishers India.

2. Food Microbiology – Frazier W.C and Westhoff D.C., Tata Mc Graw-Hill

Further Reading:

1. Biotechnology Fundamentals and Applications, S.S. Purohit and S.S. Mathur; Agro Botanical Publishers India.
2. MicrobialBiotechnology, Alexander N Glazer & Hiroshi Nikaido Cambridge University Press.
3. MicrobialBiotechnology,farshad Darvishi harzevili Hongzhang Chen.CRC Press.
4. MicrobialBiotechnology Principle & Applications Lee Yuan Kein.World Scientific Press.
5. Microbial Technology-Fermentation Technology Vol 1 & 11 Peppler Perinas Elsiver.
6. Biofertilizers in Agriculture, N.S.Subha Rao;Oxford & IBH Publishing Co.Pvt.Ltd New Delhi.
7. Essentials of Biotechnology, R.C.Sobti & Suparna.S.Pachauri. Ane Books Pvt.Ltd.
8. Fermentation Technology Vol I&II.
9. Soil Microbiology – N.S. Subha Rao, 1999
10. Agriculture Microbiology – Rangaswamy
11. Microbial control and pest Management – S. Jayaraj.
12. Food Microbiology – Frazier W.C and Westhoff D.C., Tata Mc Graw-Hill
13. Food Microbiology – Rose A.H. in Economic Microbiology, Academic Pr

SBS M II E 1715: ECOLOGY AND ENVIRONMENT

Course Objectives:

1. To understand the basic principles of Ecology and Environment
2. To familiarize the major environment problems in the world
3. To introduce the topic of Climate Change

Module No	Module Content	Credits
1	**Introduction to Ecology and different ecological objects:** Basic concept of environment – components of environment, definition of ecology, ecological objects. **Autecological and Synecological concepts:** A. Population Ecology**:** (a) Characteristics of populations (b) Genecology - ecads, ecotypes, ecospecies, coenospecies; k-selection and r-selection populations; B. **Synecological concepts** (a) Ecological processes of community formation, ecotone, edge effect. Classification of communities - criteria of classification, dynamic system of classification by Clement (b) Special plant communities - quantitative, qualitative and synthetic characteristics of plant communities, (c) Dynamic community characteristics - cyclic replacement changes and cyclic no-replacement changes	1.0
2	**Ecological succession -** (a) The concept – autogenic and allogenic succession, primary and secondary, autotrophic and heterotrophic (b) Retrogressive changes or the concept of degradation, concept of climax or stable communities, resilience of communities, ecological balance and survival thresholds; **Biosphere and Ecosystem -** (a) Significance of habitat, biodiversity, ecological niche, trophic level, primary and secondary productivity, food chains, food webs, ecological pyramids, energy flow and nutrient cycles (b) Comparative study of the major world ecosystems: Different aquatic and terrestrial ecosystems with regard to their productivity, biodiversity, energy flow, food chains and trophic levels	0.5
3.	**Natural Resources:** Soil, water and air Resources – soils and parent materials – ecology of soil fertility; **Fresh water and marine resources** – global distribution of water resources – surface and ground water resources – water conservation – prevention of marine pollution – conservation of marine resources; **Atmospheric resources** – structure of atmosphere – climate and weather – climatic factors – precipitation, wind temperature, aerosols	0.5
4	**Environmental pollution:** (a) Definition and classification (b) Water pollution: Water quality parameters and standards, different types of pollutants and their consequences. Types of water pollution, prevention and control - water shed management, different kinds of waste water treatments; phyto and bioremediation (c) Air pollution: Air quality standards and index, ambient air monitoring using high volume air sampler, types and sources of air pollutants, air pollution and human health hazards, control of air pollution (d) Noise pollution (e) Radioactive and thermal pollution: Causes and hazardous effects, effective management (f) Concept of solid wastes (g) Pollution Control - Bioremediation, Phytoremediation, bioaugmentation, biofilms, biofilters, bioscrubbers and trickling filters. Use of bioreactors in	1.0

	waste management **Climate Change and other Global Environmental issues** - Factors responsible for climate change, Climate change mitigation – global conventions and protocols on climate change - *El-Nino* and *La Nina* phenomenon and its consequences; Environmental laws, environmental monitoring and bio indicators, environmental safety provisions in Indian constitution, major environmental laws in free India; UNEP and its role in climate change control– IPCC, UNFCC, annual environment summits – 1973 Stockholm conference to 2015 Paris Conference – new developments of annual UNFCC meetings in the coming years - Future Earth Programme	
	Total Credits of the Course	3

Books for Reference

Compulsory Reading:

1. MC Dash (1993) Fundamentals of Ecology, Tata McGraw Hills
2. Odum EP 3rd Edition (1991) Fundamentals of ecology, Saunders and Com

Further Reading:

1. Barbour MD et. al. (1980) Terrestrial plant ecology. The Benjamin-Cammings Pub. Com
2. Benton AH and Werner WE (1976) Field biology and Ecology, Tata McGraw Hill
3. Blanco-Canqui and Humberto LR (2008) Principles of Soil Conservation and Management, Springer
4. Molles MC (2012) Ecology – Concepts and applications, 6th Edition, Mc Graw Hill

SBS M II E 17 16 NEUROBIOLOGY

Course Objectives:

1. To introduce basic concepts about the organization, structure, and function of the human nervous system
2. To enable students to apply these fundamental principles toward understanding nervous system function and dysfunction
3. To provide the necessary foundation in neurobiology upon which students can build for the rest of their exposure and professional careers

Module No	Module Content	
1	Introduction to neurobiology: Evolution of nervous system, development of nervous system, functional neuroanatomy, reflex, blood brain barrier, cerebrospinal fluid Origin of membrane potentials: Composition of body fluids, maintenance of cell volume, ionic equilibrium, ion channels in plasma membrane, membrane conductance, membrane potential, recording of signals in neuron	

2	Mechanism of nerve action potential: Characteristics of action potential, initiation and propagation of action potential, voltage dependent sodium channels, mechanism of action potential propagation, factors affecting the speed of action potential propagation, molecular properties of voltage sensitive sodium channels, molecular properties of voltage dependent potassium channels, calcium dependent action potentials, voltage- clamp analysis of action potentials	
3.	Synaptic transmission: Chemical and electrical synapse, neurotransmitter release, synaptic potential, excitatory synaptic transmission between neurons, excitatory neurotransmitters, inhibitory synaptic transmission, inhibitory neurotransmitters, neurotransmitter gated ion channels, presynaptic inhibition and facilitation, neuronal integration, synaptic transmission at neuromuscular junction	
4	Synaptic plasticity, language and cognition: Short term changes in synaptic strength, long term changes in synaptic strength, modification of synaptic strength in reflex circuits, learning, language function and cortical areas involved in language, cognition, dementia and loss of cognitive abilities	
	Total Credits of the Course	3

Books for Reference

Compulsory Reading:

1. Basic Neurochemistry- Molecular, cellular and medical aspects. George J Siegel, Bernard W Agra noff R, Wayne Albers, Stephen K Fisher & Michael D Uhler
2. Neurobiology: Molecules, cells and systems. Gary G Mattews

Further Reading:

1. From Neuron to Brain- John G Nicholls, A Robert Martin, Bruce G Wallace & Paul A Fuchs
2. Vander's Human Physiology- The mechanism of body function. Widmaier, Raff & Strang

SBS M II E 1717: ENVIRONMENT SCIENCE

Course Objectives:

1. To introduce the principles and scope of environment science

2. To introduce the problems of pollution

3. To explain environment impact and monitoring

Module No	Module Content	Credits
1	Definition, principles and scope of environmental science, Earth, Man and environment, ecosystem, pathways in ecosystem .Physic-Chemical and Biological factors in the environment Geographical classification and Zones .Structure and functions of ecosystem, Abiotic and biotic components, energy flows, food chains, Food, web, Ecological pyramids, types and diversity Terrestrial (Forest, grass land) and Aquatic (Fresh water,marine,eustarine) ecosystems. mineral cycling. Habitat and niche. Major terrestrial biomes. Impact of microorganisms on global ecology, microorganisms in extreme environment	
2	Definition , Principles and scope of ecology, Human ecology and Human settlement, evolution, origin of life and speciation Population ecology characteristics and regulation. Community ecology structure and attributes. Levels of species diversity and its management, Edges and ecotones.Ecological succession. Concept of climax. Common Flora and fauna in India .Endangere and Threatened Species	
3.	Biodiversity status,monitoring and documentation Biodiversity management approaches. Conservation of biological diversity, methods and strategies for conservation.Natural resources, conservation and sustainable development. Hotspots of biodiversity,. National parks and Sanctuaries	
4	Environmental pollution- Air: Natural and anthropogenic source of pollution, Primary and Secondary pollutants , Methods of monitoring and control of air pollution, effects of pollutant on human beings, plants animals, material and on climate, Acid rain, Air Quality standards Water: types, Sources and consequences of water pollution, Physio-chemical and Bacteriological sampling and analysis of water quality, Soil: Physio-chemical and Bacteriological sampling as analysis of soil quality, Soil pollution- control, Industrial waste effluents, and heavy metals Their interaction with soil components, Noise: Sources of noise pollution, Noise control and battement measures. Impact of noise on human health, Radioactive and thermal Pollution. Bioremediation- Strategies for bioremediation, Biosensors, biological indicators of pollution and monitoring. Detoxification of hazardous chemicals, mycotoxins. Biological weapons	

5	Introduction to environmental impact analysis, Impact Assessment Methodologies Generalized approach to impact analysis ,Guidelines for Environmental Audit Introduction to environmental Planning,Environmental priorities in India and Sustainable development ,Environment protection-issues and problems, International and national efforts for environment Protection. Global environmental problems-Ozone depletion, global warming ,climatic change, desertification ,greenmovement, ecofeminism.current environmental issues in India	
	Total Credits of the Course	3

Books for Reference

Compulsory Reading:

1. Odum E. P and Barret G W .Fundamentals of ecology. W. B Saunders company, Philadelphia

2. Chapman and Reiss, Ecology principles and applications. Cambridge University

Further Reading:

1. Jobes A. M., Environmental biology, Routledge, London.
2. Odum E. P. Basic ecology. Saunders College.
3. A textbook of environmental sciences, Arvind kumar.
4. Alleby M.Basics of environmental science. Routledge, Newyork
5. Cunningham, W. P and Siago, B. W ,Environmental science.
6. Kewin T. P and Owen C. A., Introduction to global environmental issues. Routledge, London.
7. Chiras,D.D, Environmental science

SBS M II E 1718: MOLECULAR MICROBIOLOGY

Course offered by: Dr. Radhakrishnan E K

Course Objectives:

1. To introduce molecular biology methods using microbiology

2. To introduce importance of unculturable bacteria and its importance

3. To introduce advances in use of microorganisms for various applications

Module No	Module Content	Credits

1	Molecular biology of Microbial evolution, rRNA sequence and cellular evolution, Signature sequence and phylogenetic probe. Identification and characterization of microorganisms, Molecular methods for microbial identification, Molecular typing methods: Bacterial strain typing, Pulsed Field Gel Electrophoresis, PCR-based microbial typing, Genotyping by Variable Number Tandem Repeats, Multilocus Sequence Typing, Automated Ribotyping	
2	Unculturable bacteria and Metagenomics, Methods used in metagenomics, New generation sequencing technologies for metagenome study, Human microbiome, Importance of human microbiome in relation to human health and disease.	
3.	Molecular basis of microbial virulence. Bacterial adherence: basic principles, effects of adhesion on bacteria and host cells. Bacterial invasion of host cells; mechanism. Bacterial toxins: classification based on molecular features, Molecular detection and characterisation of bacterial pathogens, detection of bioterrorism. Laboratory controls and standards in molecular diagnostics.	
4	Microbial production of recombinant proteins : expression, purification and applications, Microbes in plant transformation, *Agrobacterium tumefaciens* T-DNA transfer process, Application of microorganisms for combinatorial and engineered biosynthesis, Engineering *E.coli* for the production of curcumin	
	Total Credits of the Course	3

Books for Reference

Compulsory Reading:

1. Molecular Microbiology – Diagnostic Principles and Practice, David H. Persing, Fred C. Tenover, James Versalovic, Yi-Wei Tang, Elizabeth R. Unger, David A. Relman, Thomas J. , ASM Press., 2016
2. 2.Brock Biology of Microorganisms- Michael T. Madigan and John M.Martinko, Prentice Hall, 2015

Further Reading:

1. Microbial Physiology – Albert G. Moat, John W. Foster and Michael P. Spector , 2002
2. Metagenomics for Microbiology, Jacques Izard Maria Rivera , 1st edition, Academic Press Published Date: 12th November 2014
3. Production of Recombinant Proteins: Novel Microbial and Eukaryotic Expression Systems, Gerd Gellissen, May 2005

SBS M II E 1719: DEVELOPMENTAL BIOLOGY

Course Objectives:

1. To understand the importance of Developmental Biology
2. To familiarize students the reproductive parts and reproductive process in plants
3. To understand fertilization and post-fertilization development in plants

Module No	Module Content	Credits
1	**Introduction:** Basic concepts of developmental Biology; An overview of plant and animal development, Potency, Commitment, Specification, Induction, Competence, Determination and Differentiation morphogenetic gradients; cell fate and cell lineages; stem cells; genomic equivalence and the cytoplasmic determinants; imprinting; mutants and transgenics in analysis of development	1.0
2	**Development in flowering plants**: **(a)** Angiosperm life cycle **(b)** Anther: Structure and development, microsporogenesis, male gametophyte development. Palynology: Pollen morphology, exine sculpturing, pollen kit, NPC formula. Applications of palynology- palynology in relation to taxonomy. Viability of pollen grains Pollination, pollen germination, growth and nutrition of pollen tube. **(c)** Ovule: Structure, ontogeny and types. Megasporogenesis. Embryosac – development, types, ultrastructure, and nutrition of embryosac. Female gametophyte development.	0.5
3.	**Fertilization in Plants:** Double fertilization; embryo development - different types. Endosperm development, types of endosperm, haustorial behavior of endosperm. Xenia and metaxenia. Polyembryony – types and causes. Seed formation, dormancy and germination. Apomixis, Parthenogenesis.	0.5
4	**Morphogenesis and organogenesis in plants:** Shoot and root development; Leaf development and Phyllotaxy. Transition to flowering, floral meristems and floral development; Homeotic genes in plants; Senescence, programmed cell death and hypersensitive response in plants.	1.0
	Total Credits of the Course	3

Books for Reference

Compulsory Reading:

1. Maheswari P. 1950. An introduction to the embryology of Angiosperms. McGraw Hill
2. Wolpert L, C Tickle and AM Arias (2015) Principles of development

Further Reading:

3. Krishnamurthy KV (2015) Growth and Development in Plants
4. Raghavan V (2000) Developmental Biology of Flowering Plants
5. Gilbert SF (2000) Developmental Biology
6. Developmental Biology, 8th Ed, Gilbert
7. Developmental Biology Paperback – 2008 by Werner A. Muller

THIRD SEMESTER PROGRAMME IN BIOPHYSICS

SCHEME OF THIRD SEMESTER BIOPHYSICS		
Course No	**Subject of the Course**	Credit
SBS M III C 1724	Enzymology	4
SBS M III C 1740	Molecular Biophysics	4
SBS M III C 1741	Electrophysiology	4
SBS M III C 1727	Laboratory Course - 5	3
SBS M III C 1742	Laboratory Course - 6	3
Course taken by the student from other department	Open course	4
Total Credits of the 3rd Semester Programme in M Sc Biophysics		**22**

SBS M III C 1724 ENZYMOLOGY

Course Objectives:

1. To enable students have an indepth knowledge into mechanisms by which cellular reactions are accelerated
2. To understand the basics of drug development process

Module No	Module Content	Credits
1	**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 Enhancement 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	

2	**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 Michaelis - Menten equation and Km value determination and its significance, Definition of V_{max} value of enzyme and its significance, Lineweaver- Burk plot; Bi-substrate reactions: Classification, Reaction mechanisms; Allosteric enzymes: Examples of Cooperativity and Allostery in Proteins, Models of Allosteric Behavior, Effects of Cooperativity on Velocity Curves, Sigmoidal Kinetics for Nonallosteric Enzymes	
3.	**Enzyme inhibition:** Reversible and irreversible – examples. Reversible-competitive, noncompetitive and uncompetitive inhibition; Graphic Determination of Inhibitor Type; Dose—Response Curves of Enzyme Inhibition; Mutually Exclusive Binding of Two Inhibitors; Structure—Activity Relationships and Inhibitor Design; Tight Binding Inhibitors: Identifying Tight Binding Inhibition, examples; Time-Dependent Inhibition: examples; Distinguishing between modes of inhibitor interaction with enzyme	
4	**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 regulation: example Aspartate trascarbamoylase, Isoenzymes- Lactate dehydrogenase and creatine phosphokinase	
5	**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; Enzyme engineering	
	Total Credits of the Course	**4**

Books for Reference

Compulsory Reading:

1. 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
2. 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

Further Reading:

3. Enzyme Kinetics and Mechanisms by Taylor Publisher: Spring ISBN: 8184890478 ISBN-13: 9788184890471, 978-8184890471
4. Enzyme Mechanism by P.K. Shivraj Kumar (2007) Publisher: RBSA Publishers ISBN: 8176114235 ISBN-13: 9788176114233, 978-8176114233
5. Enzymes and Enzyme Technology by Kumar (2009) Anshan Pub ISBN: 1905740875, ISBN-13: 9781905740871, 978-1905740871
6. Enzymes in Industry: Production And Applications by Aehle W (2007) Publisher**:** John Wiley & Sons Inc ISBN: 3527316892 ISBN-13: 9783527316892, 978-3527316892

7. Enzymes: Biochemistry, Biotechnology, Clinical Chemistry (second Edition) by Trevor Palmer, Philip Bonner (2007) Publisher: Horwood Publishing Limited ISBN: 1904275273 ISBN-13: 9781904275275, 978-1904275275

SBS M III C 1740: MOLECULAR BIOPHYSICS

Course Objectives:

1. To introduce the student to structural and molecular area of Biophysics
2. To give an insight into the structure and function of proteins, poly saccharides, membrane proteins, drug receptor interaction, protein-ligand interaction, protein sequencing, nucleic acid sequencing, protein evolution, proteomics, proteomics software, mass spectrometry

Module No	Module Content	Credits
1	Structural level of proteins and stabilizing forces, Super secondary structural domains, Domain and motifs, Classification and role of reverse turn, Hydrogen bonding in globular proteins. Main chain and side chain conformation of globular proteins. Globular and fibrous proteins. Conformation, organization and interactions of structural proteins such as collagen, alpha-keratin, silk fibroin, actin and myosin. Examination of 3D structure of chymotrypsin and Rubisco. Folded conformation of globular proteins- lysozyme and cytochromes. Principle of virus assembly and structure . Structure and conformation of polysaccharide - Amylase, Chitin. Structure of membrane proteins- Integral membrane proteins, Peripheral membrane proteins, Polypeptide toxins, Membrane protein complex.	
2	Biological receptors, drug-receptor interaction. Relationship between protein conformations and binding. Protein ligand interaction: Ligand-binding sites of Immunoglobulins, substrate- binding sites of Seriene proteases, Haeme-binding sites, Nucleotide- binding sites, Binding sites for phosphoryl groups, Interaction of proteins with other macromolecules- lipoprotein, Glycoprotein and Nucleoprotein. Protein folding, Protein sequencing and Nucleic acid sequencing. Inroduction to evolution- Concept of protein evolution, Protein speciation, phylogeny, phylogenetic tree- cladogram, phylogenetic study of cytochrome c. Homologies and analogies- convergent, divergent and parallel evolution	

3.	Mass spectrometry- Principles of operation and instrumentation,ion formation and types; molecular ions, meta stable ions, fragmentation processes, fragmentation patterns and fragment characteristics in relation to parent structure and functional groups ,mass spectrum; its characteristics, presentation and interpretation. Sector Mass spectrometer, Quadrupole Mass spectrometer, Ion trap Mass spectrometer, Time-of flight Mass spectrometer, Fourier transform Mass spectrometer. Combination with chromatographic methods, Biological application	
4	Introduction to transcriptomics, proteomics and metabolomics Tools of proteomics- SDS PAGE, 2D PAGE , Liquid chromatography , Mass Spectrometry (ESI and MALDI) ,Protein identification by peptide mass fingerprinting ,Applications of proteomics-. Protein identity based on composition, Motifs and patterns, Analysis and characterization of proteins and metabolites. Proteomics approaches to the analysis of protein-protein interactions, and metabolic profiling through emerging metabolomic techniques like 2D gel electrophoresis and Mass spectrometric and computational techniques. Protein sequence databases - SWISS-PROT and TrEMBL – Pattern and profile databases – PROSITE and BLOCKS - 2D PAGE databases – Structure databases - PDB- Metabolic databases – post translational modification databases – Application of proteomics to medicine, agriculture, industry, toxicology and pharmaceuticals. Protein Engineering	
	Total Credits	3

References

Compulsory Reading:

1. Introduction to Proteomics Tools for the New Biology: Daniel C. Liebler, Humana press
2. Proteins, Structure and molecular properties, Thomas E Creighton

Further Reading:

1. Molecular Biophysics- Volkenstain M.V
2. Biopolymers, AP- Watson,A.G & Blackwell,J
3. Principles of protein structure Schulz, G.E. & Schimmer, R.H..
4. Structure and Molecular Principles, W.H. Freeman & Co.Creighton, T.E.
5. Saenger,W., Principles of Nucleic Acid Structure, Springer.
6. Protein-Protein Interactions: Erica Golemis, CSHL Press.
7. Protein Architecture A practical Approach: A.M.Lesk,
8. Molecular and Cellular biophysics, Jack A. Tuszynski, Chapman & Hall/ CRC

SBS M III C 1741: ELECTROPHYSIOLOGY

Course Objectives:

1. To provide the theoretical basis and applied design principles for medical devices and instrumentation that interact with electrically excitable tissues of the body
2. Excitable tissues include cardiac muscle, skeletal muscle, and central and peripheral neurons involved in sensing, control of movement and control of autonomic functions.

Module No	Module Content	Credits
1	Basic principles of electricity, overview of electrophysiological instrumentation, types of electrophysiological recordings, current voltage relationship and the membrane potential Electrophysiology of heart, electrocardiogram (ECG), source of ECG voltage- dipole theory, vector analysis of ECG, Brain Potentials, electroencephalogram (EEG), source and mechanism of formation of rhythmic pattern of EEG, characteristics of EEG waves	2.0
2	Event related potential (evoked potential)-types, characteristics and significance electromyogram (EMG) – motor unit potential, physiological significance and analysis of EMG	0.5
3.	Structure of retina, electrical response of the photoreceptors to light, molecular mechanism of phototransduction process, auditory system in brain, mechanoreceptors of vibration sense, cochlear mechanics	0.5
4	Chemical sense, structure of olfactory epithelium, chemotransduction in olfactory receptor cells, processing of olfactory information in brain, structure of the taste buds, chemotransduction in taste receptor cells, processing of taste information in brain	1
	Total Credits of the Course	3

Books for Reference

Compulsory Reading:

1. The Physiology of Excitable Cells- David J. Aidley
1. Review of Medical Physiology- William F. Ganong

Further Reading:

1. Ion Channels. Molecules in action- David J.Aidley & Peter R Stanfield

2. Principles of Neural Science-Kandel, Eric R., James H. Schwartz, and Thomas M. Jessell.

SBS M III C 1727 LABORATORY COURSE 5

Course Objectives:

1

Module No	Module Content	Credits
1	Enzyme Assay • Direct assay • Indirect assay	
2	Extraction of enzymes and assay: • Acid phosphatase from Fresh Potato (*Solanum tuberosum*) • β- amylase from Sweet potato (*Ipomoea batates*) • Urease from Jack bean (*Canavalia ensiformis*) • Phytase from Seeds	
3.	Enzyme Kinetics: • Effect of Substrate Concentration on velocity of Enzyme catalyzed reaction: Determination of K_M and V_{max} using Line weaver- Burk plot • Effect of Temperature on velocity of Enzyme catalyzed reaction: Determination of Q_{10} • Effect of pH on velocity of Enzyme catalyzed reaction: • Effect of activators on velocity of Enzyme catalyzed reaction: • Determination of type of inhibition using Line-weaver Burk plot	
4	Immobilization of enzyme and assay of activity of immobilized enzyme	
5	Docking of Enzymes with ligand molecules using docking softwares Determine the drug likeliness of ligand molecules Determining Binding energies of ligand with receptors Determining Ki values	
	Total Credits of the Course	**3**

Books for Reference

Compulsory Reading:

Further Reading:

SBS M III C 1742 LABCOURSE-6

Course Objectives:

1. To familiarize the student to various Biophysical and Molecular techniques.
2. To develop laboratory experience on spectrometry, chromatography, electrophoresis, Isolation of DNA

Module No	Module Content	Credits
1	1. To study the characteristics of UV absorption spectra of Aromatic Amino Acids 2. To study the characteristics of UV absorption spectra of Proteins 3. To study the characteristics of absorption spectra of Nucleic Acids and Nucleotides 4. Paper chromatography of Plant Pigments 5. Paper chromatography of aminoacids	
2	6. Paper chromatography of sugars. 7. Thin layer chromatography of aminoacids. 8. Thin layer chromatography of plant pigments 9. To isolate the proteins- Casein from milk and Hb from RBC 10. To analyse the Erythrocytes membrane lipids by TLC	
3.	11. To perform the separation of Proteins using HPLC 12. Fractionation of Sugars from fruit juice using TLC/HPTLC 13. Column Chromatography of proteins. 14. HPTLC of Amino acids & sugars. 15. Paper Electrophoresis of Amino acids	
4	16. Cellulose acetate strip Electrophoresis of Amino acids 17. Polyacrylamide Gel Electrophoresis (PAGE). 18. SDS- Polyacrylamide Gel Electrophoresis (PAGE) 19. DNA isolation from bacteria and plants. 20. PCR Technique	

Total Credits of the Course	3
Books for Reference	
Compulsory Reading: 1. 2.	
Further Reading: 3. 4. 5.	

SCHEME OF THIRD SEMESTER OPEN ELECTIVE COURSES

Students need to select one open elective course offered by other departments

45	SBS M III O 1743	Biotechnology and Society	4
46	SBS M III O 1744	Microbiology in Everyday Life	4
47	SBS M III O 1745	Environment Lead Auditor Course	4
48	SBS M III O 1746	System Biology	4
49	SBS M III O 1747	Sustainable Agriculture	4
51	SBS M III O 1748	Ecology of Soil Fertility	4
52	SBS M III O 1749	Infectious Disease Management	4
53	SBS M III O 17 50	Probiotics and Nutraceuticals	4

SBS M III O 1743: BIOTECHNOLOGY AND SOCIETY

Course Offered By:

1. **Dr. Linu Mathew (co-ordinator), Assistant professor in Biotechnology and**
2. **Dr K Jayachandran, Associate Professor in Biotechnology, School of Biosciences**

Course Objectives:

1. This course is meant for No Bioscience PG students of MG University
2. The course deals with the applications of Biotechnology in a societal perspective; the learner has a previous knowledge about biotechnology through mass media and their secondary school education
3. In this course they will develop a scientific understanding about biotechnology and how it benefit the society

Module No	Module Content	Credits
1	An Introduction to biotechnology: Biotechnology – a boon or a bane, Biotechnology- an interdisciplinary pursuit, public perception of biotechnology, biotechnology and the developing world, biotechnology – Indian scenario	
2	Industrial and environmental biotechnology: Industrial genetics, bioprocess and fermentation technology, enzyme technology; food and beverage biotechnogy; biological fuel generation and single cell protein, GM food and controversies associated, Biosensors and biochips, Biotechnology for profit making	
3.	Genetics and biotechnology: Protoplast and cell fusion techniques, genetic engineering, whole genome sequencing, Animal cloning - ethics and applications, genetic engineering - social, moral and ethical considerations, mitochondrial evolution – tracing your routes, DNA Fingerprinting - concept and applications	
4	Biotechnology in agriculture and medicine: Creation and applications of transgenic animals and plants, applications of plant and animal cell culture; gene therapy- techniques and applications	
5	Protection and safety of biotechnological inventions: Patents trade secrets and plant breeders' rights, biological and physical containment, and problems of organism pathogenesis and biologically active biotechnology products, Bioterrorism	
	Total Credits of the Course	4

Books for Reference

Compulsory Reading:

1. Biotechnology, John E Smith, Cambridge low price editions; Cambridge University press

ISBN 0-521-58694

2. An introduction to genetic engineering, Desmond. T. Nicholl. Cambridge University press ISBN 81-7596-101-5

Further Reading:

1. Gene cloning and DNA analysis an introduction, T A Brown, Blackwell science publishers ISBN 0-632-05901-X
2. 4. Molecular biotechnology, Principles and Applications of Recombinant DNA, Glick Pasternak and Patten, 4th edition ISBN 978-1-55581-498-4 Wiley International Publishers

SBS M III O 1744: MICROBIOLOGY IN EVERYDAY LIFE

Course Offered By: Dr Radhakrishnan EK, Assistant Professor

Course Objectives:

1. To introduce basics of microbiology

2.To introduce microbiology in relation with health and disease

3. To introduce microbiology in relation to food and industry

Module No	Module Content	Credits
1	**History and Developments in Microbiology:** Prokaryotic and eukaryotic cell, Contributions from Leuwenhoek, Louis Pasteur, and Robert Koch. Microbiome, An overview of microorganisms, the bacteria and the archea. General characteristics, morphology, Structure of bacteria. Virion, viroids and prions, Eukaryotic Microorganisms., A brief introduction to microscopy, Staining of bacteria and fungi, Cultivation of bacteria and fungi, culture media and methods	
2	**Methods to control Microorganisms:** Disinfection, Sterilization, Sterilizing Agents, Antibiotics, Antibiotic Sensitivity tests, Antibiotic Resistance	
3.	**Microbes in relation to health and disease:** Human microbiome, Infection, source of infection, method, of transmission, Immunity, Innate and adaptive immunity, Microorganisms involved in respiratory tract infection, Meningitis, Urinary tract infection, STD, Skin infection, Nosocomial infection, Tuberculosis, Typhoid fever, Dengue, AIDS, Hepatitis and Ebola	
4	**Microbes in relation to food:** Microorganisms in preparation of food materials, lactic acid bacteria, role of microorganisms in preparation of curd, cheese and cultured dairy products, probiotics, and their importance, single cell protein, Microorganisms responsible for food borne infection and intoxication. Water borne diseases- prevention and control Fermented food, milk and milk products, role of food preservative	

	Industrially important microbial products: Role of Microorganisms in production of bread and beer. Microbial enzymes and their uses- detergent, enzymes, therapeutic enzyme Streptokinase	
	Total Credits of the Course	4

Books for Reference

Compulsory Reading:

1. Microbiology. Prescott, Harley and Klein wim C Brown publishers, 2014
2. Brock Biology of Microorganisms, Michael T. Madigan, John M. Martinko, David A. Stahl, David P. Clark,14th edition, 2015

Further Reading:

1. Principles and practice of disinfection, preservation and sterilization – Russel AD et al., Blackwell Scientific Publications, 2013
2. 4.Microbiology Concepts and Applications. Pelczar Jr Chan. Creig. McGraw Hill Inc, 5 th edition, 2001
3. Topley and wilson's Principles of Bacteriology, Virology and Immunology – Arnold – Heinemann, 1990

SBS M III O 1745: ENVIRONMENT LEAD AUDITOR COURSE

Course offered by: Dr J G Ray, Professor

Course Objectives:

1. Provide a thorough understanding of the basic principles of ecology and environment
2. Introduce the basic concept of ecological objects – population, community and ecosystem
3. To equip as environment auditors - 'Lead Auditor' as per ISO 14001 Standards: syllabus content is same as that of the 'Environment Lead Auditor Course' of the British Standard Institution (BSI)

Module No	Module Content	Credits
1	**Introduction to Ecology and Environment science**: concept of environment; Life as a system phenomenon- hierarchy in the system of life; Ecological objects- population, community and ecosystem; Ecology of humans, Concept of sustainable environment quality. Environment Pollution – definition and classification; Water pollution – water quality parameters and standards, control of water pollution, wastewater treatments; Air pollution – primary and secondary pollutions, air pollution monitoring and control; Land pollution – solid waste management, recycling, reuse and recovery, problems of plastic waste	1.0
2	**Natural Resources and Biodiversity Conservation**: classification of resources, resource depletion, preservation, conservation and restoration of resources; Concept of biodiversity – genetic, species and ecosystem diversities, principles of biodiversity conservation, ex-situ and in-situ conservations; IUCN accounting of biodiversity – hot spots, red data book; Global environmental crisis - UNEP, UNFCC, One earth programme,	0.5

	globally important agricultural heritage (GIAH)	
3.	**Legal methods to sustain environment quality**: environment laws – national and international environment laws; Montreal protocol and its amendments, Kyoto protocol, constitutional provisions of environment quality in India, major environment laws of India, environment protection act of 1986, National environment policy; Environment Impact Assessment	0.5
4	**Environment Audit:** definition, types of audit, objectives of environmental audit, benefits of environmental audit, basic environment management philosophy, key steps to environment audit – pre audit, onsite audit and post audit, step by step approach of auditing, action plan, auditor requirements; **Environment Management Systems:** ISO-14000-2004, model for this international standard, different clauses in ISO 14000 standard – scope, normative references, terms and definitions, EMS requirements – clauses 4.1 to 4.6	2.0
	Total Credits of the course	4

Books for References

Compulsory Reading:

1. Ray J G (2010) Basic Principles of Ecology and Environment, Prathibha Publications, Kerala,India

2. Mehrotra A et al (2001) A to Z of Environmental Audit,SOFEM Publ. New Delhi

3. Dash M C (1993) Fundamentals of Ecology, Tata McGraw Hills Publ. Co. New Delhi

Further Reading:

3. Singer FD (2016) Ecology in Action, Cambridge University Press

4. Chapman JL and Reiss MJ (1998) Ecological Principles and Applications, Cambridge University Press, London

4.Trivedi RK (Ed) International Encyclopaedia of Ecology and Environment (Volumes 1-30), IIE, New Delhi

5. Ramade F (1981) Ecology of Natural Resources, John Wiley and Sons, New York

SBS M III O 1746: SYSTEM BIOLOGY

Course offered by: Dr Harikumaran Nair, Assistant Professor

Course Objective:

1. This course will introduce the student to contemporary Systems Biology focused on mammalian cells, their constituents and their functions
2. The student will be exposed to the fundamental mechanisms underlying normal function of cells, tissues, organs, and organ systems of the human body

Module No	Module Content	Credits
1	Body organization, cells, tissues, organ and organ systems, body fluid compartments, reflex, biological rhythms, Cell membrane, cell organelles, movement of molecules across cell membranes, diffusion, osmosis, endocytosis, exocytosis	1.0
2	Neuron, basic principles of electricity, neuronal potentials, neuronal communications, brain, spinal cord, different nervous systems, somatic sensation, vision, hearing, chemical sense, motivation, emotion, learning, memory	0.5
3.	Muscles, muscle contraction, body movement, heart, cardiac functions, blood, hypertension, respiration, gas transport between lungs and tissues, respiratory problems	0.5
4	Kidney, dialysis, digestion and absorption of food, diabetes mellitus, increased plasma cholesterol, body temperature, pituitary and hypothalamus hormones, nuerohypophysial hormones, melanotropic hormones, gastrointestinal hormones, pancreatic hormones, growth hormones, thyroid hormones, adrenal hormones, sex hormones gametogenesis, male and female reproductive functions	2.0
	Total Credits for the Course	4

Books for Reference

Compulsory Reading:

1. Systems Biology: Definitions and Perspectives. Alberghina, L. and Westerhoff, H,
2. Essentials of Medical Physiology. K Sembulingam & Prema Sembulingam

Further Reading:

1. Vander’s Human Physiology- The mechanism of body function. Widmaier, Raff & Strang
2. Text book of Medical Physiology- Arthur C Guyton & John E Hall

SBS M III O 1747: SUSTAINABLE AGRICULTURE

Course offered by: Dr J G Ray, Professor

Course Objectives:

1. To introduce the concept of sustainable agriculture – principles of ecological sustainability
2. To equip students to understand the concept of organic farming
3. Enable understanding of plant nutrient management as well as pest management in sustainable agriculture

Module No	Module Content	Credits
1	**Introduction to Sustainable agriculture:** Concept of ecological sustainability and sustainable agriculture-Natural, Ecological and organic farming – definition, concepts, and practices – management, principles, methods, merits and demerits. Components - Organic farming for sustainable agriculture - Features of organic orchards – Challenges to Sustainable agriculture – Productivity vs sustainability; Soil organic matter- decomposition, C: N ratios, mineralization and immobilization processes, humus, role of organic matter in soil quality – natural way to prevent soil degradation and erosion, types and control measures. Soil related water pollution-sources, different pollutants in soils and their managements	1.0
2	**Plant nutrient management in sustainable agriculture:** Bio-availability of **nutrients** in soils, deficiency symptoms on plants, nutrient interactions and chelated micronutrients. Soil fertility assessment in sustainable agriculture - evaluation and management for plant growth, soil testing and fertilizer recommendations. Bio-fertilizers – benefits - classifications, production - maintenance and application	1.0
3.	**Organic Manures** – bulky and concentrated – FYM – Biocomposting, Compost – rural, urban, vermicompost and coirpith; Panchagavya preparation and other organic nutrients application - Enrichment of organic manures; Sewage and sludge; Green manures – potentials and limitations; Quality parameters of organic manures and specifications – Biofertilizers - Soil micro flora – nutrient transformations - Integrated Nutrient Management (INM) and Integrated Plant Nutrient Supply System (IPNS) - NPOP, organic produce quality considerations, certification, labelling, accreditation process and marketing	1.0
4	**Biopesticides and biological control agents:** Types of biocontrol agents-biological agents and pheromones, control of weeds, diseases and insect pests and field sanitation - competition, predation, antibiosis and fungistasis; Efficacy of traditional bio pesticides - Botanical insecticides- useful and beneficial insects like honeybee, lac insect, silkworm and pollinatorsBiological control - concepts and potentialities for managing soil borne pathogens. Types of biological interactions, competition, mycoparasitism; Mycorrhizal associations, operational mechanisms and its relevance in biological control - biopesticides available in market - quality control system of bio-control agents, Biodynamic products, Biodynamic composting, Liquid manure, Influence of Bio-dynamic products on crop production. Preparation of soil samples for chemical and biological tests - Bio assay of available	1.0

	K; Soil fertility evaluation by Neubauer technique; Visit to Organic Farms	
	Total Credits of the Course	3

Books for Reference

Compulsory Reading:

1. Dahama AK (2007). Organic Farming for Sustainable Agriculture. 2nd Edn. Published by AGROBIOS (India) Jodhpur
2. National Standards Programme for Organic Production and Organic Products (2000) Department of Commerce, Ministry of Commerce and Industry, Govt. of India

Further Reading:

3. Gehlot D (2005). Organic Farming: Standards, Accreditation, Certification and Inseption, AGROBIOS (India) Jodhpur
4. Gupta PK (2007). Soil, Plant, Water and Fertilizer Analysis Published by AGROBIOS (India), Jodpur
5. Sadasivam S and Manickam A (1992). Biochemical Methods for Agricultural Sciences Wiley Eastern Limited and Tamil Nadu Agricultural University, Coimbatore

SBS M III O 1748: ECOLOGY OF SOIL FERTILITY

Course offered by: Dr J G Ray, Professor

Course Objectives:

1. To know what soils are and how they form
2. To understand the nature and importance of soil organic matter - the carbon, nitrogen, and phosphorus cycles
3. To know the extent and importance of soil biodiversity - the influences of plants on soil processes

Module No	Module Content	Credits
1	Concept of soils – soil and parent materials– soil formation – role of climate and vegetation in soil formation – soil profile, soil taxonomy,; water relations of soils – hygroscopic, capillary and field water content – run-off water – factors affecting percolation	1.0
2	Soil Physics and Chemistry; soil physical properties - color and texture, soil structure - aggregate formation, aggregate stability, capillarity, porosity; Soil chemistry, ph, carbon in soils –humus – its chemistry and role in soil, exchangeable and soluble cations and anions in soils soil as a buffer system; soil amendments – problems of tillage – problems of irrigation – problems of chemical fertilizers and liming	1.0

3.	Soil biology – role of soil biota – soil fauna and flora - soil ecological processes and microbial function - decomposition - introduction, overview, fragmentation, factors controlling decomposition, carbon, nitrogen and phosphorus cycles in soils, transformations of nitrogen nitrification-immobilization-volatilization, denitrification, soil ecosystem management and soil biota	1.0
4	Agriculture – traditional versus modern – problems of chemicalized agriculture-control of soil degradation - desertificatication of soils – soil reclamation – soil conservation –prevention of soil erosion - mulching, contour bunds – sustainable soil fertility - ecology of soil fertility – principles of ecological and organic farming - climate change, global warming and soil ecology	1.0
	Total Credits of the Course	4

Books for Reference

Compulsory Reading:

1. Nyle C Brady (1984) Nature and properties of Soil, Mc Milan Publishers

2. Ray J G (2010) Basic Principles of Ecology and Environment, Prathibha Publi., Kerala, India

Further Reading:

3. Colemn DC et al (2003) Fundamentals of soil ecology, Elsevier

4. Christian Ditchfield (2003) Soils, Children's Press, Dublin

5. James BN (2003) The world beneath our feet: A guide to life in the soil, Oxford University Press

SBS M III O 1749: INFECTIOUS DISEASE MANAGEMENT

Course Offered by: Dr Radhakrishnan EK, Assistant Professor

1. To introduce importance and relevance of infectious diseases

2.To introduce mode of transmission of various infectious diseases

3. To introduce diagnostic methods for various infectious diseases

Module No	Module Content	Credits
1	Infectious disease, etiological agents-bacteria, fungi, viruses, prions, protozoan. Reservoir- human, environment. Carriers- incubatory, inapparent infection, convalescent and chronic carrriers. Mode of transmission- direct and indirect. Portal of entry- respiratory, genitourinary, alimentary, skin and transplacental	1.0
2	Infectious disease- acute respiratory infections, diarrheal diseases, hepatitis, HIV, tuberculosis, sexually transmitted diseases, malaria, and other vector-borne diseases	0.5

3.	Lab diagnosis of infectious disease, sample collection, sample processing microscopy, culture, immunological methods, nucleic acid based identification methods and non-nucleic acid based identification methods.	0.5
4	Infectious disease management, treatment, antibiotics- types of antibiotics, mode of action, antibiotic resistance, antiviral, antifungal, and antibacterial agents, immunization and infectious diseases, vaccination against major infectious diseases, types of vaccines	1.0
	Total Credits of the Course	4.0

Books for Reference

Compulsory Reading:

1. Bailey and Scott's Diagnostic Microbiology Publisher: Elsevier Health, 28 Jun 2013

2. CURRENT Diagnosis & Treatment in Infectious Diseases, Walter R. Wilson and Merle A. Sande
3. Fundamentals of Molecular Diagnostics (1st Edition) By David Bruns Edward Ashwood Carl Burtis : Elsevier. 2007

Further Reading:

1. Textbook of Diagnostic Microbiology Hardcover, by Mahon (Author), Publisher: Elsevier Health - US; 5 edition (18 February 2014)
2. Koneman's Color Atlas and Textbook of Diagnostic Microbiology 7th Edition by Gary W. Procop MD MS, Elmer W. Koneman, Publisher: LWW; 7 edition (June 15, 2016).
3. Advanced techniques in Diagnostic microbiology. Yi-wei Ting, Charles W. Stratton: Springer
4. Sherris Medical Microbiology (5^{th} edition) by Kenneth J. Ryan, C. George Ray
5. Infectious Disease: Pathogenesis, Prevention and Case Studies By Nandini Shetty, Julian W Tang, Julie. Wiley-Blackwell (April, 2009).

SBS M III O 17 50: PROTEOMICS AND NUTRACEUTICALS

Course offered by: Dr Keerthy TR, Professor

Course Objectives:

1. To know the concept of nutraceuticals - extra health benefits in addition to the basic nutritional value of food
2. Enable students to recognize the link between nutrition, health and diseases
3. Identify major types of health foods and nutraceutical products in the market
4. To expose students the market opportunity of nutraceuticals and the nutraceutical industry

Module No	Module Content	Credits
1	**Concept of Functional Foods/Neutraceuticals**: Definition and classification of nutraceuticals, dietary supplements, fortified foods, functional foods and phytonutracuticals. Scope involved in the industry, Indian and global scenario. Relation of functional foods; Nutraceutical (FFN) to foods & drugs. Applications of herbs to functional foods. Concept of free	1.0

	radicals and antioxidants; Nutritive and Non-nutritive food components with potential health effects. Role of nutraceuticals in the prevention and treatment with special reference to diabetes mellitus, hypertension, hypercholesterolemia. Concept of antioxidants - use of antioxidants as dietary supplements in prevention and treatment of cancer, obesity and stress	
2	**Nutraceuticals of plant origin:** Nutraceuticals in Fruits and Vegetables and their Health Benefits; Sources and role of Isoprenoids, Isoflavones, Flavonoids, carotenoids, Tocotrienols,polyunsaturated fatty acids, sphingolipids, lecithin, choline. terpenoids. Vegetables, Cereals,milk and dairy products as Functional foods. Health effects of common beans, *Capsicum annum*, mustards, , garlic, grape, citrus fruits	1.0
3.	**Nutraceuticals of animal origin:** Animal metabolites - Sources and extraction of nutraceuticals of animal origin. Examples: chitin, chitosan, glucosamine, chondroitin sulphate and other polysaccharides of animal origin, uses and applications in preventive medicine and treatment. fish oils, and sea foods	1.0
4	**Microbial and algal nutraceuticals:** Concept of prebiotics and probiotics - principle, mechanism, production and technology involved,different forms available in the market. Benefits &applications - examples of bacteria used as probiotics, Types & use of prebiotics in maintaining the useful microflora & other health benefits - extraction from plant sources. Synbiotics for maintaining good health. Algae as source of omega - 3 fatty acids, antioxidants and minerals - extraction and enrichment	1.0
	Total Credits of the Course	4

Books for Reference

Compulsory Reading:

1. 1. Shi, J. Asian Functional Foods CRC Press 2005
2. Webb, G.P. Dietary Supplement and Functional Foods Blackwell 2006

Further Reading:

3. Shi, J. Functional Food Ingredients and Nutraceuticals : Processing Technologies CRC Press 2007
4. Bagchi D. Nutraceutical and functional food regulations in the United States
5. and around the world, Elsevier/Academic Press, 2008.
6. Shibamoto T. Functional food and health, Oxford University Press, 2008.
7. Guo M. Functional foods : principles and technology, CRC Press, 2009.
8. J.Paulo Sousa e Silva.,Ana.C.Freiles.Probiotic Bacteria .Pan slanford publishing Pte.Ltd
9. Faizel Bux .Biotechnological Application of Microalgae.CRC Press.
10. Wayne.R Bidlack.,Roymond L Rodringuez.Nutritional Genomics.CRC Press.
11. Frances Sizer ., Elecener Whitney Nutrition concept and contraversesis Wordswerth Publishers.
12. Thomas J Mont Ville.,Kart R Matthews 7 Kalmia E Kniel Food Microbiology, ASM Press

FOURTH SEMESTER PROGRAMME IN BIOPHYSICS

SCHEME OF FOURTH SEMESTER BIOPHYSICS

(Core courses 14 credits + Elective 6 credits: two elective courses of three credits each)

Sl No	Course Code	Course Title	Credits
63	SBS M IV C 1760	Biophysical Chemistry	4
64	SBS M IV C 1761	Lab Course 7	3
65	SBS M IV C 1762	Major Research Project	7
	Elective 1	To be selected from among the elective courses offered	3
	Elective 2	To be selected from among the elective courses offered	3
		Total Credits of the 4th Semester Programme	20

SBS M IV C 1760: BIOPHYSICAL CHEMISTRY

Course Objectives:

1. To understand the student about the link between Physics, Chemistry, Biology and Information science
2. To perceive the knowledge about ligand binding, models of ligand binding, light scattering, calorimetry, x-ray crystallography, Bioinformatics, Databases, Bioinformatics softwares, molecular modeling, molecular docking ,Cheminformatics, and Nanoscience

Module No	Module Content	Credits
1	Ligand interaction at equilibrium, identical and independent sites model, Scatchard plot, multiple classes of independent sites, interaction between binding sites , Allosterism, MWC model, sequential model, oxygen-hemoglobin binding, binding of two different ligands , cooperative binding, anti-cooperative binding and excluded site binding ,energetics & dynamics of binding, binding of immunoglobulin and DNA binding protein. Static and dynamic light scattering, Surface Plasmon resonance, isothermal titration calorimetry and differential scanning calorimetry	1.0
2	Introduction to crystallography-Crystals, Molecular crystal symmetry, Miller indices, reciprocal Lattice, Ewalds Construction, X ray diffraction by crystals, Bragg's Law & Bragg's diffraction equation, laue powder and rotation methods & Laue's equations, diffraction methods-Laue's method, Weissenberg diffraction camera and powder method. Protein X-ray crystallography- production of suitable crystals, Acquisition of the	0.5

	diffraction pattern, Determination of phases, Heavy atom replacement method, Calculation of the electron density and refinement. Phase problem in crystallography. Neutron diffraction, Electron diffraction, Synchrotron diffraction, Fibre diffraction and its application	
3.	Introduction to Bioinformatics and Biological databases, Major Bioinformatics Resources- NCBI, SWISS-PROT, EMBL. Databases- Classification of database; primary, secondary and composite. Sequence databases: Nucleotide sequence databases and protein sequence databases. Information & retrieval from biological databases. Bioinformatics tools- Pair wise Alignment (Global and Local), Multiple sequence alignment, Alignment algorithms, BLAST (Basic Logical Alignment Search Tool) FASTA, Multiple Alignment, DNA micro array technique	0.5
4	Visualization of bimolecular structures, Concepts in molecular modeling, Energy minimization, Dynamic simulation & conformational analysis, Applications of molecular modeling packages, structural similarity & overlaps, structural prediction & molecular docking, Applications of protein modeling. Introduction to cheminformatics and drug designing. Introduction to nanotechnology-origin of nanotechnology, nanoscience, biosynthesis and characterization of nanoparticles, nanotoxicology. Applications of nanomaterials in biology and Medicine	1.0
	Total Credits of the Course	3

Books for Reference

Compulsory Reading:

1. X-ray structure determination , George.H. Stout, Lyle H Jensen, John Wiley & Sons.
2. Introduction to Bioinformatics, V.Kothekar, DHRUV Publications
3. Methods in Modern Biophysics, Bengt nolting, II edition.

Further Reading:

- 3. Biophysical Chemistry, P.R.Bergethon, E.R.Simons
- Principles of Instrumental Analysis, Skoog, Holler, Nieman
- Biophysics, Vasantha Pattabhi, N.Gautham
- Biophysical Chemistry, Techniques for the study of biological structure And function , Cantor $ Schimmel part II
- Bioseparations Science and Engineering: Roger G Harrison, Paul Todd, Scott .R. Rudge, Oxford University Press.
- Methods in Modern Biophysics, Bengt Nolting.
- Practical Protein crystalloigraphy, Duncan.E, Mc Rec
- Introduction to Bioinformatics, Arthur M.Lesk
- Emerging Trends in Bioinformatics, Irfan A Khan, Atiya Khanum, Ukaaz Publications4.

SBS M IV C 1761: Lab Course 7

Course Objectives:

3. To familiarize the student to various Biophysical, Physiological, Radiation and Bioinformatics techniques
4. To develop laboratory skills on Separation techniques, Physiological experiments, Study of effects of Radiation and Bioinformatics tools

Module No	Module Content	Credits
1	1. To study the Erythrocytes Membrane Permeability and Transport effects of Hypotonic & Hypertonic shock 2. To determine the partial characteristics of Membrane Protein by SDS-PAGE. 3. To determine the effects of UV on E.coli and elucidation of cell survival curve. 4. Determination of effects of UV on cell membrane	1.0
2	5. Determination of effects of UV on cell membrane. 6. To study the renal stone using Infra-Red (IR) Spectroscopy. 7. To determine the oil content of oil seeds using Nondestructive IR Spectrophotometry. 8. Denaturation & Renaturation of DNA. 9. To isolate the chloroplast and characterize the chloroplast membrane protein	0.5
3.	10.Identification of Nucleic Acid Binding Proteins Using Nondenaturing Sodium Decyl Sulfate Polyacrylamide Gel Electrophoresis (SDecS-Page) 11.Internet search for Bioinformatics resources. 12. Nucleic acids and Protein sequence database search. 13. Multiple sequence alignment and Conserved Amino acid residues. 14. Analysis and study of sequence using different types of BLAST tool	0.5
4	15.Analysis and study of sequence using FASTA 16.ECG, (demonstration). 17. Spirometry, Body temperature, pulse sensors, 18. Breath holding time, Measure the pulse rates, Heart beat rate, BP measurement	1.0
	Total Credits of the Course	3

Books for Reference

Compulsory Reading:

1.

2.

Further Reading:

3.

4. 5.

SCHEME OF FOURTH SEMESTER ELECTIVE COURSES **Students need to select any two of the following elective courses**			
66	SBS M IV E 1763	Quality control in herbal drugs	3
67	SBS M IV E 1764	Environment Biotechnology	3
68	SBS M IV E 1765	IPR and Patenting	3
69	SBS M IV E 1766	Omics in Biotechnology	3
70	SBS M IV E 1767	Molecular Phylogenetics	3
71	SBS M IV E 1768	Plant Microbe Interactions	3
72	SBS M IV E 1769	Human Virology	3
73	SBS M IV E 1770	Advanced Techniques in Diagnostic Microbiology	3
74	SBS M IV E 1771	Physiological Biophysics	3
75	SBS M IV E 1772	Radiation Biophysics	3
76	SBS M IV E 1773	Good Laboratory Practices	3
77	SBS M IV E 1774	Medical Biophysics	3
78	SBS M IV E 1775	Algal Biofuel Technology	3
79	SBS M IV E 17766	Biofertilizers and Biopesticides	3
80	SBS M IV E 1777	Health and Nutrition	3
81	SBS M IV E 1778	Neutrophil Biology	3
82	SBS M IV E 1779	Medicinal Plants	3

SBS M IV E 1763: QUALITY CONTROL IN HERBAL DRUGS

Course Offered by: Dr Prakashkumar B

Course Objectives:

1. To traduce the students into concepts of Quality control as applied to Herbal drug industry

Module No	Module Content	Credits
1	WHO Guidelines for Quality Control of herbal raw materials. Determination of pesticide residue, arsenic and heavy metals, afflatoxins and microbial contaminants	
2	Definition, principle of the various extraction techniques like maceration, percolation, hot continuous extraction, pilot scale extraction, microwave assisted extraction and supercritical fluid extraction. GMP for the production of quality botanicals.	
3.	General methods for isolation and purification of active principles from medicinal plants. Application of chromatographic techniques in isolation & characterisation of phytochemical constituents viz., paper chromatography, thin layer chromatography, column chromatography, gas chromatography (GC), high performance liquid chromatography (HPLC) and high performance thin layer chromatography (HPTLC).	
4	Role of chemical and biological markers in standardization of herbal products	
5	General methods for structural elucidation of natural products, Application of spectroscopy for characterisation of phytoconstituents	
	Total Credits	3

References

Compulsory Reading:

1. Herbal Drug Technology, S. S. Agrawal, M. Paridhavi, Publisher Universities Press, 2007, ISBN 8173715793, 9788173715792

Further Reading:

2. Pharmaceutical Analysis Hiquchi, Bechmman, Hassan.
3. Methods of Drug Analysis Gearien, Graboski.
4. Text Book of BioPharmaceutic Analysis Robert Smith and James Stewart.
5. Pharmaceutical Analysis Modern methods Part A and B Munson James. W.
6. Quantitative Analysis of Drugs Garrot.
7. Quantitative Analysis of Drugs in Pharmaceutical Formulations P. D. Sethi.

SBS M IV E 1764: ENVIRONMENT BIOTECHNOLOGY

Course Offered by:

Course Objectives:

1. Environmental Biotechnology is offered to train the students both in theory and practical aspects of identifying environmental problem
2. Enable students in formulating ideal solution to environment problems based on green chemistry concept

Module No	Module Content	Credits
1	**Industrial pollution causes, problems:** Air, Soil and Water pollutants, Types of pollutants characterization, Persistence and Biomagnification of Xenobiotics, recalcitrant molecules, nitroaromatic polychlorinated, biphenyls and dioxans, synthetic polymers, alkylbenzyl sulphonates, Hydrocarbons, Pesticides, Phenolics, Anilines, Inorganic pollutants, Heavy metals. Detection and Quantification of pollutants. Environmental laws	1.0
2	**Biodegradation, Process and application:** Microbial infallibility, types of biodegradation, factors affecting biodegradation, enzymes involved in biodegradation, catabolic plasmids, Molecular Approaches, Biogeochemical cycles, Bioleaching. Biodegradation of Hydrocarbons, cellulose, lignin, Phenoland pesticides. Application of TOC, FT/IR, GC-MS analysis in biodegradation studies	0.5
3.	**Industrial wastewater:** Types of industrial effluents, characterization of the wastewater. Chemical Oxygen Demand, Biological Oxygen Demand, Total organic carbon, Nitrogen contents, Suspended solids. Total heterotrophic bacterial population. Bacteriological analysis of drinking water, Presumptive, completed, and confirmed test. Treatment strategies primary, Secondary and tertiary treatment Physical, Chemical and Biological treatment. Floc based and film based strategies, aerobic and anaerobic methods	0.5
4	**Biological treatment of industrial wastewater:** Activated sludge process, different stages, Types. Oxic/Anoxic, Extended aeration methods, Nitrification and denitrification. Trickling filter process, Different stages Types, Biofilm applications, Rotating Biological contactor, UASB, Submerged aerobic filters, Fluidized Bed Reactor, Packed bed reactor, Oxidation lagoons. Bioreactors for waste water treatment. Advanced treatment strategies Teritiary treatment methods, Disinfection, Chlorination, Chlorination dosage chlorination derived by products	1.0
5	**Solid waste management:** Solid waste, Types, Problems, Characterization and sorting of wastes. Municipal and industrial waste management, Landfills composting, stages in composting, Types of composting vermin composting. Methanogenesis, stages in anaerobic digestion, methanogens Anaerobic reactors Biogas generation, Household treatment strategies, Present problem and Possible remedies	

Total Credits of the Course	3

Books for Reference

Compulsory Reading:

1. Microbial Bioremediation,P.Rajendran and P Gunasekharan ,MJP Publishers, Chennai 2006

2. Environmental Microbiology, K.Vijaya Ramesh,. MJP Publishers, Chennai 2006

Further Reading:

3. Waste water Microbiology, Gabriel Bitton, 4 th edition , Wiley Blackwell, 2010

4. Biotechnology-A text book of Industrial Microbiology, Wulf Cruger , Wiley,1990

5. Environmental Science and Management, Abhijit Mallick, Viva Books,New Delhi,2014

6. Environmental Biotechnology-a biosystems approach, 2nd edition, Daniel Vallero, Elsievier , New York

SBS M IV E 1765: IPR AND PATENTING

Course offered by Dr Linu Mathew:

Course Objectives:

1. To enable students understanding the various aspects of intellectual property rights and patenting

Module No	Module Content	Credits
1	Introduction. Definitions General Agreement on Trade and Tariff (GATT) and World Trade Organizations Establishment and functions of GATT, WTO and WIPO. WTO Guidelines and Summits. Physical and Intellectual Property	1.0
2	TRIPS Different types of intellectual property rights (IPR) - Patents, Trade mark, Trade secret, Copy right and Geographical indications Requirement of patentability Biotechnological examples of patents, trademark, trade secret and copy right	0.5
3.	Patenting research tools and the law: Patents as a Strategy for Protection of Intellectual Property, Benefits and Costs of Patents, Requirements for Patent Protection, patentable subjects and protection in biotechnology, international convention for the protection of new varieties – Strasbourg convention, UPOV	0.5

	convention Experimental Use Exemption	
4	Patent filing and Infringement Patent application- forms and guidelines, fee structure, time frames; Types of patent applications: provisional and complete specifications; PCT and convention patent applications; International patenting-requirement, procedures and costs; financial assistance for patenting-introduction to existing schemes; Indian Patent Act, 1970 and recent amendments Publication of patents in India Status of patenting in Europe and US. Patenting by research students, lecturers and scientists University/organizational rules in India and abroad, credit sharing by workers, financial incentives, Patent infringement- meaning, scope, litigation, case studies and examples	1.0
5	The patentablility of microorganisms, legal protection for plants and other higher organisms, new plant varieties by rights, tissue culture protocols, transfer of technology. Patentability of vectors.Licensing - Flavr Savr™ tomato as a model case, Biopiracy and case studies on patents (Basmati rice, Turmeric, and Neem)	
	Total Credits of the Course	3

Books for Reference

Compulsory Reading:

1. Revised guidelines for research in Transgenic plants (August 1998), Department of Biotechnology, Ministry of Science & Technology, Government of India, New Delhi.
2. Patents (2003), N.Subbaram, Pharma Book Syndicate, Hyderabad.

Further Reading:

3. WIPO Hand book on Intellectual Property
4. Intellectual Property, W.R. Cornish, Sweet and Maxwell publishers , London

Web resources

5. https:// worldwide. espacenet.com
6. https:// patentscope. wipo. int
7. https:// ipindiaservices.gov.in

SBS M IV E 1766: OMICS IN BIOTECHNOLGY

Course offered by: Dr Keerthy TR

Course Objectives:

1. To understand the basic principles of genome and genomics

2. To understand the basic principles of proteomics and metabolomics

3. To understand the basic principles of metagenomics and biological database

Module No	Module Content	Credits
1	**Genome & Genomics**: Definition of Genome & Genomics. Types of genomics,, Functional Genomics.Structural genomics & Comparative genomics, Tools in Genomics,Structural genomics:-Classical ways of genome analysis, large fragment genomic libraries; Physical & Genetic mapping of genomes; Genome sequencing, sequence assembly, annotation& bioinformatics. Functional genomics:-DNA chips and their use in transcriptome analysis; Mutants and RNAi in functional genomics, Next generation sequencing methods; Structure of genomes: bacteria, yeast, nematode, Arabidopsis, rice, zebra fish, mouse and man. Applications of genomics	1.0
2	**Proteomics,Transcriptomics & Metabolomics:** Basic concepts , Introduction to transcriptomics, proteomics and metabolomics. Tools of proteomics- SDS PAGE, 2D PAGE , Liquid chromatography , Mass Spectrometry (ESI and MALDI) ,Protein identification by peptide mass fingerprinting ,Applications of proteomics-. Protein identity based on composition, Motifs and patterns, Analysis and characterization of proteins and metabolites:. Proteomics approaches to the analysis of protein-protein interactions, and metabolic profiling through emerging metabolomic techniques like 2D gel electrophoresis and Mass spectrometric and computational techniques. Applications of proteomics in agriculture, human health and industry	0.5
3.	**Metagenomics:** Definition of metagenomics**,** Techniques in metagenomics- Isolating DNA from an environmental sampleClone DNA,Insert into plasmid, Develop sample library, Screen or sequence, Analysis of metagenomic data. Application of metagenomics	0.5
4	**Biological data bases:** Classification databases. Biological databases- primary sequence databases- Composite sequence databases- Secondary databases-composite protein pattern databases,Pattern and profile databases Genome Information Resources: DNA sequence databases-specialized genomic resources, GRAIL, GENSCAN Proteome databases Protein sequence databases - SWISS-PROT and TrEMBL — PROSITE and BLOCKS - 2D PAGE databases – Structure databases - PDB- Metabolic databases – post translational modification databases	1.0

Total Credits of the Course	3

Books for Reference

Compulsory Reading:

1. Introduction to proteomics,Daniel.C.Libeler,Humana Press 2002
2. Thompson, J.D., Schaeffer-Reiss, C., and Ueffing, M. 2008. *Functional Proteomics. Methods andProtocols*. Humana Press, New York.
3. Bostjan Koba.,Mitchell Guss & Thomas Habs Structural Proteomics.Humana Press.
4. Aurthur M Lesk Introduction to Bioinformatics .Oxford University press.

Further Reading:

5. Twyman, R.M. 2004. *Principles of Proteomics*. Taylor & Francis
6. Mass Spectrometry for Biotechnology by Gary Siuzdak, Academic Press.
7. Proteomics for Biological Discovery by Timothy Veenstra and John Yates, Wiley.
8. Metabolomics- Methods and Protocols by Wolfram Weckwerth, Humana Press.
9. Lipidomics- Technologies and Applications by Kim Ekroos, Wiley-VCH.
10. Web/Journal Resources.
11. Transcriptomics: Expression Pattern Analysis, Virendra Gomase, Somnath Tagore; VDM Publishing, 2009 – Science
12. Brown TA. 2007. Genome III. Garland Science Publ.
13. Campbell AM & Heyer L. 2004. Discovery Genomics, Proteomics and Bioinformatics. Pearson Education.
14. Jollès P & Jörnvall H. 2000. Proteomics in Functional Genomics: Protein Structure Analysis
15. . Birkhäuser.
16. Kamp RM. 2004. Methods in Proteome and Protein Analysis. Springer.
17. Primrose SB & Twyman RM. 2007. Principles of Genome Analysis and Genomics
18. Blackwell. Sensen CW. 2005. Handbook of Genome Research. Vols. I, II. Wiley CVH.

SBS M IV E 1767: MOLECULAR PHYLOGENETICS

Course offered by: Dr Linu Mathew

Course Objectives:

1. This elective course deals with the tools and techniques of Molecular phylogeny. The course has a theoretical and a practical dimension
2. The learner will develop an understanding about models of nucleic acid substitution, tree building algorithms, data mining tools and submission tools for nucleic acid data and applications of Molecular phylogeny

Module No	Module Content	Credits

1	Basic concepts of molecular evolution: Genetic information, population dynamics, evolution and speciation, data used for molecular phylogenetics, phylogenetic tree, methods for inferring phylogenetic trees, networking, RNA world	1.0
2	Sequence databases and data base searches: Sequence databases, composite databases, database mirroring, and search tools, data base searching by sequence similarity – BLAST and FASTA, multiple sequence alignments CLUSTAL, MUSCLE, T-COFFEE	0.5
3.	Phylogeneticc inference: Genetic distances and nuclear substitution models, phylogenetic inference based on distance methods- UPGMA, Neighbour Joining, Minimum Evolution, Least square	0.5
4	Phylogeneticc inference: Maximum Likelihood and Bayesian phylogenetic analysis, phylogenetic analysis based on parsimony, phylogenetics analysis using protein sequences, testing tree reliability – Bootstrapping and jackknifing	1.0
5	Testing models and trees: Models of evolution and phylogeny reconstruction, model fit, likelihood ratio tests , Practising MEGA, Paup*, RaxML, ,Mr Bayes, Model Test, Sequence submission tools SEQUIN and BankIt	
	Total Credits of the Course	3

Books for Reference

Compulsory Reading:

1. 1. The phylogenetic Hand book, 2nd Edition, Philippe Lemey, Marco Salemi, Anne – Mieke Vandamme, Cambridge University Press, ISBN-13 978-0-511-71963-9
2. Molecular evolution And Phylogenetics, Masatoshi Nei and Sudhir Kumar, Oxford University Press, ISBN 0195135857
3. Baldauf, SL (2003) “Phylogeny for the faint of heart: a tutorial.” Trends in Genetics; 19(6):345-351.

Further Reading:

4. Hall, BG. (2004) Phylogenetic Trees Made Easy: A How-To Manual, 2nded. Sinauer Associates, Inc.: Sunderland, M A. I*SBN: 978-0-87893-606-9*
5. Hartwell, LH, L Hood, ML Goldberg, AE Reynolds, LM Silver, RC Veres (2008) Genetics: From Genes to Genomes, 3rd Ed. McGraw-Hill: New York ISBN-13: 978-0073525266 ISBN-10: 007352526X

SBS M IV E 1768: PLANT MICROBE INTERACTIONS

Course offered by Dr Jisha MS

Course objectives:

1. To study plant defence mechanisms

2. To study the basis of plant pathogenesis

3. To familiarize with the microbial production of plant metabolites

Module No	Module Content	Credits
1	Different interfaces of interactions -soil-plant-microbe interactions leading to symbiotic (rhizobial and mycorrhizal), associative, endophytic and pathogenic interactions	1.0
2	Plants as a host environment. How plants defend themselves including structural defences, biochemical defences and the hypersensitive response. Genetic basis of plant defences. Quorum-sensing in bacteria and their role in plant defence mechanisms. Phytohormones and antibiotics as plant therapeutics.	0.5
3.	Plant pathogens and molecular basis of pathogenesis .Genetics of plant disease susceptibility and resistance. Systemic Acquired Resistance (SAR) and Induced Systemic Resistance (ISR), Recognition mechanism and signal transduction during plant - pathogen interaction.	0.5
4	Microbial pest control: Bacillus thuringiensis-mode of action, persistence and ecotoxicology. Biocontrol agents. Biofungicide and bioherbicides. Microbial production of plant metabolites. Plant growth promoting rhizobacteria.. Use of plant–microbe symbiosis for remediation of pollutants and carbon (C) sequestration. GM crops	1.0
	Total Credits of the Course	3

Books for Reference

Compulsory Reading:

1. 1. B. Lugtenberg (ed). 2015.Principles of plant microbe interactions, Springer
2. S. Jayaraj. Microbial control and pest Management.

Further Reading:

3. B. Lugtenberg (ed). 2015.Principles of plant microbe interactions, Springer
4. Microbial control and pest Management – S.Jayaraj.

5. Paul, E.A. 2007. Soil Microbiology, Ecology and Biochemistry, Academic Press.
6. Subba Rao, N.S. 2005. Soil Microorganisms and Plant Growth, Oxford and IBH Publishing Co.
7. M.Gillings and Holmes .2004.Plant microbiology-Bios Scientific publishers.
8. Kosuge T & Nester EW. 1989. Plant-Microbe Interactions: Molecular and Genetic Perspectives . Vols I-IV. McGraw Hill.
9. Verma DPS & Kohn TH. 1984. Genes Involved in Microbe-Plant Interactions. Springer Verlag.
10. Gary Stacey, Noel T. Keen, 1995. Plant-Microbe Interactions. Vols I-VI Springer Science & Business Media.
11. Jeng-Sheng Huang 2001.Plant Pathogenesis and Resistance Biochemistry and Physiology of Plant-Microbe Interactions .Springer Verlag

SBS M IV E 1769: HUMAN VIROLOGY

Course offered by: Dr Jyothis Mathew

Course Objectives:

1.To study the properties of important human viruses

2.To understand the pathogenesis of viral diseases

3.To familiarize with the diagnostics methods in Virology

Module No	Module Content	Credits
1	Study of properties of human DNA viruses viz. Pox, Herpes, Adeno, Papova, and Parvoviruses. Pathogenesis and laboratory diagnosis of diseases caused by these viruses	1.0
2	Study of properties of human RNA viruses viz. Picorna, Orthomyxo, Paramyxo, Rhabdo, and Rubella viruses	0.5
3.	Arboviruses and Hepatitis viruses - Properties. Pathogenesis and laboratory diagnosis of diseases caused by these viruses Viral haemorrhagic fevers, SARS, HIV- Properties , pathogenesis and laboratory diagnosis of AIDS. Slow virus infections, Prion diseases	0.5
4	Viruses and cancer, Viral oncogenesis, Viruses implicated in the cancers of humans, Prophylaxis of viral diseases, antiviral agents. Mechanisms of action Interferons	1.0
	Total Credits of the Course	3

Books for Reference

Compulsory Reading:

1. Jawetz,Melnick& Adelberg's Medical Microbiology (27th Edition) Carrol, Butel, Morse, Mietzner Mc Graw Hill
2. Ananthanarayan & Panicker's Text book of Microbiology. (9th Edition) Arti Kapil (Ed) University Press (India) Pvt.Ltd.

Further Reading:

3. Jawetz,Melnick& Adelberg's Medical Microbiology (27th Edition) Carrol, Butel, Morse, Mietzner Mc Graw Hill
4. Ananthanarayan & Panicker's Text book of Microbiology. (9th Edition) Arti Kapil (Ed) University Press (India) Pvt.Ltd.

1. Human Virology (Fourth Edition) Leslie Collier, John Oxford & Paul Kellam Oxford University Press.
2. Fundamental Virology (5th Edition) David M.Knipe& Lippincott Williams & Wilkins
3. Viruses Biology,Applications & Control

SBS M IV E 1770: ADVANCED TECHNIQUES IN DIAGNOSTIC MICROBIOLOGY

Course offered by: Dr Radhakrishnan E K

Course Objectives:

1. To introduce basics and advancement in diagnostic microbiology

2.To introduce methods used in specimen collection and processing in diagnostic microbiology

3. To introduce various techniques using diagnostic microbiology

Module No	Module Content	Credits
1	Introduction to diagnostic microbiology,laboratory safety, hospital epidemiology. Lab methods in Medical Microbiology, basic virology, basic mycology, Clinical material - collection and transport. Etiological agents recovered from different clinical materials	
2	Biochemical profile based microbial identification systems, Urea breath test, Rapid antigen tests, Enzyme-Linked Immunoassay, Western blot, Advanced antibody detection, Bacterial antimicrobial susceptibility tests	

3.	Polymerase chain reaction, Principle, applications and types of PCR in medical diagnostic field, Microbial Identification Based on PCR amplification of 16S rDNA, Sequence analysis, Application of Real Time PCR in Diagnostic Microbiology, Microbial Strain Typing Using Repetitive Sequences Advances in the Diagnosis of *Mycobacterium tuberculosis* and methicillin resistant *Staphylococcus aureus.*	
4	Probe-Based Microbial Detection and Identification, Southern Blot Hybridization, Microarray- Based Microbial Identification and Characterization, Recent advances in medical microbiology	
	Total Credits of the Course	3

Books for Reference

Compulsory Reading:

1. Bailey and Scott's Diagnostic Microbiology Publisher: Elsevier Health, 28 Jun 2013
2. Advanced Techniques in Diagnostic Microbiology Editors: **Wu,** Shangwei**, Stratton,** Charles, 2012

Further Reading:

3. Textbook of Diagnostic Microbiology Hardcover, by Mahon (Author), Publisher: Elsevier Health - US; 5 edition (18 February 2014)
4. Koneman's Color Atlas and Textbook of Diagnostic Microbiology 7th Edition by Gary W. Procop MD MS , Elmer W. Koneman, Publisher: LWW; 7 edition (June 15, 2016)

SBS M IV E 1771: PHYSIOLOGICAL BIOPHYSICS

Course offered by Dr Harikumaran Nair

Course Objectives:

1. To introduce the physical principles that underlie the dynamics of life from the macro to molecular scale
2. To introduce the basic notions of physical and chemical laws related the architecture of different functional organs
3. To explain how human tissues interact / behave at their boundaries

Module No	Module Content	Credits
1	Chemical composition of body, movement of molecules across cell membranes, control of cells by chemical messengers, design of circulatory system, pressure, flow and resistance in circulatory system, physical characteristics of blood, hemodynamics principles & equations, genesis & spread of cardiac impulse, cardiodynamics, regulation of blood pressure & blood volume, heartbeat coordination, mechanical events of cardiac cycle, cardiac output, cardiovascular responses to stress	1.0
2	Lung mechanics, ventilation ,gas exchange process, gas diffusion, gas transport, pulmonary circulation, neural generation of rhythmical breathing, control of respiration by partial pressure of gases and hydrogen ion concentration, ventilation in response to stress, pulmonary function tests	0.5
3.	Ionic composition & distribution of body fluids, division of labour in kidney tubules, concept of renal clearance, regulation of sodium, water and potassium balance, calcium regulation, hydrogen ion regulation, renal mechanics, acidosis, alkalosis, basic concepts of energy expenditure, regulation of total body energy stores, regulation of body temperature	0.5
4	Molecular mechanism of muscle contraction, mechanics of single-fiber contraction and whole muscle contraction, muscle energy metabolism, control of body movement, maintenance of upright posture and balance, walking, vestibular system and equilibrium, state of consciousness, motivation and emotion, cerebral dominance and language	1.0
	Total Credits of the Course	3

Books for Reference

Compulsory Reading:

1. Brobeck J.R, Best and Taylor's Physiological bases of medical practice
2. Basar E, Biophysical and physiological system analysis

Further Reading:

1. Phil Nelson, WH Freeman-Biological Physics – Energy, Information, Life
2. Robert Glambos, Nerves and muscles

SBS M IV E 1772: RADIATION BIOPHYSICS

Course offered by: Mrs Resmi

Course Objectives:

1. To introduce the student to an important division of Biophysics- Radiation Biophysics

2. To familiarize the topics of Radiation and Radioactivity, its interactions, effects, dosimetry, , hazards, protection and application in different fields		
Module No	**Module Content**	**Credits**
1	Isotope, Radioactivity, Laws of radioactivity, α, β, γ rays. Properties of electromagnetic radiation. Radiation units; Exposure and Dose, Dose equivalent unit. , KERMA, Absorbed dose and Derived Units- Equivalent Dose and Effective dose, Dose rate. Interaction of radiation with matter- Bremsstrahlung, Photoelectric effect, Compton effect, Ion pair production. Interaction, absorption and scattering of electron. Heavy charged particles and Neutrons. Attenuation coefficient and absorption coefficient. HVL, Mean free path, Absorption edges, LET, Relative biological effectiveness (RBE)	1.0
2	Radiolysis of water, Production of free radicals & their interactions, Competition kinetics, Diffusion kinetics & Physicochemical effects, Role of scavengers, G-value, Genetic Effect of radiolysis,, Chromosomal breakage and Aberrations Direct and Indirect action, Oxygen and temperature effect, OER. Target theory, Single hit & Multi hit theory, Multi target theory, Calculation of target, Mass, Volume & Molecular weight, Effect of radiation on Nucleic acids, Proteins, Enzymes & Carbohydrates., Somatic effect of radiation, Somatic and genetic effects of radiation, Stochastic and deterministic effects, early and late effects, Radiation sickness , Radiation syndrome, Haemopoietic syndrome, G.I syndrome, CNS syndrome, Acute radiation damage, Early and late effects of radiation, Effect of chronic exposure to radiation. Acute radiation damage, LD-50, Dose effect relationship. Cell recovery and modification of Radiation damage	0.5
3.	Principles of radiation detection and measurement- Dosimetry- General requirements of Dosimeters, Radiation sources, Telegamma Unit (Cobalt unit), Gamma chamber, Nuclear reactors, Thermal & fast neutron sources.Dosimeters- Basic principles, Design & Working of physical dosimeters- Ionization chamber, Proportional counters, GM- Counter, Concepts of Gas amplification, Resolving time & Dead time, Scintillation Detectors, Thermolumeniscent Dosimeter, Semiconductor, Surface barrier & Lithium detectors, Area survey meter & Pocket dosimeter, Film badge, General principle of chemical dosimetry, Salient Features of Chemical dosimeter, Dose evaluation formula for chemical dosimetry, Principles of radiolytic reaction, Experimental methods- Influencing factors of Fricke dosimeter methyl orange, FBX dosimeter, Free radical dosimeter, Ceric sulphate dosimeter, PMMA, PVC, chlorobenzene dosimeter, High & low dose indicators	0.5
4	Natural and man-made radiation exposures, maximum possible dose, Radiation hazards- external and internal radiation hazards. Radiation protection measurement in industrial establishment, Radioisotope labs, diagnostic and therapeutic installation and during the transportation of radioactive substances, Disposal of radioactive wastes. Applications of	1.0

	radiation- Radioisotopes in Biology, Agriculture, Plant breeding, Plant Physiology, Medicine. Internally administered isotopes. Radioiodine in thyroid function analysis. Renal, liver and lung function analysis. Radio immuno assay, Radiotracer techniques. Auto radiography. Specialized radio isotopic applications in industries	
	Total Credits of the Course	3

Books for Reference

Compulsory Reading:

1. Glenn.F.knoll., Radiation detection and Measurement; III Edition,John Wiley & Sons, Inc.
2. Edward L. Alphen., Radiation Biophysics©, Prentice Hall

Further Reading:

1. Frank.H. Attix., Introduction to Radiological Physics & Radiation dosimetry
2. Wagner, Szabo, Buchanan., Principles of Nuclear medicine.
3. Orton, C.G., Radiation Dosimetry: Physical and Biological aspects.
3. Girish Lahari- Nuclear Physics,Mohit Books International.
4. S.P.Yarmonenko;Radiobiology, Mir Publishers.
5. Jozsef Konya.Noemi M. Nagy; Nuclear and Radiochemistry,Elsevier insights

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SBS M IV E 1773: GOOD LABORATORY PRACTICES

Course offered by: Dr Harikumaran Nair

Course Objectives:

1. To introduce the concept of 'Good Laboratory Practices' (GLP)
2. To familiarize students the standard by which, laboratory studies are designed, implemented, and reported to assure the public that the results are accurate/reliable and the experiment can be reproduced accordingly
3. Enable students to understand various regulations related to in the practices of scientists working on the safety testing of prospective drugs and other chemical or biochemical entities

Module No	Module Content	Credits

1	Introduction to good laboratory practices (GLP) and its application, history of GLP, fundamental points of GLP, Resources-personnel, Facilities - buildings and equipment, Characterization- test item, test system, rules for performing studies-the study plan or protocol, standard operating procedures (SOPs) raw data and data collection-records and recording, study report, archives and archiving, quality assurance, audit and inspections, implementation of GLP	2.0
2	Applications of the GLP principles to field studies, applications of the GLP principles to short term studies, applications of the GLP principles to *in vitro* studies	0.5
3.	Ethics in research- locating ethics in research, justice in research, science and society, ethical issues in biotechnology, ethical guidelines related to human experimentation, guidelines regarding animal use in research, institutional biosafety monitoring mechanisms	0.5
	Total Credits of the Course	3

Books for Reference

Compulsory Reading:

1. Handbook on Good Laboratory Practice- World Health Organization
2. Ethical Guidelines for Biomedical Research on Human Participants- Indian Council of Medical Research

Further Reading:

1. Guidelines on the regulation of scientific experiments on animals- Ministry of Environment and Forests, India
2. Text Book on Ethics in Research- European Commission, Publications Office of the European Union

SBS M IV E 1774: MEDICAL BIOPHYSICS

Course offered by: Mrs Resmi S

Course Objectives:

1. To introduce the student to important areas of medical Biophysics like Bioelectric signals,

Laser, Medical imaging, Sonography, Fluoroscopy, Nuclear medicine, Radiation therapy and Ergonomics.

2. To get an insight on how experimental methods and theoretical approaches from physics can give answers related to the structure and functions of biological system.

Module No	Module Content	Credits
1	Origin and Characteristics of Bioelectric signals & recording, Electrodes-types Design and properties and Utility, Skin contact impedance of Electrodes, noise suppression techniques, recording system, Medical Display systems, Patient Monitoring systems, Biomedical Telemetry, Computer Applications in medical field, Patient Safety. Cardiac pace makers, Defibrillators, Hemodialysis machines, Short wave and Micro wave Diathermy, Ultrasonic Therapy, Pain relief through electrical stimulation, Surgical Diathermy, Laser, principle of operation, Types, Laser tissue interaction, Biomedical applications in surgery and therapy	1.0
2	Principle, Working of Blood flow Meters, Pulmonary function analyzers, Blood gas analyzer, Oximeters, Audiometer. Medical-Imaging Techniques . Physical aspects of Medical-imaging, Principle, Practical System, Medical utility of X-ray imaging, Fluoroscopy, Xeroradiography, Computerized Axial Tomography, Mammography, Angiography, Myelography, Magnetic resonance imaging, Ultrasonography	0.5
3.	Basic principles of Nuclear Medicine, Diagnostic use of Radioisotopes In-vivo & In-vitro procedures, (Single isotope, Double isotope methods) , Radio immunoassay counting system, General principles & procedures of organ scanning, Renal imaging, Cardiac imaging, Thyroid scanning, Blood volume determination by isotope method, Rectilinear scanners & Gamma scintillation camera, Positron emission Tomography (PET), Single Photon emission computer Tomography (SPECT), Radio pharmaceuticals & their Diagnostic applications	0.5
4	Concepts of teletherapy & Brachytherapy, Co-60 Therapy, Basic principles & scope of radio therapy, Benign & Malignant tumors, Tissue tolerance dose & Tumor lethal dose, Medical dosometry, Dose fractionation, Palliative & Curative therapy, Treatment planning, Isodose distribution, Patient data, Correction & Setup, Field shapping, Skin dose and field separation, brachytherapy, Sources, Calibrations, Dose distribution implant dosimetry. LINAC(Linear accelators) . Ergonomics, Muscle mechanics, Load velocity relation, Length tension relation, Entire State, Role of elastic components in muscle contraction, Ergonomic problems of computer users.	1.0
	Total Credits of the Course	3
Books for Reference		
Compulsory Reading:		

1. Hand book of Biomedical Instrumentation: R.S Khandpur,Tata McGraw-Hill Publishing company Ltd
2. Biomedical Instrumentation and measurements:Leslie Cromwell, Fred.J. Weibell,Erich. A.Pfeiffer. Prentice-Hall of India Private Ltd

Further Reading:

1. Bioinstrumentation: John.G.Webster.Wiley-India
2. Medical Physics: Martin Hollins.University of BATH

SBS M IV E 1775: ALGAL BIOFUEL TECHNOLOGY

Course offered by: Dr J G Ray

Course Objectives:

1. To introduce the nature and principle of different form of biomass energy
2. To familiarize the principle in the selection of suitable biomass fuels for different bio-energy applications
3. To explain the advantages and limitations of biofuels over traditional fuels such as coal and oil

Module No	Module Content	Credits
1	Introduction – Current situation and overview on different energy sources – petroleum fuels – scope, limitations and challenges; various alternative energy forms – wind, geothermal, solar – limitations and scope; Basic characteristics of biomass as source of energy – 1st generation, 2nd generation and 3rd generation biofuels – scope and limitations Significance of algal biomass resource – classification of algae – morphology and taxonomy of algae- morphological characteristics of the three major groups – cycanobacteria – green algae and diatoms – micro algae and macro algae in biomass production.	1.0
2	Basic characteristics of algal feed stocks – cultivation – Photoautotrophic vs. Heterotrophic - Open vs. Closed Systems - Scale-Up Challenges, Process-Development-Scale and Integrated Bio-refinery Stability of Large-Scale Cultures, Scalable System Designs: Maintaining Productivity, Nutrient Sources, Sustainability, and Management, Water Management, Conservation, and Sustainability, fermentation tanks – closed bioreactors – open ponds – scope and limitations of each kind - Harvesting/ dewatering of biomass – Ultrasonic Harvesting, Filtration, Flocculation and Sedimentation, Flocculation and Dissolved Air Flotation, Centrifugation, Other Harvesting Techniques; Drying, Microalgae Drying Methods	1.0

3.	Extraction - Lipid Separations and Extractions from Algae, Physical Methods of Extraction and/or Cellular Biomass, Pre-treatment, Microwave Assisted, Pulsed Electric Field, Ultrasonic , Catalytic Methods, of Extraction and/or Cellular Biomass Pre-treatment, Acid/Base Hydrolysis, Solvent-Based Extraction of Lipids Solvent Extraction Accelerated Solvent Extraction, Mixed Solvent Extraction, Supercritical Fluid Extraction, Switchable Solvents, Comparison of Extraction Methods, Lipid Extraction Challenges, Presence of Water Associated with the Biomass, Separation of Desired Extracts from Solvent Stream	0.5
4	Production of Biofuels from Algae through Heterotrophic Fermentation or by Direct Secretion, Alcohols , Alkanes, Processing of Whole Algae, Pyrolysis, Gasification, Anaerobic Digestion of Whole Algae, Supercritical Processing, Hydrothermal Processing, Conversion of Extracted Algae , Chemical Transesterification, Direct Transesterification of Lipids into Fatty Acid, Methyl Esters, Carbohydrate and Protein Fermentation, Biochemical (Enzymatic) Conversion, Catalytic Transesterification, Conversion to Renewable Diesel, Gasoline, and Jet Fuel, Processing of Algal Residuals after Extraction	0.5
	Total Credits of the Course	3

Books for Reference

Compulsory Reading:

1. Carney, Laura T., and Todd W. Lane. 2014. “Parasites in algae mass culture.” Frontiers in Microbiology 5, Article 278. doi:10.3389/fmicb.2014.00278
2. Chisti, Yusuf. 2007. “Biodiesel from microalgae.” Biotechnology Advances 25 (3): 294–306. doi:10.1016/j. biotechadv.2007.02.001.
3. Bracmort, K. 2014. Algae’s Potential as a Transportation Biofuel. Congressional Research Service Report 7-5700. https://www.fas.org/sgp/crs/misc/R42122.pdf
4. Darzins, A., P. Pienkos, and L. Edye. 2010. Current Status and Potential of Algal Biofuels Production. IEA Bioenergy Task 39. Report T39-T2. http://www.fao.org/uploads/media/1008_IEA_Bioenergy_-_Current_status_and_potential_for_algal_biofuels_production.pdf

Further Reading:

5. H.Verachtert et al.: Ethanol production by immobilized microorganisms, 1984, Katholieke Universitiet te Leuven, p.21
6. Blanken, W, P. R. Postma, L. de Winter, R. H. Wijffels, and M. Janssen. 2016. “Predicting microalgae growth.” Algal Research 14: 28–38. doi:10.1016/j.algal.2015.12.020.
7. Coons, J. E., D. M. Kalb, T. Dale, and B. L. Marrone. 2014. “Getting to low-cost algal biofuels: A monograph on conventional and cutting-edge harvesting and extraction technologies.” Algal Research 6 (B): 250–70. doi:10.1016/j.algal.2014.08.005.

SBS M IV E 1776: BIOFERTILIZERS AND BIOPESTICIDES

Course offered by: Dr J G Ray

Course Objectives:

1. To ntroduce the concept of biofertilizers and biopesticides
2. To familiarize different agriculturally important microorganisms which are being used as biofertilizers for maintaining the soil and plant health
3. To conventional biopesticides and the basic chemistry and action of the same

Module No	Module Content	Credits
1	Different agriculturally important beneficial microorganisms – free living, symbiotic (rhizobial, actinorhizal), associative and endophytic nitrogen fixers including cyanobacteria, taxonomic classification, nodule formation, competitiveness and quantification of N2 fixed	0.5
2	Different agriculturally important beneficial microorganisms – phosphate solubilizing bacteria and fungi, including mycorrhiza; Different agriculturally important beneficial microorganisms – plant growth promoting rhizobacteria , Different agriculturally important beneficial microorganisms – Biocontrol microbial inoculants; Different agriculturally important beneficial microorganisms for recycling of organic waste and compositing, bioremediators and other related microbes	0.5
3.	Different agriculturally important beneficial microorganisms - selection, establishment, competitiveness, crop productivity, soil & plant health, mass scale production and quality control of bio inoculants. Biofertilizer inoculation and microbial communities in the soil.	0.5
4	Conventional natural insect control agents such as pyrethrins, rotenones, nicotine, ryanodine, isobutylamides, drimane sesquiterpenoids, withanolides, clerodanes, quassinoids and limonoids - sources, isolation, characterization, synthesis, application and mode of action Phytoalexins, stress metabolites: Sources such as Leguminosae, Solanaceae etc. Acetylene and polyacetylene phytoalexins Pesticides of microbial origin : Sources, chemistry and mode of action of tetranactin, avermectins, milbimycins and spinosad. Herbicides like biolaphos and phosphonothricin. Phytotoxins like Alternaria alternata toxin, tentoxin, cornexistin, hydantoxidin. Other microbials such as NPV based insecticides Allelochemicals and chemical ecology. Application of biotechnology in pest management (ex. Bt)	1.5
	Total Credits of the course	3

Books for Reference

Compulsory Reading:

1. Sylvia DM, Fuhrmann JJ, Hartlly PT & Zuberer D. 2005. Principles and Applications of Soil Microbiology. 2nd Ed. Pearson Prentice Hall Edu.
2. Copping LG. 1996. Crop Protection Agents from Nature: Natural Products and Analogues. Royal Soc. Chem., London

Further Reading:

3. van Elsas JD, Trevors JT & Wellington EMH. 1997. Modern Soil Microbiology. CRC Press.

4. Bergerson FJ. 1980. Methods for Evaluating Biological Nitrogen Fixation. John Wiley & Sons

SBS M IV E 1777: HEALTH AND NUTRITION

Course offered by Dr Anie Y

Course Objectives:

To understand the basic principles of health and nutrition

Module No	Module Content	Credits
1	**Introduction to nutrition -** Food as source of nutrients, functions of food, definition of nutrition, nutrients & energy, adequate, optimum & good nutrition, malnutrition. Basics of energy metabolism, nutrition & dietetics - Unit of measuring energy, calorific value of food, BMR & factors affecting it, SDA of food, calculation of energy requirement, balanced diet, nutrition in health & disease. Nutritional disorders- Epidemiology, clinical features, prevention and dietary treatment for Protein Energy malnutrition, nutritional anaemia.	1.0
2	**Food sources:** Carbohydrates: Functions, classification, food sources, storage in body. Fats & oils : composition, saturated and unsaturated fatty acids, classification, food sources, function of fats. Proteins - composition, sources, essential & non-essential amino acids, functions, Protein deficiency	0.5
3.	**Water, Vitamins and minerals-** Water - as a nutrient, function, sources, requirement, water balance & effect. Minerals - macro & micronutrients. - Functions, sources. Bioavailability and deficiency of Calcium, Iron, Iodine, Sodium & Potassium (very briefly). Vitamins (water & fat soluble) - definition, classification & functions. Effect of cooking & heat processing on the nutritive value of foods. Processed supplementary foods.	0.5

4	**Nutritional problems affecting the community**-Etiology, prevalence, clinical features and preventive strategies of-Undernutrition - Protein energy malnutrition: Nutritional Anaemias, Vitamin A Deficiency, Iodine Deficiency Disorders. Overnutrition – obesity, coronary heart disease, diabetes. Fluorosis	1.0
	Total Credits of the Course	3

References

Compulsory Reading:

1. Mudambi, SR and Rajagopal, MV. Fundame ntals of Foods, Nutrition and Diet Therapy; Fifth Ed; 2012; New Age International Publishers
2. Mudambi, SR, Rao SM and Rajagopal, MV . Food Science; Second Ed; 2006; New Age International Publishers

Further Reading:

3. Srilakshmi B. Nutrition Science; 2012; New Age International (P) Ltd.
4. Swaminathan M. Handbook of Foods and Nu trition; Fifth Ed; 1986; BAPPCO.
5. Bamji MS, Krishnaswamy K and Brahmam GNV (Eds) (2009). Textbook of Human Nutrition, 3rd edition. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.

SBS M IV E 1778: NEUTROPHIL BIOLOGY

Course offered by: Dr Anie Y

Course Objectives:

1. To understand the role of neutrophils in immune system

Module No	Module Content	Credits
1	**Introduction to immune system-** innate and adaptive immune system, cells involved in immune system, humoral immunity, cytokines, antibodies, complement system. cell- mediated and humoral immune response	1.0

2	**Neutrophil Physiology**-Neutrophil structure, Granule types- azurophilic, specific, gelatinase, secretory vesicles, Antimicrobial peptides. Neutrophil Subpopulations. Neutrophil activation, apoptosis and clearance. Neutrophils in the resolution of inflammation. Neutrophil in immune cross-talk	0.5
3.	**Neutrophil defense mechanisms-** Chemotaxis, Phagocytosis, degranulation, ROS generation,NADPH oxidase, Neutrophil extracellular trap formation, NETosis vs. apoptosis and necrosis, Cytokine secretion. Diseases associated with altered neutrophil defence- Autoimmunity, cancers, thrombosis.	0.5
4	**Techniques to study neutrophils:** Neutrophil isolation and maintenance, Cell counting, Phagocytic assays, chemotactic assays, NBT assay, MTT assay, other assays of ROS production, Granule isolation, Neutrophil protein analysis, microscopic analysis of neutrophils and granules – Light and fluorescent microscopy, SEM and TEM	1.0
	Total Credits of the Course	3

Books for Reference

Compulsory Reading:

1. Neutrophil Methods and Protocols, Quinn, Mark T., DeLeo, Frank R., Bokoch, Gary M. (Eds.). ISBN 978-1-59745-467-4.
2. Neutrophil function: Mechanisms to diseases. Borko Amulic, Christel Cazalet,Garret L. Hayes, Kathleen D. Metzlerand Arturo Zychlinsky; Annu. Rev. Immunol. 2012. 30:459–89.

Further Reading:

3. Neutrophil biology: an update. Yoshiro Kobayashi, EXCLI J. 2015; 14: 220–227. doi: 10.17179/excli2015-102.
4. Advances in neutrophil biology: clinical implications. Cowburn AS, Condliffe AM, Farahi N, Summers C, Chilvers ER. Chest. 2008 Sep;134(3):606-12. doi: 10.1378/chest.08-0422.
5. The Neutrophils: New Outlook for Old Cells. 3rd Edition.Edited by: Dmitry Gabrilovich (H Lee Moffitt Cancer Center, USA & University of South Florida, USA). ISBN: 978-1-84816-836-7

SBS M IV E 1779: MEDICINAL PLANTS

Course offered by: Dr J G Ray

Course Objectives:

1. To introduce the significance of medicinal plants of ethno-medicine in modern research

2. To familiarize highly valuable medicinal plants for divers medicinal uses

Module No	Module Content	Credits
1	**Introduction to Herbal Medicines:** Principles of identifying medicinal plants, Basics of the botanical description – basic principles of morphology and taxonomy – Plants as medicines in Ayurveda – Unani – Siddha and Homeopathy - Ethno botany **Major Indian plants known as Antiseptic, Anti-allergic and Expectorants** botanical descriptions – cultivation, processing as crude remedies and basic knowledge of the phyto-chemistry: *Eclipta alba, Mentha piperita, Aloe vera, Melia azadirachta, Coscinium fenestratum, Syzigium aromaticum, Sesamum indicum, Aegle marmelos, Ruta graveloens, Curcuma longa, Curcuma aromatica, Curcuma celosia, Pterocarpus santanilus, Ricinus communis, Lawsonia inermis and Ophiorrhiza mungos;* ***Expectorants****: Adathoda beddomei, Tylophora indica, Terminalia chebula, Ocimum sanctum, Ocimum basilicum, Eucalyptus globulus, Clitoria ternatea, Glycorrhiza glabra, Kaempferia galanga, Piper longum and Piper nigrum*	1.0
2	**Indian Hallucinogenic, toxic and perfume-yielding plants**: botanical descriptions – cultivation, processing as crude remedies and basic knowledge of the phyto-chemistry: Papaver somniferum, *Datura alba, Nerium oleander, Strychnos nux-vomica, Cliestanthus colinus, Cannabis sativa, Gloriosa superba, Anamirta cocculus, Citrulus colocynthis, Abrus precatorius, Semecarpus anacardium, Excoecaria agallocha, Digitalis purpurea, Aconitum ferox, Croton triglium, Plumbago zeylanica, Jatropa gossypifolia, Euphorbia neerifolia, Parthenium* hyssterophorus and **Arisaema triphyllum**	0.5
3.	**Indian plants known as Nerve tonics** - botanical descriptions – cultivation, processing as crude remedies and basic knowledge of the phyto-chemistry: **Nerve tonics**: *Centella asiatica, Coriandrum sativum, Acorus calamus, Cardiospermum halicacabum, Allium cepa, Allium sativum, Cymbopogon citratus, Moringa olefera, Crocus sativus, Sida cordifolia, Bacopa monnieri, Withania somnifera, Solanum nigrum, Plumbago zeylanica, Vitex negundo, Samadera indica, Cynodon dactylon*	0.5
4	**Indian Medicinal plants for digestive problems and liver remedies (silagogues, carminatives, febrifuges, digestives, hepatoprotectives and laxatives)**: botanical descriptions – cultivation, processing as crude remedies and basic knowledge of the phyto-chemistry: *Tamarindus indica, Trigonella foenum-graceum, Solanum xanthocarpum, Coleus aromaticus, Abelmoschus moschatus, Syzigium cumini, Elettaria cardomomu, Cuminum cyminum, Punica granatumm, Curcuma amada, Ferula asafetida, Oxalis corniculata, Cinnamomum zeylanicum, Vernonia cinerea, Tinospora cordifolia, Andrographis paniculatus, Phyllanthus niruri, Phyllanthus emblica, Terminalia bellerica, Zingiber officianalis, Achyranthes aspera, Carica papaya, Casia alata and Boerahaavia diffusa.*	1.0
	Total Credits of the Course	3

Books for Reference

Compulsory Reading:

1. Tribal medicines by Pal DC and Jain SK, Naya Prakash Publishers, Calcutta
2. Hand book on herbal drugs and its plants sources, H Panda, National Institute of Industrial Research, Delhi

Further Reading:

1. Glossary of useful and economically important plants, Ashok K Panigrahi and Alaka Sahu, Central Book Agency, Calcutta.
2. Indian Medicinal Plants Vol ! and II, PS Warrier, Orient Longman
3. Medicinal Plants of India with special reference to Ayurveda, CKN Nair and N Mohanan, Nag Publishers, Delhi.
4. Indian Materia Medica Vol: 1 by, Dr. K.M. Nadkarani, Publisher: Popular Prakash, Mumbai.