KARPAGAM ACADEMY OF HIGHER EDUCATION

(Deemed to be University)
(Established under Section 3 of UGC Act, 1956)
Eachanari Post, Coimbatore - 641 021, India

FACULTY OF ARTS, SCIENCE AND HUMANITIES
UNDER-GRADUATE PROGRAMMES
REGULAR MODE
REGULATIONS - 2021

The following Regulations are effective from the academic year 2021-2022 and are applicable to candidates admitted to Under Graduate Degree (UG) programmes in the Faculty of Arts, Science, and Humanities, Karpagam Academy of Higher Education (KAHE) from the academic year 2021-2022 onwards.

1. PROGRAMMES OFFERED, MODE OF STUDY AND ADMISSION REQUIREMENTS

1.1 U.G. Programmes Offered

A candidate may undergo a programme in any one of the under graduate programme approved by the KAHE as given below.

S. No.	DEGREE	DISCIPLINE
1	B. Sc.	Biochemistry
2	B. Sc.	Biotechnology
3	B. Sc.	Computer Science
4	B.Sc.	Mathematics
5	B.Sc.	Physics
6	B. Sc.	Chemistry
7	B. Sc.	Microbiology
8	B. Sc.	Information Technology
9	B. Sc.	Computer Technology
10	B.Sc.	Computer Science (Cognitive Systems)
11	B.Sc.	Computer Science (Artificial Intelligence and Data Science)
12	BCA	Computer Application
13	B.Sc.	Applied Science (Material Science)
14	B.Sc.	Applied Science (Foundry Science)
15	B. Com.	Commerce
16	B.Com (CA)	Commerce with Computer Applications
17	B. Com. (PA)	Commerce with Professional Accounting
18	B. Com. (BPS)	Commerce with Business Process Services

19	B.B.A.	Business Administration
20	B. Com	Financial Analytics
21	B. Com	International Accounting and Finance

1.2 Mode of Study

Full-Time

All programs are offered under Full-Time Regular mode. Candidates admitted under '**Full-Time'** should be present in the KAHE during the complete working hours for curricular, co-curricular and extra-curricular activities assigned to them.

1.3 Admission Requirements (Eligibility)

A candidate for admission to the first year of the UG Degree programme shall be required to have passed the Higher Secondary Examination (10 + 2) [Academic or Vocational] prescribed by the Government of Tamil Nadu Board or any similar examination of any other Board accepted by the KAHE as equivalent thereto.(Annexure I).

2. DURATION OF THE PROGRAMMES

2.1 The minimum and maximum period for the completion of the U.G. Programmes are given below:

Programme	Min. No. of Semesters	Max. No. of Semesters
B.Sc., B.Com, BCA, BBA	6	12

2.2 Each semester normally consists of 90 working days or 450 Instructional hours of study. Examination shall be conducted at the end of every semester for the respective courses.

3. CHOICE BASED CREDIT SYSTEM

3.1. All programmes are offered under Choice Based Credit System with a total credit of 140 for UG Programmes.

3.2. Credits

Credit means the weightage given to each course by the experts of the Board of Studies concerned. Total credits 140 as per UGC Guidelines for the UG programme (Three Years).

4. STRUCTURE OF THE PROGRAMME

4.1 Tamil or any one of the Indian / Foreign Languages *viz*, Malayalam, Hindi, Sanskrit, French are offered as an additional course for Arts & Science Programmes. Four credits are awarded for each course and the examinations will be conducted at the end of each semester.

4.2. Core Course, Discipline Specific Elective, Generic Elective, Skill Enhancement Course, Project, Ability Enhancement Course are part of curricular structure.

4.2.1. Core Course

Core course consists of theory and practical for Department domains for which examinations shall be conducted at the end of each semester. The students have to study 12 Core Courses compulsorily. Students have to earn 87 Credits in Core Course.

4.2.2. Discipline Specific Electives (DSE)

DSE is offered in the fifth and sixth semesters of third year. The examination shall be conducted at the end of each semester. Final year students (V and VI Semesters) will have to choose the elective courses in V semester and VI Semester from the list of elective courses given in the curriculum, in addition to the project work. Students have to earn 14 Credits in Discipline Specific Electives.

4.2.3. Generic Elective

Generic elective is an elective course chosen generally from an unrelated discipline/subject, with an intention to provide exposure in other areas of interest also to students.

The students have to choose two Generic Electives- one each in the First year (3 or 4 courses) and second year (3 or 4 courses) of the programme from the list of elective courses given in the curriculum.

Note: A particular elective course will be offered only if at least one third of the students in a class choose that course. If less, the elective selected has to be studied as a self-study course only. Students have to earn 12 Credits in Generic Elective/ Allied Courses.

4.2.4. Skill Enhancement Courses

Skill Enhancement Courses are offered in the third and fourth semesters of second year programme and in the fifth and sixth

semesters of the third year programme. Second year students (III and IV Semesters) will have to choose atleast one elective course each in both III and IV Semesters from the list of elective courses given in the curriculum. Similarly final year students (V and VI Semesters) will have to choose at least one elective course each in both V and VI Semesters from the list of elective courses given in the curriculum. The examination shall be conducted at the end of each semester. Students have to earn 20 Credits in Skill Enhancement Courses.

Note: A particular elective course will be offered only if at least one third of the students in a class choose that course. If less, the elective selected has to be studied as a self-study course only.

4.2.5. Project Work

The project work shall start at the beginning of sixth semester and the Project Report has to be submitted at the end of the sixth semester. The project may be an individual or group task**.** The Head of Department concerned shall assign a project supervisor who in turn shall monitor the project work of the student(s). A project/ dissertation work may be given *in lieu* of a discipline-specific elective paper. Maximum number of students per project batch is 5.

4.2.6. Ability Enhancement Course

Ability Enhancement **Course-1**

The course (English I & II for Science Programmes / Communicative English I & II for Arts Programmes) shall be offered during the first and second semester for which examinations shall be conducted at the end of the semester. Four credits are awarded for each course and the examinations will be conducted at the end of each semester.

Ability Enhancement **Compulsory Course-2**

Students shall study the course Environmental Studies in the First / Second Semester for which examinations shall be conducted at the end of the semester.

4.2.7. Internship

The student shall undergo 15 days internship in the end of II and IV semester.

4.3. Value Added Courses

Courses of varying durations but not less than 30 hours which are optional and offered outside the curriculum that add value and help the students for getting placement. Students of all programmes are eligible to enroll for the value-added courses. The student can choose one Value-added course per semester from the list of Value-added courses available in KAHE. The examinations shall be conducted at the end of the value added course at the Department level and the student has to secure a minimum of 50% of marks to get a pass. The certificate for the value added course for the passed students shall be issued duly signed by the HOD and Dean of the Faculty concerned.

4.4. Online Course

Student shall study at least one online course from SWAYAM / NPTEL / MOOC in any one of the first five semesters for which examination shall be conducted at the end of the course by the respective external agencies if any. The student can register to the courses which are approved by the Department. The student shall produce a Pass Certificate from the respective agencies before the end of the fifth semester. The credit(s) earned by the students will be considered as additional credit(s) over and above the credits minimum required to earn a particular degree.

4.5. Extension Activities

Every student is encouraged to participate in at least any one of the following Extension activities:

- NSS
- NCC
- Sports / Mass drill
- YRC
- Club activities
- Other Co-curricular and Extra curricular activities

The student's performance shall be examined by the staff in-charge of Extension Activities along with the faculty mentor and the Head of the respective department on the following parameters.

- 75 % weightage for active participation in Extension Activities in / out of the KAHE.
- 25 % weightage for Exemplary Awards / Honours / Prizes secured.

4.6. Marks for Co-curricular and Extra-curricular shall be sent to the CoE before the commencement of the Sixth End Semester Examinations.

The above activities shall be conducted outside the regular working hours of the KAHE.

5. MEDIUM OF INSTRUCTION

The medium of instruction and examinations for the courses under Language I – Tamil / Hindi / Malayalam / French / Sanskrit shall be in the language concerned. For all other courses, the medium of instruction and examination should be in English.

6. MAXIMUM MARKS

Each of the theory and practical courses shall carry a maximum of 100 marks. Out of which 40 marks is awarded for Continuous Internal Assessment (CIA) and 60 marks for End Semester Examinations (ESE).

Evaluation: Evaluation in the courses comprises two parts, one is the Continuous Internal Assessment (CIA) and the other one is the End Semester Examination (ESE).

7. REQUIREMENTS TO APPEAR FOR THE END SEMESTER EXAMINATION

a. Ideally, every student is expected to attend all classes and should secure 100% attendance. However, in order to allow for certain unavoidable circumstances, the student is expected to attend at least 75% of the classes and the conduct of the candidate has been satisfactory during the course.

b. A candidate who has secured attendance between 65% and 74% (both included), due to medical reasons (Hospitalization / Accident / Specific Illness) or due to participation in University / District / State / National / International level sports or due to participation in Seminar / Conference / Workshop / Training Programme / Voluntary Service / Extension activities or similar programmes with prior permission from the Registrar shall be given exemption from prescribed minimum attendance requirements and shall be permitted to appear for the examination on the recommendation of the Head of Department concerned and Dean to condone the shortage of attendance. The Head of Department has to verify and certify the genuineness of the case before recommending to the Dean concerned. However, the candidate has to pay the prescribed condonation fee to the KAHE.

c. However, a candidate who has secured attendance less than 64% in the current semester due to any reason shall not be permitted to appear for the current semester examinations. But he/she will be permitted to appear for his/her supplementary examinations, if any and he/she has to re-do the same semester with the approval of the "Students' Affairs Committee" and Registrar.

8. a. FACULTY MENTOR

To help students in planning their courses of study and for general advice on the academic programme, the HoD shall allot twenty students to a faculty who will function as faculty mentor throughout their period of study. Faculty mentor shall advise the students and monitor their behavior and academic performance. Problems if any shall be counseled by them periodically. The Faculty mentor is also responsible to inform the parents of their wards' progress. Faculty mentor shall display the cumulative attendance particulars of his / her ward students' periodically (once in 2 weeks) on the Notice Board to enable the students, know their attendance status and satisfy the **clause 7** of this regulation.

b. **ONLINE COURSE COORDINATOR**

To help students in planning their online courses and for general advice on online courses, the HOD shall nominate a coordinator for the online courses. The Online course coordinator shall identify the courses which students can select for their programme from the available online courses offered by the different agencies periodically and inform the same to the students. Further, the coordinators shall advice the students regarding the online courses and monitor their course.

9. CLASS COMMITTEE

Every class shall have a Class Committee consisting of the faculty members of the various courses of the class concerned, student representatives (Minimum 2 boys and 2 girls of various capabilities and Maximum of 6 members) and the concerned HoD / senior faculty as Chairperson. The objective of the Class Committee Meeting is all about the teaching – learning process. Class Committee shall be convened at least once in a month. The functions of the Class Committee shall include

- Analysing and solving problems experienced by students in the class room and in the laboratories.
- Analyzing the performance of the students of the class after each test and finding the ways and means to improve the performance.

- The Class Committee of a particular class of any department is normally constituted by the HoD / Chairperson of the Class Committee. However, if the students of different departments are mixed in a class, the Class Committee shall be constituted by the respective Dean of the Faculty.
- The class committee shall be constituted during the first week of each semester.
- The HoD / Chairperson of the Class committee is authorized to convene the meeting of the class committee.
- The respective Dean of the Faculty has the right to participate in any Class committee meeting.
- The Chairperson is required to prepare the minutes of every meeting, and submit the same to Dean concerned within two days after having convened the meeting. Serious issues if any shall be brought to the notice of the Registrar by the HoD / Chairperson immediately.

10. COURSE COMMITTEE FOR COMMON COURSES

Each common theory course offered to more than one discipline or department shall have a "Course Committee" comprising all the teachers handling the common course with one of them nominated as Course Coordinator. The nomination of the course coordinator shall be made by the respective Dean depending upon whether all the teachers handling the common course belong to a single department or to various other departments. The 'Course Committee' shall meet in order to arrive at a common scheme of evaluation for the tests to ensure a uniform evaluation of the tests. If feasible, the course committee shall prepare a common question paper for the Internal Assessment test(s). Course Committee Meeting is conducted once in a semester.

11. PROCEDURE FOR AWARDING MARKS FOR INTERNAL ASSESSMENT

11.1 **Attendance and assessment:** Every Faculty is required to maintain an **Attendance and Assessment Record (Log book)** which consists of attendance of students marked for each lecture / practical / project work class, the test marks and the record of class work (topic covered), separately for each course. This should be submitted to the HoD once in a fortnight for checking the syllabus coverage and the records of test marks and attendance. The HoD shall sign with date after due verification. The same shall be submitted to respective Dean once in a

month. After the completion of the semester the HoD should keep this record in safe custody for five years. Because records of attendance and assessment shall be submitted for Inspection as and when required by the KAHE / any other approved body.

11.2 **Continuous Internal Assessment (CIA)**: The performance of students in each course will be continuously assessed by the respective faculty as per the guidelines given below:

Theory Courses

S. No.	Category	Maximum Marks
1.	Assignment*	5
2.	Attendance	5
3	Seminar	5
4.	Test – I (1 ½ units- Unit I and II)	8
5	Test – II (1 ½ units Unit II and III)	8
6	Test III (2 units Unit IV and V)	9
Continuous Internal Assessment : Total		40

* Two Assignments (Assignment I before Internal Test – I and assignment II before Internal Test – II).

Practical Courses

S. No.	Category	Maximum Marks
1.	Attendance	5
2.	Observation work	5
3.	Record work	5
4.	Model Examination	20
5.	*Viva – voce* [Comprehensive]*	5
Continuous Internal Assessment: Total		**40**

* Includes *Viva- voce* conducted during the model Exam practical.

Every practical Exercise / Experiment shall be evaluated based on the conduct of Exercise/ Experiment and records maintained.

11.3 Pattern of Test Question Paper

Portions for Internal Test – I : First 1 ½ Units(Unit I and II)

Portions for Internal Test – II : Second 1 ½ Units (Unit II and III)

Portions for Internal Test – III : Two units (Unit IV and V)

Instruction	Remarks
Maximum Marks	50 marks
Duration	2 Hours
Part – A	Objective type (20x1=20)
Part - B	Short Answer Type (3 x 2 = 6)
Part - C	3 Eight mark questions 'either – or' choice (3 x 8 = 24 Marks)

11.4 Attendance

Marks Distribution for Attendance

S. No.	Attendance (%)	Maximum Marks
1	91 and above	5.0
2	81 - 90	4.0
3	76 - 80	3.0
4	Less than 75	0

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12. ESE EXAMINATIONS

12.1 End Semester Examination (ESE): End Semester Examination will be held at the end of each semester for each course. The question paper is for a maximum 60 marks.

Pattern of ESE Question Paper:

Instruction	Remarks
Maximum Marks	60 marks for ESE.
Duration	3 hours (½ Hr for Part – A Online & 2 ½ Hours for Part – B and C
Part - A	20 Questions of 1 mark each (20 x 1 = 20 Marks) Question No. 1 to 20 Online Multiple Choice Questions
Part- B	5 Questions of 2 marks each(5 x 2 = 10 Marks) Covering all the five units of the syllabus Question No. 21 to 25
Part- C	5 six marks Questions of 6 marks each (5 x 6 = 30 Marks.) Question No. 26 to 30 will be 'either-or' type, covering all five units of the syllabus; i.e., Question No. 26: Unit - I, either 26 (a) or 26 (b), Question No. 27: Unit - II, either 27 (a) or 27 (b), Question No. 28: Unit - III, either 28 (a) or 28 (b), Question No. 29: Unit - IV, either 29 (a) or 29 (b), Question No. 30: Unit - V, either 30 (a) or 30 (b)

12.2 **Practical:** There shall be combined valuation. The pattern of distribution of marks shall be as given below.

Experiments	: 40 Marks
Record	: 10 Marks
Viva-voce	: 10 Marks
Total	**: 60 Marks**

Record Notebooks for Practical Examination

Candidate taking the practical examination should submit Bonafide Record Notebook prescribed for the practical examination; failing which the candidate will not be permitted to take the practical examination.

In case of failures in Practical Examination, the marks awarded for the Record at the time of first appearance of the Practical Examination shall remain the same at the subsequent appearance also by the candidate.

12.3. **Evaluation of Project Work**

12.3.1 The project work shall carry a maximum of 100 marks. (CIA - 40 and ESE – 60*)

*Combined valuation of Internal and External Examiners.

12.3.2 The project report prepared according to the approved guidelines and duly signed by the supervisor(s) shall be submitted to HoD.

12.3.3 The evaluation of the project will be based on the project report submitted and a *viva-voce* Examination by a team consisting of the supervisor, who will be the Internal Examiner and an External Examiner who shall be appointed by the COE. In case the guide is not available, the HoD shall act as an Internal Examiner for the same.

12.3.4 If a candidate fails to submit the project report on or before the specified date given by the Examination Section, the candidate is deemed to have failed in the Project Work and shall re-enroll for the same in a subsequent semester.

If a candidate fails in the respective viva-voce examinations he/she has to resubmit the Project Report within 30 days from the date of declaration of the results. For this purpose the same Internal and External examiner shall evaluate the resubmitted report.

12.3.5 Copy of the approved project report after the successful completion of *viva-voce* examination shall be kept in the KAHE library.

13. PASSING REQUIREMENTS

13.1 Passing minimum: There is a passing minimum 20 marks out of 40 marks for CIA and the passing minimum is 30 marks out of 60 marks in ESE. The overall passing in each course is 50 out of 100 marks (Sum of the marks in CIA and ESE examination).

13.2 If a candidate fails to secure a pass in a particular course (either CIA or ESE or Both) as per clause 13.1, it is mandatory that the candidate has to register and reappear for the examination in that course during the subsequent semester when examination is conducted for the same till he / she receives a pass both in CIA and ESE (vide Clause 2.1).

13.3 Candidate failed in CIA will be permitted to improve CIA marks in the subsequent semesters by writing tests and by re-submitting Assignments.

13.4 CIA marks (if it is pass) obtained by the candidate in the first appearance shall be retained by the Office of the Controller of Examinations and considered valid for all subsequent attempts till the candidate secures a pass in ESE

13.5 Candidate who is absent in ESE in a Course / Practical / Project Work after having enrolled for the same shall be considered to have **failed** in that examination.

14. IMPROVEMENT OF MARKS IN THE COURSES ALREADY PASSED

Candidates desirous to improve the marks secured in a passed course in their first attempt shall reappear once (**only in ESE**) in the subsequent semester. **The improved marks shall be considered for classification but not for ranking.** If there is no improvement there shall be no change in the marks awarded earlier.

15. AWARD OF LETTER GRADES

All assessments of a course will be done on absolute marks basis. However, for the purpose of reporting the performance of a candidate, letter grades, each carrying certain number of points, will be awarded as per the range of total marks (out of 100) obtained by the candidate in each course as detailed below:

Letter grade	Marks Range	Grade Point	Description
O	91 - 100	10	OUTSTANDING
A+	81- 90	9	EXCELLENT
A	71-80	8	VERY GOOD
B+	66- 70	7	GOOD
B	61 – 65	6	ABOVE AVERAGE
C	55 - 60	5	AVERAGE
D	50 - 54	4	PASS
RA	<50	-	REAPPEARANCE
AAA	-	-	ABSENT

16. GRADE SHEET

After the declaration of the results, Grade Sheets will be issued to each student which will contain the following details:

i. The list of courses enrolled during the semester and the grade scored.

ii. The Grade Point Average (**GPA**) for the semester and

iii. The Cumulative Grade Point Average (**CGPA**) of all courses enrolled from first semester onwards.

iv. Remark on Extension Activities (only in the 6th Semester Grade Sheet)

GPA of a Semester and CGPA of a programme will be calculated as follows.

GPA of a Semester = (Sum of the product of the GP by the corresponding credits of the courses offered in that Semester) / (Sum of the credits of the courses of that Semester)

i.e. **GPA** of a Semester = $\frac{\sum_i CiGPi}{\sum_i Ci}$

CGPA of the entire programme = (Sum of the product of the GPs by the corresponding credits of the courses offered for the entire programme) / (Sum of the credits of the courses of the entire programme)

i.e. **CGPA** of the entire programme = $\frac{\sum_n \sum_i CniGPni}{\sum_n \sum_i Cni}$

where,

Ci is the credit fixed for the course 'i' in any semester

GPi is the grade point obtained for the course 'i' in any semester

'n' refers to the Semester in which such courses are credited.

Note: RA grade will be excluded for calculating **GPA** and **CGPA**.

17. REVALUATION

A candidate can apply for revaluation and re-totaling of his / her semester examination answer script (**theory courses only**), within 2 weeks from the date of declaration of results, on payment of a prescribed fee. For the same, the prescribed application has to be sent to the Controller of Examinations through the HoD. **A candidate can apply for revaluation of answer scripts not exceeding 5 courses at a time.** The Controller of Examinations will arrange for the revaluation and the results will be intimated to the candidate through the HoD concerned**.** Revaluation is not permitted for supplementary theory courses.

18. TRANSPARENCY AND GRIEVANCE COMMITTEE

Revaluation and Re-totaling is allowed on representation (clause 17). Student may get the Xerox copy of the answer script on payment of prescribed fee, if he / she wishes. The student may represent the grievance, if any, to the Grievance Committee, which consists of Dean of the Faculty, (if Dean is HoD, the Dean of another Faculty nominated by the KAHE), The HoD of Department concerned, the faculty of the course and Dean from other discipline nominated by the KAHE and the CoE. If the Committee feels that the grievance is genuine, the script may be sent for external valuation; the marks awarded by the External examiner will be final. The student has to pay the prescribed fee for the same.

19. ELIGIBILITY FOR THE AWARD OF THE DEGREE

A student shall be declared to be eligible for the conferment of the Degree if he / she has

- Successfully completed all the components prescribed under Part I to Part IV in the CBCS pattern to earn the minimum required credits as specified in the curriculum corresponding to his / her programme within the stipulated period vide class 2.1.
- Not any disciplinary action pending against him / her.
- The award of the degree must be approved by the Board of Management.

20. CLASSIFICATION OF THE DEGREE AWARDED

20.1 Candidate who qualifies for the award of the Degree (vide clause 19) having passed the examination in all the courses in his / her first appearance, within the specified minimum number of semesters and securing a **CGPA not less than 8** shall be declared to have passed the examination in the **First Class with Distinction.**

20.2 Candidate who qualifies for the award of the Degree (vide clause 19) having passed the examination in all the courses within the specified maximum number of semesters (vide clause 2.1), securing a **CGPA not less than 6.5** shall be declared to have passed the examination in the **First Class**.

20.3 All other candidates (not covered in clauses 20.1 and 20.2) who qualify for the award of the degree (vide Clause 19) shall be declared to have passed the examination in the **Second Class**.

21. PROVISION FOR WITHDRAWAL FROM END-SEMESTER EXAMINATION

21.1 Candidate due to valid reasons and on prior application, be granted permission to withdraw from appearing for the examination of any one course or consecutive examinations of more than one course in a semester examination.

21.2 Such withdrawal shall be permitted only once during the entire period of study of the degree programme.

21.3 Withdrawal of application is valid only if it is made within 10 days prior to the commencement of the examination in that course or courses and recommended by the HoD / Dean concerned and approved by the Registrar.

21.3.1 Notwithstanding the requirement of mandatory TEN days notice, applications for withdrawal for special cases under extraordinary conditions will be considered on the merit of the case.

21.4 Withdrawal shall not be construed as an appearance for the eligibility of a candidate for First Class with Distinction. This provision is not applicable to those who seek withdrawal during **VI semester**.

21.5 Withdrawal from the End semester examination is **NOT** applicable to arrears courses of previous semesters.

21.6 The candidate shall reappear for the withdrawn courses during the examination conducted in the subsequent semester.

22. PROVISION FOR AUTHORISED BREAK OF STUDY

22.1 Break of Study shall be granted only once for valid reasons for a maximum of one year during the entire period of study of the degree programme**.** However, in extraordinary situation the candidate may apply for additional break of study not exceeding another one year by paying prescribed fee for break of study. If a candidate intends to temporarily discontinue the programme in the middle of the semester for

valid reasons, and to rejoin the programme in a subsequent year, permission may be granted based on the merits of the case provided he / she applies to the Registrar, but not later than the last date for registering for the end semester examination of the semester in question, through the Head of the Department stating the reasons therefore and the probable date of rejoining the programme.

22.2 The candidate thus permitted to rejoin the Programme after the break shall be governed by the Curriculum and Regulations in force at the time of rejoining. Such candidates may have to do additional courses as per the Regulations in force at that period of time.

22.3 The authorized break of study (for a maximum of one year) will not be counted for the duration specified for passing all the courses for the purpose of classification. (Vide Clause 20). However, additional break of study granted will be counted for the purpose of classification.

22.4 The total period for completion of the Programme reckoned from, the commencement of the first semester to which the candidate was admitted shall not exceed the maximum period specified in clause 2.1 irrespective of the period of break of study (vide clause 22.1) in order that he/she may be eligible for the award of the degree.

22.5 If any student is detained for want of requisite attendance, progress and good conduct, the period spent in that semester shall not be considered as permitted 'Break of Study' or 'Withdrawal' (Clause 21 and 22) is not applicable for this case.

23. RANKING

A candidate who qualifies for the UG Degree programme passing all the Examinations in the first attempt, within the minimum period prescribed for the programme of study from Semester I through Semester VI to the programme shall be eligible for ranking. Such ranking will be confined to 10% of the total number of candidates qualified in that particular programme of study subject to a maximum of 10 ranks.

24. SUPPLEMENTARY EXAMINATION

Supplementary Examination will be conducted only for the final semester students within ten days from the date of publication of results for students who have failed in one theory course only. Such students shall apply with prescribed fee to the Controller of Examinations within the stipulated time.

25. DISCIPLINE

25.1. If a student indulges in malpractice in any of the Internal / External Examinations he / she shall be liable for punitive action as prescribed by the KAHE from time to time.

25.2. Every student is required to observe discipline and decorous behavior both inside and outside the campus and not to indulge in any activity which will tend to bring down the prestige of the KAHE. The erring students will be referred to the disciplinary committee constituted by the KAHE, to enquire into acts of indiscipline and recommend the disciplinary action to be taken.

26. REVISION OF REGULATION AND CURRICULUM

Karpagam Academy of Higher Education may from time to time revise, amend or change the Regulations, Scheme of Examinations and syllabi if found necessary.

Annexure I

S.No	Programme	Subject	Eligibility
1	B. Sc.	Biochemistry	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern taking Biology or Botany or Zoology or chemistry as subjects at the Higher Secondary level.
2	B. Sc.	Biotechnology	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern taking Biology or Botany or Zoology or chemistry as subjects at the Higher Secondary level.
3	B. Sc.	Computer Science	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern preferably taking Mathematics/Statistics/Computer/Information Science being one of the subjects(OR)3 year diploma after 10^{th} or 10+2 pattern of education taking computer science/maths as one of the subject.
4	B.Sc.	Mathematics	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern taking Mathematics /statistics as subjects at the Higher Secondary level. (OR)3 year diploma after 10^{th} or 10+2 pattern of education taking maths as one of the subject.
5	B.Sc.	Physics	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern taking Physics as one of the subjects at the Higher Secondary level (OR) 3 year diploma after 10^{th} or 10+2 pattern of education taking physics as one of the subject.
6	B. Sc.	Chemistry	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern taking Chemistry as one of the subjects at the Higher Secondary level.
7	B. Sc.	Microbiology	Candidates who have passed Higher Secondary

			Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern taking Biology or Botany Zoology or chemistry as subjects at the Higher Secondary level.
8	B. Sc.	Information Technology	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern preferably taking Mathematics/Statistics/Computer/Information Science being one of the subjects(OR)3 year diploma after 10^{th} or 10+2 pattern of education taking computer science/maths as one of the subject.
9	B. Sc.	Computer Technology	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern preferably taking Mathematics/Statistics/Computer/Information Science being one of the subjects(OR)3 year diploma after 10^{th} or 10+2 pattern of education taking computer science/maths as one of the subject.
10	B.Sc.	Computer Science(Cognitive Systems)	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern preferably taking Mathematics/Statistics/Computer/Information Science being one of the subjects(OR)3 year diploma after 10^{th} or 10+2 pattern of education taking computer science/maths as one of the subject.
11	B.Sc.	Computer Science (Artificial Intelligence and Data Science)	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern preferably taking Mathematics/Statistics/Computer/Information Science being one of the subjects(OR)3 year diploma after 10^{th} or 10+2 pattern of education taking computer science/maths as one of the subject.
12	BCA	Computer Application	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern preferably taking Mathematics/Statistics/Computer/Information Science being one of the subjects(OR)3 year diploma after 10^{th} or 10+2 pattern of education taking computer science/maths as one of the subject.

13	B.Sc.	Applied Science (Material Science)	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern taking Physics as one of the subjects at the Higher Secondary level (OR) 3 year diploma after 10^{th} or 10+2 pattern of education taking the respective subject as one of the subject.
14	B.Sc.	Applied Science (Foundary Science)	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern taking Physics as one of the subjects at the Higher Secondary level (OR) 3 year diploma after 10^{th} or 10+2 pattern of education taking the respective subject as one of the subject.
15	B. Com.	Commerce	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern Commerce as a subject under the academic or vocational stream at the Higher Secondary level
16	B.Com (CA)	Commerce with Computer Applications	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern Commerce as a subject under the academic or vocational stream at the Higher Secondary level
17	B. Com. (PA)	Commerce with Professional Accounting	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern Commerce as a subject under the academic or vocational stream at the Higher Secondary level
18	B. Com. (BPS)	Commerce with Business Process Services	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern Commerce as a subject under the academic or vocational stream at the Higher Secondary level
19	B.B.A.	Business Administration	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern Commerce as a subject under the academic or vocational stream at the Higher Secondary level
20	B. Com	Financial Analytics	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination

			conducted by a State Government or a University or Board under the 10+2 pattern Commerce as a subject under the academic or vocational stream at the Higher Secondary level
21	B. Com	International Accounting and Finance	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern Commerce as a subject under the academic or vocational stream at the Higher Secondary level

B.Sc., BIOCHEMISTRY

PREAMBLE

- Biochemistry is the study of chemistry associated with biological organisms.
- Biochemistry is often viewed as a hybrid branch of organic chemistry, which specializes in the chemical processes and transformation mechanisms that occurs within living organisms.
- All life forms are generally believed to have descended from a single proto-biotic ancestor, which likely explain why all known living things naturally have similar biochemical configurations.
- Biochemistry essentially remains the study of the structure and functions of cellular components (such as enzymes and cellular organelles) and the processes carry out both on and by organic macromolecules - especially proteins, but also carbohydrates, lipids, nucleic acids and other biomolecules.
- Together, biochemistry refers to the chemistry of life.

KARPAGAM ACADEMY OF HIGHER EDUCATION
Coimbatore – 641 021
DEPARTMENT OF BIOCHEMISTRY
FACULTY OF ARTS, SCIENCE AND HUMANITIES
UG PROGRAM (CBCS)-B.Sc., Biochemistry
(2021–2022 and onwards)

Course code	Name of the course	Objectives and out comes		Instruction hours / week			Credit(s)	Maximum Marks			Category	Page Number
		PEOs	POs	L	T	P		CIA	ESE	Total		
								40	60	100		
SEMESTER – I												
21LSU101	Language –I	I	a	4	-	-	4	40	60	100	AEC	9
21ENU101	English I	I	a	4	-	-	4	40	60	100	AEC	12
21BCU101	Molecules of Life	I	e,f	4	-	-	4	40	60	100	CC	14
21BCU102	Cell Biology	I	e,f	4	-	-	4	40	60	100	CC	16
21BCU103	Chemistry-I	I	d,k	4	-	-	4	40	60	100	GE	18
21BCU111	Molecules of Life- Practical	III	e,f	-	-	3	2	40	60	100	CC	20
21BCU112	Cell Biology – Practical	III	e,f	-	-	3	2	40	60	100	CC	22
21BCU113	Chemistry Practical- I	III	d,k	-	-	4	2	40	60	100	GE	24
Semester Total				**20**	**-**	**10**	**26**	**320**	**480**	**800**		
SEMESTER – II												
21LSU 201	Language – II	I	a	4	-	-	4	40	60	100	AEC	25
21ENU201	English – II	I	a	4	-	-	4	40	60	100	AEC	29
21BCU201	Proteins and Enzymes	III	f	4	-	-	4	40	60	100	CC	31
21BCU202	Bioanalytical Techniques	III	f	4	-	-	4	40	60	100	CC	34
21BCU203	Chemistry-II	I	d	4	-	-	4	40	60	100	GE	36
21BCU211	Bioanalytical Techniques - Practical	III	f.k	-	-	4	2	40	60	100	CC	38
21BCU212	Chemistry Practical -II	III	d,k	-	-	3	1	40	60	100	GE	40
20AEC201	Environmental Studies	IV	i	3	-	-	3	40	60	100	AEC	41
Semester Total				**23**	**-**	**7**	**26**	**320**	**480**	**800**		
SEMESTER – III												
21BCU301	Macromolecular Metabolism	I	f	4	-	-	4	40	60	100	CC	44
21BCU302	Human Physiology	I	g	4	-	-	4	40	60	100	CC	46
21BCU303	Hormones: Biochemistry and Functions	I	g	4		-	4	40	60	100	CC	48
21BCU311	Proteins and Enzymes Practical	III	f,k	-	-	4	2	40	60	100	CC	50
21BCU312	Macro molecular Metabolism – Practical	III	e,g	-	-	4	2	40	60	100	CC	52
21BCU313	Human Physiology and Endocrinology – Practical	III	e,g	-	-	4	2	40	60	100	CC	54
21BCU304A	Plant Tissue Culture	II	e,g	3	-	-	3	40	60	100	SEC	56
21BCU304B	Food Processing Techniques	I	e,g								SEC	58
21BCU314A	Plant Tissue Culture- Practical	III	e,g	-	-	3	1	40	60	100	SEC	60
21BCU314B	Food Processing Techniques - Practical	III	e,g								SEC	62
Semester Total				**15**	**-**	**15**	**22**	**320**	**480**	**800**		

SEMESTER – IV												
21BCU401	Molecular Biology	I, II	h	4	-		4	40	60	100	CC	63
21BCU402	Clinical Biochemistry	I, II	h	4	-		4	40	60	100	CC	65
21BCU403	Bioinformatics	I, II	h	3	1	-	4	40	60	100	CC	67
21BCU411	Molecular Biology - Practical	III	e, h	-	-	4	2	40	60	100	CC	69
21BCU412	Clinical Biochemistry - Practical	III	e, h	-	-	4	2	40	60	100	CC	71
21BCU413	Bioinformatics – Practical	III	e, h	-	-	4	2	40	60	100	CC	73
21BCU404A	Animal Tissue Culture	III	e, h	3	-	-	3	40	60	100	SEC	75
21BCU404B	Nanobiology		e, h								SEC	77
21BCU414A	Animal Tissue Culture Practical	III	e, h	-	-	3	1	40	60	100	SEC	79
21BCU414B	Nanobiology Practical		e, h								SEC	81
Semester Total				**14**	**1**	**15**	**22**	**320**	**480**	**800**		
SEMESTER – V												
21BCU501	Immunology	V	e, g	3	1	-	4	40	60	100	CC	83
21BCU502A	Plant Biochemistry	II, III	e, g	3	-	-	3	40	60	100	DSE	85
21BCU502B	Genetics and Genomics	II, III	e, g								DSE	87
21BCU503A	Microbiology and Infectious Diseases	I	e, g	4	-	-	4	40	60	100	DSE	89
21BCU503B	Molecular Basis of Non-infectious Diseases	I	j								DSE	91
21BCU504A	Food Biochemistry	V	e	4	-	-	4	40	60	100	SEC	93
21BCU504B	Membrane Biology and Bioenergetics	V	e, g								SEC	95
21BCU511	Immunology – Practical	III	g, k	-	-	4	2	40	60	100	CC	97
21BCU512A	Plant Biochemistry - Practical	III	g, k	-	-	3	1	40	60	100	DSE	98
21BCU512B	Genetics and Genomics - Practical	III	g, k								DSE	100
21BCU513A	Microbiology and Infectious Diseases Practical	III	g, k	-	-	4	2	40	60	100	DSE	102
21BCU513B	Molecular Basis of Non- infectious Diseases – Practical	III	J								DSE	104
21BCU514A	Food Biochemistry - Practical	III	g. k	-	-	4	2	40	60	100	SEC	106
21BCU514B	Membrane Biology and Bioenergetics – Practical	III	g. k								SEC	108
Semester Total				**14**	**1**	**15**	**22**	**320**	**480**	**800**		
SEMESTER – VI												
21BCU601	Drug Biochemistry and Clinical Toxicology	V	e, g	3	1	-	4	40	60	100	CC	109
21BCU602A	Recombinant DNA Technology	I	h	3	-	-	3	40	60	100	DSE	111
21BCU602B	Biostatistics and Research Methodology	V	I, k								DSE	113
21BCU603A	Bioentrepreneurship	II	f, j	4	-	-	4	40	60	100	SEC	115
21BCU603B	Stem Cell and Cancer Biology	III	f								SEC	117
21BCU611	Drug Biochemistry and Clinical Toxicology – Practical	III	f, g	-	-	4	2	40	60	100	CC	119
21BCU612A	Recombinant DNA Technology - Practical	III	h.k	-	-	3	1	40	60	100	DSE	121
21BCU612B	Biostatistics and Research Methodology – Practical	III	k								DSE	123
21BCU613A	Bioentrepreneurship - Practical	II	e,k	-	-	4	2	40	60	100	SEC	124
21BCU613B	Stem Cell and Cancer Biology -	III	f,,k								SEC	126

	Practical											
21BCU691	Project work	IV	a-o	2	-	6	6	40	60	100	CC	128
ECA / NCC / NSS / Sports / General interest etc							**Good**					
Semester Total				**12**	**1**	**17**	**22**	**280**	**420**	**700**		
Program Total				**94**	**4**	**82**	**140**	**1880**	**2820**	**4700**		

Blue – Employability

Green – Entrepreneurship

Red – Skill Development

Value Added Courses (VAC)		
Semester	**Course Code**	**Name of the Course**
I	21VACBC01	Health and Fitness
II	21VACBC02	Organic Terrace gardening
III	21VACBC03	Medicinal Plant and Herbal Technology
IV	21VACBC04	Tissue Processing Techniques
V	21VACBC05	Medical Laboratory Technology

Ability Enhancement Courses (AEC)		
Semester	**Course Code**	**Name of the Course**
I	21LSU101	Language –I
	21ENU101	English - I
II	21LSU201	Language –II
	21ENU201	English – II
	21AEC201	Environmental Studies

Generic Elective Courses (GE) /Allied Courses		
Semester	**Course Code**	**Name of the Course**
I	21BCU103	Chemistry – I
	21BCU113	Chemistry Practical – I
II	21BCU203	Chemistry – II
	21BCU212	Chemistry Practical – II

Core Courses (CC)		
Semester	**Course Code**	**Name of the Course**
I	21BCU101	Molecules of Life
	21BCU102	Cell Biology
	21BCU111	Molecules of Life- Practical
	21BCU112	Cell Biology - Practical
II	21BCU201	Proteins and Enzymes
	21BCU202	Bioanalytical Techniques
	21BCU211	Bioanalytical Techniques - Practical
III	21BCU301	Macromolecular Metabolism
	21BCU302	Human Physiology
	21BCU303	Hormones: Biochemistry and Functions
	21BCU311	Proteins and Enzymes Practical
	21BCU312	Macromolecular Metabolism - Practical

	21BCU313	Human Physiology and Endocrinology - Practical
IV	21BCU401	Molecular Biology
	21BCU402	Clinical Biochemistry
	21BCU403	Bioinformatics
	21BCU411	Molecular Biology - Practical
	21BCU412	Clinical Biochemistry - Practical
	21BCU413	Bioinformatics - Practical
V	21BCU501	Immunology
	21BCU511	Immunology - Practical
VI	21BCU601	Drug Biochemistry and Clinical Toxicology
	21BCU611	Drug Biochemistry and Clinical Toxicology - Practical
	21BCU691	Project work

Skill Enhancement Courses(SEC)		
Semester	**Course Code**	**Name of the Course**
III	21BCU304A	Plant Tissue Culture
	21BCU304B	Food Processing Techniques
	21BCU314A	Plant Tissue Culture- Practical
	21BCU314B	Food Processing Techniques - Practical
IV	21BCU404A	Animal Tissue Culture
	21BCU404B	Nanobiology
	21BCU414A	Animal Tissue Culture - Practical
	21BCU414B	Nanobiology- Practical
V	21BCU504A	Food Biochemistry
	21BCU504B	Membrane Biology and Bioenergetics
	21BCU514A	Food Biochemistry - Practical
	21BCU514B	Membrane Biology and Bioenergetics - Practical
VI	21BCU603A	Bioentrepreneurship
	21BCU603B	Stem Cell and Cancer Biology
	21BCU613A	Bioentrepreneurship - Practical
	21BCU613B	Stem Cell and Cancer Biology - Practical

Discipline Specific Elective Courses (DSE)		
Semester	**Course Code**	**Name of the Course**
V	21BCU502A	Plant Biochemistry
	21BCU502B	Genetics and Genomics
	21BCU503A	Microbiology and Infectious Diseases
	21BCU503B	Molecular Basis of Non-infectious Diseases
	21BCU512A	Plant Biochemistry – Practical
	21BCU512B	Genetics and Genomics – Practical
	21BCU513A	Microbiology and Infectious Diseases - Practical
	21BCU513B	Molecular Basis of Non-infectious Diseases - Practical
VI	21BCU602A	Recombinant DNA Technology
	21BCU602B	Biostatistics and Research Methodology
	21BCU612A	Recombinant DNA Technology- Practical
	21BCU612B	Biostatistics and Research Methodology - Practical

PROGRAMME OUTCOME (POs).

The biochemistry graduate will be able to:

a. **Critical Thinking and Language Training:** Acquire the ability to analyze information objectively and make a reasonable judgment and conclusion by evaluating data, facts, observable phenomenon, and research findings from a set of information and distinguish among priorities to solve a problem, and the programme also aims to train the candidates to communicate science by improving language skills, viz., speak, read, write and listen clearly in person and/or through electronic media, both in English and in one of the Indian languages, and rendering them to connect with people, ideas, books, media and technology.

b. **Ethics:** Recognize and implement different value systems including self, and understand the moral dimensions of decisions made, and acceptance of scientific and social responsibilities.

c. **Social Interaction:** Elicit views of others, mediate disagreements and help reach conclusions in group settings. Demonstrate empathetic social concern and equity-centred nation development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

d. **Correlation of Biochemistry with Chemistry**: Introduce the concepts of the stereochemistry of organic compounds, elements of photochemistry, concepts of thermodynamics and to provide fundamentals of electrochemistry and apply the knowledge for the better understanding of biochemistry.

e. **Understanding of Cellular Functions:** Equip candidates with basic and advanced knowledge in cell biology in order to avail placements in cell-based R & D institution/laboratories.

f. **Protein-based Skills:** Understand protein and enzyme physiology to lay a solid foundation, and to crack competitive examinations. It also aims to equip the candidates to acquire placements in recombinant protein production industries/laboratory.

g. **Understanding of the Endocrine System and Metabolism:** Train the candidates on the regulatory role of the hormone on the metabolism of carbohydrates, lipids, amino acids and nucleic acid.

h. **Understanding of Molecular Genetics:** Induct training on the genetic regulation of the immune system and use of computational tools.

i. **Environment and Sustainability:** Understand issues related to the environment and sustainability development.

j. **Self-directed and Life-long Learning:** Acquire the ability to engage in independent and life-long learning in the broadest context of socio-technological changes.

k. **Skill Development:** To gain hands-on experience in various biochemical experiments and to equip the candidates to interpret scientific data.

PROGRAMME-SPECIFIC OUTCOME (PSOs)

a. Demonstrate foundation knowledge in emerging areas of biochemistry such as cell biology, biomolecules, protein biochemistry, molecular biology, pharmaceutical chemistry and hormonal biochemistry.

b. Integrate knowledge acquired across discipline-specific courses like chemistry, microbiology, plant biochemistry, nutritional biochemistry, biostatistics, drug biochemistry and biotechnology.

c. Employ standard laboratory protocols/procedures in biochemistry, modern instrumentations, laboratory safety and classical techniques to carry out experiments and also use computers in data acquisition and processing, and use software as a tool in data analysis.

d. Understand the applications of biological sciences in genetics, biochemical correlates of communicable and non-communicable diseases, microbiology, genetic engineering and biotechnology.

PROGRAMME EDUCATIONAL OBJECTIVES (PEO)

I. To impart students with the basics of biochemistry and confer knowledge on scientific ethics.

II. To develop analytical and critical-thinking skills that allow independent exploration of biological phenomena via scientific methods.

III. To acquaint knowledge on modern methods of biochemical experimentation to implement for prospective studies.

IV. To motivate students for social responsibilities and to educate them on ethical values in addition to inculcating environmental awareness.

V. To enable students to execute a research objective through experimentation.

Mapping of PEOs and POs

POs	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
PEO I	X	X	X	X		X	X	X	X	X	X	X			
PEO II	X		X		X	X	X	X		X	X	X	X	X	X
PEO III	X		X	X	X	X	X	X		X	X	X	X	X	X
PEO IV	X	X	X						X	X	X	X			X
PEO V	X		X	X	X	X	X	X		X	X	X	X	X	X

Semester I

21LSU101 **TAMIL-1** **4H-4C**

Instruction Hours / week: L:4 T:0 P:0 Marks: Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

(இளநிலை அறிவியல் பட்டவகுப்புகளுக்குரியது)

(For I-UG Science Degree Classes)

பாடத்திட்டப்பொதுநோக்கம்

- கற்றல் வழி சிந்தனைத் திறனையும், கருத்து வெளிப்பாட்டுத் திறனையும், மேம்படுத்துதல்.
- ஆய்வுநோக்கைமேம்படுத்துதல்.
- இலக்கியங்கள் உணர்த்தும் வாழ்வின் நுட்பமான பகுதிகளை உணர்த்துதல்.
- மனித மனத்தினைப் பக்குவப்படுத்துதலில் இலக்கியம் தரும் பங்கினை உணர்த்துதல்.
- வளர்ந்து வரும் சமூகத்தில் அறஉணர்வு, பண்பாடு போன்றவை குறித்து அறிவூட்டல்.
- அரசுத் தேர்வுகளுக்கு மாணவர்களை ஆயத்தமாக்குதல்.

பாடத்திட்டப்பயன்விளைவு

- இந்தியகுடியுரிமைப்பணிமுதலானபோட்டித்தேர்வுகளில், விருப்பப்பாடமாகஇடம்பெறுகின்ற, 'தமிழ்இலக்கியவரலாறு' குறித்தமுழுமையானஅறிமுகம்பெற்றிருத்தல்.
- கல்வெட்டியல், ஓலைச்சுவடியியல்மற்றும்தொல்லியல்சார்ந்தஆவணத்தேடலுக்குரியஆய்வுமனப் பான்மையுடன், இலக்கியங்களைஅணுகுதல்.
- தமிழின்வளர்ச்சித்துறையாகிய, 'அறிவியல்தமிழ்'; 'இணையதமிழ்' குறித்தபன்நோக்குஅணுகுமுறையிலானஆய்வுச்சிந்தனைமேம்பாடு.
- வேலைவாய்ப்புக்குரியசுயதிறன்மேம்பாட்டுடன், படைப்பாக்கத்திறன்மேம்பாடும்பெற்றிருத்தல் .
- சமுதாயமற்றும்வாழ்வியல்மதிப்புகளைப்பேணுவதற்குக்கருவியாகஇலக்கியங்க ளைநாடுகின்றமனப்பான்மைவளர்ச்சி.
- மொழிபெயப்புத்துறைசார்ந்தவேலைவாய்புத்திறன்பெற்றிருத்தல்

தாள்கள்வரிசையும்தேர்வுச்செயல்திட்டமும்

பகுதி-I தமிழ்

இளநிலைப்பட்ட அறிவியல் வகுப்புகள்

பருவம்	தாள்	கற்பிக்கும் நேரம்/வாரம்	தேர்வு மணிகள்	மதிப்பெண் அக/எழுத்து	மொத்தம்	மதிப்பீடு
ஒன்று	I	4	3	40 / 60	100	4

அலகு – I : தமிழ்இலக்கியவரலாறு– I (8 மணிநேரம்)

முச்சங்கவரலாறு - சங்கஇலக்கியத்தொகுப்பு - பாட்டும்தொகையும் - சங்கஇலக்கியச்சிறப்பியல்புகள் - சங்கம்மருவியகாலம் - பதினெண்கீழ்க்கணக்குநூல்கள் – திருக்குறள் -நாலடியார் - நான்மணிக்கடிகை - பழமொழிநானூறு – பிற்காலஅறஇலக்கியங்கள் - கொன்றைவேந்தன் – நீதிநூல் - காப்பியங்கள் - தமிழில்காப்பியஇலக்கணம் - தமிழில்பெருங்காப்பியங்களும்சிறுகாப்பியங்களும் - இரட்டைக்காப்பியங்களாகச்சிலம்பும்மேகலையும்.

அலகு - II:சங்கஇலக்கியம் (12 மணிநேரம்)

அ).எட்டுத்தொகை

நற்றிணை:கொண்டல்மாமழை – குறிஞ்சி – தலைவன்கூற்று - 140

குறுந்தொகை : வாரார்ஆயினும், வரினும் –முல்லை– தலைவிகூற்று - 110

ஐங்குறுநூறு :மருதம் –தோழிகூற்று-வேட்கைப்பத்து: வாழிஆதன்வாழிஅவினி - 6

பதிற்றுப்பத்து: சிதைந்ததுமன்ற- 27

பரிபாடல்: புறத்திரட்டு- மதுரைநகர்ச்சிறப்பு –

உலகம்ஒரு நிறையாத்தான்-7, மாயோன் கொப்பூழ்-8, செய்யாட்கு இழைத்த-9, கார்த்திகை காதில்-10, ஈவாரைக் கொண்டாடி-11.

கலித்தொகை:பாலைக்கலி-செவிலி – எறித்தரு கதிர்தாங்கி-9

அகநானூறு:அன்னைஅறியினும்அறிக – தோழி - நெய்தல் - 110

புறநானூறு :யாதும்ஊரேயாவருங்கேளிர் –பொதுவியல்- 192

ஆ).பத்துப்பாட்டு: நெடுநல்வாடை - கார்காலச்சிறப்பு : வையகம்பனிப்ப -1-70

அலகு – III: அறஇலக்கியம் (10 மணிநேரம்)

1. **திருவள்ளுவர்- திருக்குறள்**– அதிகாரம் 67 – வினைத்திட்பம், அதிகாரம் 100 - பண்புடைமை
2. **முன்றுறையரையனார் – பழமொழிநானூறு**5 பாடல்கள்
   உணற்குஇனிய 5, பரந்ததிறலாரை 32, நெடியதுகாண்கிலாய் 46, இனியாரும் 153, உரைசான்ற 195.
3. **ஔவையார் – கொன்றைவேந்தன்** (1- 50 பாடல்கள்)
   அன்னையும்பிதாவும் – புலையும்கொலையும்களவும்தவிர்
4. **வேதநாயகம்பிள்ளை - நீதிநூல்** – (அதிகாரம்-7-தாய் தந்தையரைப்போற்றுதல்-தேர்ந்தெடுக்கப்பட்ட5பாடல்கள்)

சின்னவோர்பொருள், கடவுளைவருந்தி, எப்புவிகளும், வைத்தவர், ஈன்றவர்

அலகு - IV :காப்பிய இலக்கியம் (10 மணிநேரம்)

(அ). சிலப்பதிகாரம்(5மணிநேரம்)

மங்கலவாழ்த்துப்பாடல்: (21-29) - நாகநீள்நகரொடு-கண்ணகிஎன்பாண்மன்னோ.

வழக்குரைகாதை, (48-56) - நீர்வார்கண்ணை-புகாரென்பதியே .

வஞ்சினமாலை: (5-34) - வன்னிமரமும் – பிறந்தபதிப்பிறந்தேன்.

நடுகற்காதை: (207-234) - அருத்திறலரசர் – மன்னவரேறென்

வாழ்த்துக்காதை: (9) - என்னேயிஃதென்னே – மீவிசும்பிற்றோன்றுமால்.

(ஆ). மணிமேகலை(5 மணிநேரம்)

பசியின்கொடுமை: பாத்திரம்பெற்றகாதை:

'போதிநீழல்' - 'பெருகியதன்றோ' , 'ஆற்றுநர்க்களிப்போர்' - 'நல்லறம்கண்டனை' (73-98).

சிறைக்கோட்டம்அறக்கோட்டமாக்கியகாதை:மாவண்கிள்ளிக்குகாவலன்உரைத்தவை:

'பைஞ்சேறுமெழுகாப்பசும்பொன்மண்டபத்து -

அறவோர்க்காக்கினன்அரசாள்வேந்தன்' (116-163).

அலகு- V :அடிப்படைஇலக்கணமும்பயன்பாட்டுத்தமிழும் -I (8 மணிநேரம்)

அ).எழுத்து, சொல், பொருள் இலக்கணங்கள் (4 மணிநேரம்)

1. முதல்மற்றும்சார்பெழுத்துகள்- பெயர், வினை, இடை, உரிச்சொல்முதலானஅடிப்படைஇலக்கணவிளக்கப்பயிற்சிகள்

2). அகத்திணைமற்றும்புறத்திணைஇலக்கணங்கள்

ஆ). கடிதப்பயிற்சி(4 மணிநேரம்)

1. தன்விவரக்குறிப்புடன்வேலைவேண்டிவிண்ணப்பம்எழுதுதல்
2. பல்கலைக்கழகப்பன்னாட்டுக்கருத்தரங்கச்செய்தியைநாளிதழில்வெளியிட வேண்டிநாளிதழின்பதிப்பாசிரியருக்குக்கடிதம்
3. கருத்தரங்கப்பங்கேற்புக்குஅனுமதிக்கடிதம்
4. பல்கலைக்கழகவிழாவுக்குத்தலைமையேற்கவேண்டி, மாவட்டஆட்சியருக்குவிண்ணப்பம்
5. கல்விகடன்வேண்டிவங்கிமேலாளருக்குவிண்ணப்பம்
6. வசிப்பிடத்திற்குஅடிப்படைவசதிவேண்டிவட்டாட்சியருக்குவிண்ணப்பம்
7. தேசியவிருதுபெற்றநண்பனுக்குப்பாராட்டுக்கடிதம்
8. புத்தகங்கள்அனுப்பிஉதவவேண்டி, பதிப்பகத்தாருக்குவிண்ணப்பம்

21ENU101 **ENGLISH I** **4H- 4C**

Instruction hours/week: L:4 T:0 P:0 Marks: Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course Objectives

- To give basic knowledge on grammar.
- To train communication in real life situation.
- To be familiar with the four basic skills of English.
- To train students to acquire proficiency in English by reading different genres of literature and learning grammar.
- To provide aesthetic pleasure through literature.
- To develop the moral values of students

Course Outcomes (CO's)

1. Retrieve fundaments of English language to construct error free sentences.
2. Develop the knowledge of interpersonal skills.
3. Establish and maintain social relationships.
4. Develop communication skills in business environment.
5. Refine communication competency through LSRW skills.
6. Improving intrapersonal skills through literary works

UNIT - I: **Grammar**

Types of Sentences, Subject and Predicate, Parts of Speech, Tenses, Preposition and Articles

UNIT – II: Communication Exercise

Importance of Business Language- Words often Confused- Words often Misspelt- Common Errors in English-Charts and Pictorial Writing.

UNIT - III: **Interpersonal Skills**

Greetings & Introduction- Giving & Denying Permission- Telephone Etiquette-Oral Presentation – Plan, PowerPoint Presentation- Preparation of Speech- Audience psychology- Secrets of Good Delivery

UNIT - IV: LSRW Skills

Listening- Listening and its types, Basic Listening Lessons
Speaking- Basics of speaking, Regular English, Business English, Interview English
Reading- Reading and its purposes, Types of Reading, Reading Techniques
Writing- Types of Writing, Components of Writing, Language and Style with accordance to the contexts

UNIT - V: Literature

Prose: Let's Do What India Needs from Us - Dr. A.P.J. Abdul Kalam
Poem: A Prayer for My Daughter - W.B. Yeats
Short Story: Sparrows- K. Ahmad Abbas

SUGGESTED READING

1. Hewings Martin, 2013. Advanced Grammar in Use, Cambridge University Press
2. Haines Simon, 2015. Advanced Skills, A resource Book of Advanced- Level Skill Activities

21BCU101 **MOLECULES OF LIFE** **4H-4C**

Instruction hours/week: L: 4 T: 0 P: 0 **Marks:** Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course Objectives

Equip the students:

- To understand the properties and importance of water in biological system
- To know the biological significance of amino acids and proteins in living systems
- To know the biological significance of lipids and fats in living systems
- To know the biological significance of carbohydrate metabolites in living systems
- To understand the functional role of nucleic acid in living systems
- To introduce the importance of vitamins in human body

Course Outcomes (CO's)

After successful completion of the course, the student will:

1. Recognize water as a universal solvent and elixir of life by knowing its importance
2. Identify the properties and classification of carbohydrates
3. Recall the role of various lipids in bio membrane including signal transduction
4. Categorize the amino acids and know their properties
5. Differentiate the structure, properties and functions of DNA and RNA
6. List the functions and deficiency disease of fat- and water-soluble vitamins

Unit I: Water and Carbohydrates

Water

Unique characterization and properties of water, weak interactions in aqueous systems, ionization of water, buffers, water as a reactant and fitness of the aqueous environment.

Carbohydrates

Monosaccharides - Structure of aldoses and ketoses, ring structure of sugars, conformations of sugars, mutarotation, anomers, epimers and enantiomers, structure of biologically important sugar derivatives, oxidation of sugars. Formation of disaccharides, reducing and non-reducing dissaccharides. Polysaccharides – homo- and heteropolysaccharides, structural and storage polysaccharides. Structure and role of proteoglycans, glycoproteins and glycolipids (gangliosides and lipopolysaccharides). Carbohydrates as informational molecules.

Unit II: Lipids

Classification, preparation and applications of lipids. Physicochemical properties of fatty acids, glycerol, ceramide. Storage lipids – triacyl- glycerol and waxes. Structural lipids in membranes – glycerophospholipids, galactolipids and sulpholipids, sphingolipids and sterols, structure, distribution and role of membrane lipids and signals lipids. Role of lipids in energy storage. Plant steroids and animal steroids.

Unit III: Amino acids and Proteins

Amino acids

Structure and classification, physical, chemical and optical properties of amino acids. Chemical synthesis of peptides – solid phase peptide synthesis.

Proteins

Proteins – Classification, purification, and criteria of homogeneity. Structural organization, sequence determination and characterization of proteins. Conformation of proteins – Ramachandran plot. Denaturation of proteins. Apoprotein and Prosthetic group - Porphyrins – Structure and properties of porphyrins – heme, chlorophyll and cytochromes.

Unit IV: Nucleic acid

Nucleotides – Structure and properties, physicochemical properties of nucleic acids, cleavage of nucleic acids by enzymatic methods, non – enzymatic transformation of nucleotides and nucleic acids, methylation, Sequencing, chemical synthesis of DNA. Three dimensional structure of DNA. Different forms of DNA – circular DNA and Supercoiling. Types of RNA- mRNA, tRNA, rRNA, SnRNA, SiRNA, Hn RNA. Structure of t-RNA. Nucleotides as the source of energy, component of coenzymes, second messengers.

Unit V: Vitamins and Porphyrins

Water soluble - thiamine, riboflavin, niacin, pyridoxine, folic acid, ascorbic acid sources, 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.

SUGGESTED READING

1. D. L. Nelson and M. M. Cox, (2017). Lehninger Principles of Biochemistry (7th Edition), W.H. Freeman.

2. J. M. Berg, J. L. Tymoczko and L. Stryer. (2020). Biochemistry (9th Edition), W.H. Freeman.

3. Murray, R.K., Bender, D.A., Botham, K.M., and Kennelly, P.J., (2016). Harper's illustrated Biochemistry, 29th Edition. McGraw-Hill Medical. London.

21BCU102 **CELL BIOLOGY** **4H-4C**

Instruction hours/week: L:4 T:0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course Objectives

Equip the students:

- To understand the structural organization of prokaryotic cells
- To understand the structural organization of eukaryotic cells
- To understand the technical basis of membrane biology
- On the structure and functions of various sub-cellular organelle
- To understand the cytoskeletal network and extracellular matrix
- To understand the cell cycle, cell division and cell death process

Course Outcomes (CO's)

After successful completion of the course, the student will:

1. Differentiate the prokaryotic and eukaryotic cell
2. Understand the principle behind studying the cell morphology using various microscope
3. Identify the structure and functions of each organelle in cell
4. Recognize the mechanism behind the protein sorting and transport to their destinations like lysosome, mitochondria and chloroplast
5. Maintenance of cytoskeleton structure and function of micro, macro and intermediary filaments
6. Enumerate the phases of cell cycle, events in cell division and mechanism of cell death

Unit I: Introduction to cell biology

Origin of life on earth, Evolution of cell and metabolism. Cell – classification and structure, cells as experimental models- *E.coli*, yeast, *C.elegans. Drosophila melanogaster*, *Arabidopsis thaliana* and vertebrates, Prokaryotic and eukaryotic cell wall components, Plasma membrane: Composition, Fluid mosaic model, Tools of cell biology: Light microscopy, phase contrast microscopy, fluorescence microscopy, confocal microscopy, electron microscopy, FACS. Centrifugation for sub-cellular fractionation.

Unit II: Structure of different cell organelles

Structure of nuclear envelope, nuclear pore complex. Selective transport of proteins to and from the nucleus. Regulation of nuclear protein import and export, Nucleus - Internal organization, ER structure. Targeting proteins to ER, Protein folding and processing in ER, smooth ER and lipid synthesis. Export of proteins and lipids from ER and into ER, Peroxisomes – Functions and assembly, Zellweger syndrome.

Unit III: Protein trafficking

Organization of Golgi. Protein glycosylation in Golgi-.N and O-linked glycosylation, Lipid and polysaccharide metabolism in Golgi. Protein sorting and export from Golgi Lysosome. – Acid hydrolases, endocytosis, phagocytosis and autophagy. Mitochondria-

Structure, Protein import and mitochondrial assembly, protein export from mitochondrial matrix. Chloroplasts- Structure, Import and sorting of chloroplast proteins.

Unit IV: Cytoskeletal proteins

Structure and organization of actin filaments. Treadmilling and role of ATP in microfilament polymerization, organization of actin filaments. Myosin - Myosin in muscle contraction. Non-muscle myosin- functions. Intermediate filament proteins, assembly and intracellular organization. Tubulin - Structure, assembly and organization. Structure and functions of cilia and flagella.

Unit V: Extracellular matrix

Cell matrix proteins. Cell-matrix interactions - Hemidesmosomes and focal adhesions. Cell-cell interactions - Adherence junctions, tight junctions, gap junctions, desmosomes and plasmodesmata. Cell cycle, cell death and cell renewal: Eukaryotic cell cycle-phases, restriction point, and cell cycle checkpoints, regulation of cell cycle progression by cyclin and cyclin-dependent kinases cell division - mitosis and meiosis. Apoptosis and necrosis – a brief outline. Salient features of a transformed cell.

SUGGESTED READING

1. Paul, A., (2007). Text Book of Cell and Molecular Biology,1st edition. Books and Allied (P) Ltd, Kolkata.

2. Verma, P.S., and.Agarwal, V.K., (2005). Cell Biology Molecular Biology and Genetics, VII Edition, S.Chand and company Ltd, New Delhi.

3. Shukla, R.M., (2013). A textbook of Cell Biology, Dominant Publishers and Distributors.

4. Lodish, H., Berk, A., Kaiser, C.A., and Krieger, M., (2012). Molecular Cell Biology, 7th edition. W.H. Freeman & Company, London.

5. Garret, R. H. and Grisham, C.M., Biochemistry (2010) 4th ed., Cengage Learning (Boston), ISBN-13: 978-0-495-11464-2.

6. Cooper, G.M., and Hausman, R.E., (2013). Cell-A Molecular Approach, 6th Edition. Sinauer Associates. USA

7. Karp, G., (2013). Cell and Molecular Biology, 7th edition. John Wiley and Sons, Inc, Hoboken, United States.

8. Alberts, B., Johnson,A., Lewis, J., and Enlarge, M., Molecular Biology of the Cell (2008) 5th ed., Garland Science (Princeton)

21BCU103 **CHEMISTRY- I** **4H-4C**

Instruction hours/week: L:4 T:0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course Objectives

Equip the students:

- On the molecular orbital theory, preparation and properties of inorganic compounds
- On the theory of covalent bond, polar effects and stereochemistry of organic compounds
- About important industrial chemicals like silicones, fuel gases
- About Fertilizers and their impact on environment
- On the elements of photochemistry, chemical kinetics and chromatography
- About the dyes, chemotherapy and vitamins

Course Outcomes (CO's)

After successful completion of the course, the student will:

1. Understand the molecular orbital theory, preparation and properties of inorganic compounds
2. Understand the theory of covalent bond, polar effects and stereochemistry of organic compounds
3. Have knowledge about important industrial chemicals like silicones, fuel gases
4. Know the classes of fertilizers and their impact on environment
5. Understand the elements of photochemistry, chemical kinetics and chromatography.
6. Understand about the dyes, chemotherapy and vitamins

UNIT-I

Chemical Bonding: Molecular orbital theory-linear combination of atomic orbitals-bonding and antibonding molecular orbitals-energy level diagram-bond order- M.O. configuration of H_2, N_2 and F_2 molecules. Diborane: Preparation, properties and structure. $NaBH_4$: Preparation and uses. Borazole: Preparation and properties. Interhalogen compounds: ICl, BrF_3, IF_5 - preparation, properties, uses and structure. Basic properties of iodine. Compounds of sulphur: Sodium hydrosulphite- preparation, properties, uses and structure. Per acids of sulphur: Preparation, properties, uses and structure.

UNIT- II

Covalent Bond and Stereoisomerism: Covalent Bond: Orbital overlap, hybridization and geometry of CH_4, C_2H_4 and C_2H_2.Polar effects: Inductive effect-electromeric effect-mesomeric effect- steric effect- hyperconjugation. **Stereoisomerism:** Elements of symmetry-polarised light and optical activity-isomerism in tartaric acid-racemisation-resolution- geometrical isomerism of maleic and fumaric acids-keto-enoltautomerism of acetoacetic esters.

UNIT-III

Industrial Chemistry: Silicones: Synthesis, properties and uses. Fuels gases: Natural gas-water gas-semi water gas-carbureted water gas-producer gas- oil gas

(Manufacturing details not required). Fertilizers: NPK fertilizer-ammonium sulphate-urea-superphosphate of lime-triple superphosphate- potassium nitrate-ammonium nitrate. Pollution: Water, air and soil pollution-sources and remedies-acid rain-ozone hole-greenhouse effect.

UNIT-IV

Elements of Photochemistry, Chemical Kinetics and Chromatography: Elements of Photochemistry: Photochemical laws-Beer Lambert's law-Grotthuss-Draper law-Stark-Einstein law (statement only). **Chemical Kinetics:** Rate-order-molecularity-pseudo first order reactions-zero order reactions-determination of order of reaction-measurement of order and rates of reactions-effect of temperature on reaction rate-energy of activation. **Chromatography:** Principles and applications of Column, Paper and Thin Layer Chromatography.

UNIT- V

Dyes, Chemotherapy and Vitamins: Dyes: Terms used chromophore, auxochrome, bathachromic shift and hypsochromic shift- classification of dyes– based on chemical structure and application-one example each for azo, triphenylmethane, vat and mordant dyes- preparation.

Chemotherapy: Preparation, uses and mechanism of action sulpha drugs- preparation and uses of prontosil, sulphadiazine and sulphafurazole-structure and uses of pencillins and Chloromycetin. **Vitamins:** Diseases caused by the deficiency of vitamins A, B_1, B_2, C and D-sources of these vitamins.

SUGGESTED READINGS

1. Thangamani, A. (2018). *Text Book on Allied Chemistry* (1st Edition). Coimbatore: Karpagam Publication.

2. Puri, B.R., Sharma, L. R., & Kalia, K. C. (2017). *Principles of Inorganic Chemistry* (33rd Edition). Jalandar: Vishal Publishing Company.

3. Bahl, A., & Bahl, B.S. (2015). *A Textbook of Organic Chemistry* (21st Revised Edition). New Delhi: S.Chand& Company Pvt. Ltd.

4. Puri, B. R., Sharma, L. R. &Pathania, M. S. (2014). *Elements ofPhysical Chemistry* (46th Edition). Jalandhar: Vishal Publishing Company.

5. Gopalan, R., &Sundaram, S. (2013). *Allied Chemistry* (III Edition). New Delhi: Sultan Chand & Sons.

21BCU111 MOLECULES OF LIFE - PRACTICAL 3H-2C

Instruction hours/week: L:0 T:0 P:3 **Marks:** Internal: **40** External: **60** Total: **10**
End Semester Exam: 3 Hours

Course Objectives

To impart hands-on training:

- To know the safety measures to be followed in laboratory
- To prepare molar, normal and ppm solutions
- On buffer preparation
- To separate the biomolecules using chromatography techniques
- To identify the biomolecules qualitatively
- To quantify the biomolecules using colorimetry

Course Outcomes (CO's)

After successful completion of the course, the student will:

1. Gain knowledge on lab safety
2. Prepare reagents and solutions
3. Understand the basis of buffer preparation
4. Understand the principle and working procedure behind chromatographic separations
5. Understand the principle and working procedure behind staining techniques
6. Understand the principle and working procedure behind colorimetric techniques

Experiments

1. Preparation of normal and molar solutions.
2. Preparation of buffers and determination of pH
3. Qualitative analysis
   i) Monosaccharides, Disaccharides and Polysaccharides
   ii) Lipids
   iii) Amino acids
4. Determination of reducing sugar- Benedict's method - Titremetry.
5. Estimation of Glycine- Formal Titration.
6. Estimation of proteins using Barford methods
7. Estimation of DNA using DPA.
8. Estimation of RNA using Orcinol reagent.
9. Estimation of Methionine
10. Separation of amino acids bases by thin layer chromatography.
11. Estimation of vitamin C.
12. Estimation of vitamin E.

EQUIPMENTS REQUIRED:

1. Colorimeter
2. Spectrophotometer

SUGGESTED READING

1. Experimental Biochemistry: A Student companion. (2005) by Sashidhar Rao, B and Deshpande, V. IK International (P) Ltd.

2. Experiments and Techniques in Biochemistry. (2007). by Sheel Sharma, Galgotia.

21BCU112 **CELL BIOLOGY PRACTICAL** **3H-2C**

Instruction hours/week: L:0 T:0 P:3 **Marks:** Internal: **40** External: **60 Total**: **100**
End Semester Exam: 3 Hours

Course Objectives

To impart hands-on training:

- On different parts of light microscopy
- On how to visualize the cells
- On phase contrast microscopy
- On how to identify different stages of mitosis and meiosis
- On staining techniques to identify the cell types
- On how to count the cells using hemocytometer

Course Outcomes (CO's)

After successful completion of the course, the student will:

1. Identify the spotters of light microscopy
2. Be able to visualize the cells
3. Use the phase contrast microscopy at appropriate magnifications
4. Identify the cells using staining techniques
5. Interpret various stages of cell division
6. Count the cells manually using hemocytometer

Experiments

1. Preparation of onion root squash and observation of cell
2. Visualization of animal and plant cell by methylene blue staining
3. Identification of different stages of mitosis in the onion root tip.
4. Identification of different stages of meiosis in grasshopper testis.
5. Cell size determination using an ocular stage micrometer
6. Micrographs of different cell components (dry lab).
7. Sub-cellular fractionation – Identification of WBC and RBC
8. Visualization of a nuclear fraction by acetocarmine stain.
9. Staining and visualization of mitochondria by Janus green stain.

EQUIPMENTS REQUIRED:

1. Microscope
2. Inverted phase- contrast microscope
3. Centrifuge

SUGGESTED READING

1. Cooper, G.M. and Hausman, R.E., (2009). The Cell: A Molecular Approach 5th ed., ASM Press & Sunderland (Washington DC), Sinauer Associates, MA, ISBN:978-0-87893-300-6.

2. Lodish, H., Berk, A., Zipursky, S.L., Matsudaira, P., Baltimore, D. and Darnell. J.,

(2012). Molecular Cell Biology 7th ed., W.H. Freeman & Company (New York), ISBN: 13:978-1-4641-0981-2 / ISBN: 10: 1-4641-0981-8.

3. Alberts, B., Johnson, A., Lewis, J., and Enlarge, M., (2008). Molecular Biology of the Cell 5th ed., Garland Science (Princeton).

21BCU113 **CHEMISTRY PRACTICAL-I** **4H–2C**

Instruction Hours/week :L: 0 T:0 P:4 **Marks:** Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course Objectives

To impart hands-on training on:

- Preliminary tests for identification of an organic compound
- Detection of elements
- Identification of aromatic or aliphatic compound
- Different functional groups and its nature
- Confirmatory test for aldehydes, ketones, amines and amides
- Confirmatory test for carbohydrates, phenol, acids, esters and nitro compounds

Course Outcomes (CO's)

After successful completion of the course, the student will:

1. Perform preliminary tests for identification of an organic compound
2. Perform and detect the elements present in the given compound
3. Identify and differentiate between aromatic and aliphatic compound
4. Identify different functional groups and its nature
5. Perform confirmatory test for aldehydes, ketones, amines and amides
6. Perform confirmatory test for carbohydrates, phenol, acids, esters and nitro compounds

Systematic analysis of an organic compound

- Preliminary tests
- Detection of elements present
- Aromatic or aliphatic
- Saturated or unsaturated
- Nature of the functional group,
- Confirmatory tests– aldehydes, ketones, amines, amides, diamide, carbohydrates, phenols, acids, esters & nitro compounds.

Note: Each student should analyse a minimum of 6 compounds.

EQUIPMENTS REQUIRED:

1. Centrifuge

SUGGESTED READINGS

1. Thomas, A.O. (2012). *Practical Chemistry for B.Sc. Main Students*. Cannanore: Kerala, Scientific Book Centre.
2. Ramasamy, R. (2011). *Allied Chemistry Practical Book*. Karur: Priya Publications.
3. Venkateswaran, V., Veeraswamy, R., & Kulandaivelu, A. R. (2015). *Basic Principles of Practical Chemistry* (2nd ed.). New Delhi: S. Chand Publications.

21LSU201 **TAMIL-2** **4H-4C**

பகுதி - I தமிழ்ப்பாடத்திட்டம் (2020 - 2020)

Instruction hours/week: L:4 T:0 P:0 Marks: Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

(இளநிலை அறிவியல் பட்டவகுப்புகளுக்குரியது)

(For I-UG Science Degree Classes)

பாடத்திட்டப்பொதுநோக்கம்

- கற்றல் வழி சிந்தனைத் திறனையும், கருத்து வெளிப்பாட்டுத் திறனையும், மேம்படுத்துதல்.
- ஆய்வுநோக்கைமேம்படுத்துதல்.
- இலக்கியங்கள் உணர்த்தும் வாழ்வின் நுட்பமான பகுதிகளை உணர்த்துதல்.
- மனித மனத்தினைப் பக்குவப்படுத்துதலில் இலக்கியம் தரும் பங்கினை உணர்த்துதல்.
- வளர்ந்து வரும் சமூகத்தில் அறஉணர்வு, பண்பாடு போன்றவை குறித்து அறிவூட்டல்.
- அரசுத் தேர்வுகளுக்கு மாணவர்களை ஆயத்தமாக்குதல்.

பாடத்திட்டப்பயன்விளைவு

- இந்தியகுடியுரிமைப்பணிமுதலானபோட்டித்தேர்வுகளில், விருப்பப்பாடமாகஇடம்பெறுகின்ற, ‘தமிழ்இலக்கியவரலாறு’ குறித்தமுழுமையானஅறிமுகம்பெற்றிருத்தல்.
- கல்வெட்டியல், ஓலைச்சுவடியியல்மற்றும்தொல்லியல்சார்ந்தஆவணத்தேடலுக்குரியஆய்வுமனப்பான்மையுடன், இலக்கியங்களைஅணுகுதல்.
- தமிழின்வளர்ச்சித்துறையாகிய, ‘அறிவியல்தமிழ்’ ; ‘இணையதமிழ்’ குறித்தபன்நோக்குஅணுகுமுறையிலானஆய்வுச்சிந்தனைமேம்பாடு.
- வேலைவாய்ப்புக்குரியசுயதிறன்மேம்பாட்டுடன், படைப்பாக்கத்திறன்மேம்பாடும்பெற்றிருத்தல் .
- சமுதாயமற்றும்வாழ்வியல்மதிப்புகளைப்பேணுவதற்குக்கருவியாகஇலக்கியங்களைநாடுகின்றமனப்பான்மைவளர்ச்சி.
- மொழிபெயப்புத்துறைசார்ந்தவேலைவாய்புத்திறன்பெற்றிருத்தல்

தாள்கள்வரிசையும்தேர்வுச்செயல்திட்டமும்

பகுதி-I தமிழ்

இளநிலைப்பட்ட அறிவியல் வகுப்புகள்

பருவம்	தாள்	கற்பிக்கும் நேரம்/வாரம்	தேர்வு மணிகள்	மதிப்பெண் அக/எழுத்து	மொத்தம்	மதிப்பீடு
இரண்டு	II	4	3	40 / 60	100	4

அலகு – I :தமிழ்இலக்கியவரலாறு- II (5 மணிநேரம்)

தமிழ்இலக்கியவரிசையில்திருமுறைகளும்நாலாயிரத்திவ்யப்பிரபந்தமும்-பன்னிருதிருமுறைகள்அறிமுகம்- திருமுறைஆசிரியர்களின்இலக்கியப்பங்களிப்பு-திருமுறைகளில்பக்திநெறியும்சமுதாயநோக்கும்-சமயக்குரவரின்அருள்நெறி-பன்னிருஆழ்வார்கள்வரலாறு-ஆழ்வார்களின்இலக்கியப்பங்களிப்பு-திவ்யப்பிரபந்தத்தில்பக்திநெறியும்இலக்கியநயமும்-தமிழில்சிற்றிலக்கியக்காலமும்கருத்தும்-தொண்ணூற்றாறுவகைச்சிற்றிலக்கியவரிசை- தமிழ்மொழியின்கவிதை - சிறுகதை – உரைநடை –இலக்கியங்களின்தோற்றம் – வளர்ச்சி – உத்திகள் – நாட்டுப்புறஇலக்கியங்கள்-கொங்குநாட்டார்வாய்மொழிவழக்காறுகள்.

அலகு – II :பக்திஇலக்கியமும்சிற்றிலக்கியமும்: (12 மணிநேரம்)

அ). பக்திஇலக்கியம்(6 மணிநேரம்)

1. **1. சைவம்-** பெரியபுராணம் – இளையான்குடிமாறநாயனார்புராணம் **-(19 பாடல்கள்) .**

   (அம்பொன்நீடிய, கொண்டுவந்து, ஆளுநாயகர், செல்வம்மேவிய, மாரிக்காலத்து, ஈரமேனியை, நமக்குமுன்பிங்கு, செல்லல்நீங்க,மற்றம்மாற்றம், உள்ளம்அன்பு, காலினால்தடவி, வந்தபின்மனைவியாரும், முறித்தவைஅடுப்பின், வழிவரும்இளைப்பினோடும், மனைவியார்கொழுநர், கணவனார்தம்மை, அழுந்தியஇடருள், மாலயற்கரிய, அன்பனேஅன்பர்பூசை)

2. வைணவம் – ஆண்டாள்நாச்சியார்திருப்பாவை: (11 பாடல்கள்):மார்கழித்திங்கள், வையத்து வாழ்வீர்கால், ஓங்கிஉலகளந்த,

ஆழிமழைக்கண்ணா, மாயனைமன்னுவடமதுரை, சிற்றம்சிறுகாலே, ஒருத்திமகனாய், மாலேமணிவண்ணா, கூடாரைவெல்லும், கறவைகள்பின்சென்று, வங்கக்கடல்கடைந்த.

ஆ). சிற்றிலக்கியம் (6 மணிநேரம்)

1. **முக்கூடற்பள்ளு** - 2 பாடல்கள் - சித்திரக்காலிவாலான் (நெல்வகைகள்) குற்றாலத்திரிகூடமால்வரை (மீன்வகைகள்)
2. **நந்திகலம்பகம்** - 5 பாடல்கள்- என்னையேபுகழ்ந்தேன், பதிதொறுபுயல்பொழி, இந்தப்புவியில், அடிவிளக்கும்துகில், வானுறுமதியை
3. **மதுரைச்சொக்கநாதர்தமிழ்விடுதூது** – தமிழின்சிறப்பு பாடியருளபத்துப்பாட்டும்-விளம்பக்கேள்.

அலகு – III: கவிதையும் சிறுகதையும் (16 மணிநேரம்)

அ). கவிதை இலக்கியம் (8 மணிநேரம்)

1. மகாகவிபாரதியார் –கண்ணன் – என்சீடன்
2. புரட்சிக்கவிஞன்பாரதிதாசன் –இளையார்ஆத்திசூடி - அழுபவன்கோழை
3. கவிமணிதேசிகவிநாயகம்பிள்ளை–கோயில்வழிபாடு
4. கவிக்கோ. அப்துல்ரகுமான் –பாருக்குள்ளே நல்ல நாடு
5. சிற்பிபாலசுப்பிரமணியன் – மலையாளக் காற்று
6. கவிஞர்தாமரை –தொலைந்துபோனேன்
7. கவிஞர்கரிகாலன்–விடுதலை

ஆ). சிறுகதைஇலக்கியம்(8 மணிநேரம்)

1. சாபவிமோசனம் – புதுமைப்பித்தன்
2. நகரம் –சுஜாதா
3. அந்நியர்கள் –ஆர். சூடாமணி
4. இந்நாட்டுமன்னர் –நாஞ்சில்நாடன்

அலகு – IV :உரைநடைஇலக்கியம் (8 மணிநேரம்)

1. ஆளுமைத்திறன்அறிவோம் - தன்னம்பிக்கைமாதஇதழிலிருந்து
2. திருக்குறளும்சமுதாயவியலும்– முனைவர்புரிசைநடராசன்
3. தமிழ் – உயர்தனிச்செம்மொழி – முனைவர்இரா. குணசீலன்

4. நொய்யல் – முனைவர் ப. தமிழரசி

அலகு- V :அடிப்படைஇலக்கணமும்பயன்பாட்டுத்தமிழும்– II (7 மணிநேரம்)

இலக்கணப்பயிற்சி: 1. அணிஇலக்கணம்

உவமையணி-பிறிதுமொழிதல்அணி-சிலேடைஅணி-தீவகஅணி-
ஏகதேசஉருவகஅணி – வேற்றுமையணி –
பின்வருநிலையணிக்கானவிளக்கங்கள்.

2. **துறைசார்கலைச்சொல்பயன்பாட்டாக்கம்**
3. **படைப்பிலக்கியப்பயிற்சிகள்**
    1. மரபுக்கவிதை, புதுக்கவிதை, சிறுகதை, கட்டுரைபடைப்பாக்க உத்திகள் - பயிற்சிகள்
    2. எழுத்தாளருடனானநேர்காணல்மற்றும்களஆய்வுக்கானவினாநிரல்தயாரித்தல்நுட்பங்களும்பயிற்சிகளும்.
4. **மொழிபெயர்ப்புப்பயிற்சிகள்**
    1. தமிழ்-ஆங்கிலமொழிபெயர்ப்புப்பயிற்சிகள் -2.
    2. ஆங்கிலம்-தமிழ்மொழிபெயர்ப்புப் பயிற்சிகள்-2.

பாடநூல்:கற்பகச்சோலை – தமிழ்ஏடு.

கற்பகம்உயர்கல்விகலைக்கழகத்தமிழ்த்துறை வெளியீடு.

21ENU201 **ENGLISH II** **4H-4C**

Instruction hours/week: L:4 T:0 P:0 Marks: Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course Objectives:

- To refresh the grammar knowledge of the students to improvise their language.
- To make the students to speak and write error free English.
- To make the students understand different kinds of communication.
- To develop knowledge on the business environment communication.
- To help the students develop their listening, speaking, reading and writing skills.
- Introducing literary works to the students to enhance their analytical and aesthetic skills.

Course Outcomes (CO's):

- Strengthen the foundation of the language to elevate the command of standard grammar.
- Inculcate the proper communication strategy.
- Formulate and communicate persuasive arguments for specific business outcome.
- Apply fundamentals of language for reading, writing and effective communication.
- Standardize and demonstrate understanding of LSRW skills.
- Introduce literature to enhance the moral and aesthetic values.

UNIT –I – Grammar

Voice, Idioms and Phrases, Clauses and Reported Speech

UNIT –II –Business and Technical Reports

Business Correspondence –Memo, Notices, Agenda, Minutes- Resume Writing- Report Writing- Letter Writing- Personal and Social Letters- E-mail Writing

UNIT –III – Communication Practice

Verbal and Non-Verbal Communication- Group Discussion and Seminars- Note-Taking and Note-Making

UNIT –IV –LSRW Skills

Listening Skills- Listening Talks and Presentations

Speaking Skills- Public Speaking- Preparatory steps, Time Management, Handling Questions and Meeting unexpected situations

Reading Skills- Language of Newspapers, Magazines and Internet

Writing Skills-Writing Paragraphs and Essays- Content Writing

UNIT –V –Literature

Prose- Morals in the Indian Context by Francis Nicholas Chelliah
Poetry- Telephone Conversation by Wole Soyinka
Short Stories-The Last Leaf by O' Henry

Books for References

Oxford Handbook of Writing: St. Martins Handbook of Writing 2013 CU Press
Sound Business, Julian Treasure 2012OUP

Semester II

21BCU201 **PROTEINS AND ENZYMES** **4H-4C**

Instruction hours/week: L:4 T:0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

- The main objective of the course explains about the physical and chemical properties of proteins.
- The course exhibits in depth knowledge on its structural organization, separation, purification and characterization of proteins by adopting various methods and techniques.
- The course also describes about some applications of specialized proteins.
- To understand the basic concepts of enzymes, the kinetics of enzyme catalyzed reactions, the mechanism of action of enzymes and enzyme inhibition and various modes of enzymes regulation.
- To learn the application of enzymes in health and diseases
- To learn different molecular techniques used for characterization of proteins

Course Outcomes (CO's)

After completing this course the student will be able to

1. Gather information on protein structure, its separation techniques and other latest developments.
2. Acknowledge information on specialized proteins and its application will be known to the students.
3. Understand the basic concepts on enzymes.
4. Relate the initial velocity and substrate concentration of enzymes and be able to understand the kinetics of inhibition reactions
5. Understand the regulation pattern of various enzymes
6. Relate the regulation pattern of enzymes for its application in health and diseases

Unit I: Introduction, Extraction and Separation of Proteins

Peptides; Definition, Biologically important peptides - hormones, antibiotics and growth factors. Multimeric proteins, conjugated proteins and metallo proteins. Extraction of proteins for downstream processing - Solubilization of proteins from their cellular and extracellular locations. Use of simple grinding methods, homogenization, ultrasonication, French press and centrifugation. Separation techniques - Ammonium sulphate fractionation, solvent fractionation, dialysis and lyophilization. N-terminal and C-terminal amino acid analysis. Sequencing techniques - Edman degradation. Mass spectrometric analysis, tandem MS, Solid phase peptide synthesis.

Unit II: Structural Organization and Analysis of Proteins

Organization of protein structure into primary, secondary, tertiary and quaternary structures. Nature of stabilizing bonds - covalent and non-covalent. Importance of primary structure in folding. The peptide bond - bond lengths and configuration.

Dihedral angles psi and phi. Helices, sheets and turns. Ramachandran map. Motifs and domains. Tertiary and quaternary structures. Structures of myoglobin and haemoglobin. Denaturation and renaturation of Ribonuclease A. Introduction to thermodynamics of folding and molten globule. Assisted folding by molecular chaperones, chaperonins and PDI. Defects in protein folding. Diseases –Alzheimer's and Prion based.

Unit III: Introduction to enzymes and enzyme kinetics

Enzymes: Introduction, definitions, protein and non-protein (ribozyme) enzymes. IUBMB classification of enzymes. Features of enzyme catalysis- Factors affecting the rate of chemical reactions, Catalytic power and specificity of enzymes (concept of active site), Fischer's lock and key hypothesis, Koshland's induced fit hypothesis. **Enzyme kinetics -** Relationship between initial velocity and substrate concentration, Michaelis-Menten equation, Lineweaver-Burk plot, Eadie-Hofstee and Hanes plot. Km and Vmax, Kcat and turnover number. Effect of pH, temperature and metal ions on the activity of enzyme. Bisubstrate reactions - Types of bi bi reactions (sequential – ordered and random, ping pong reactions).

Unit IV: Mechanism of action of enzymes and Enzyme inhibition

Mechanism of action of enzymes - General features, acid base and covalent catalysis (chymotrypsin, lysozyme). Metal activated enzymes and metalloenzymes, transition state analogues. Enzyme Inhibition - Reversible inhibition (competitive, uncompetitive, non-competitive, mixed and substrate). Mechanism based inhibitors - antibiotics as inhibitors. Control of activities of single enzymes (end product inhibition) and metabolic pathways, feedback inhibition (aspartate transcarbomoylase), reversible covalent modification (glycogen phosphorylase). Proteolytic cleavage- zymogen. Multienzyme complex as regulatory enzymes. (pyruvate dehydrogenase), Isoenzymes - properties and physiological significance (lactate dehydrogenase).

Unit V: Coenzymes, Immobilized enzymes and Biosensors

Coenzymes in enzyme catalysed reactions and applications of enzymes. Structure and Functions of TPP, FAD, NAD, pyridoxal phosphate, biotin, coenzyme A, tetrahydrofolate, lipoic acid. Immobilized enzymes – Preparation techniques and its applications. Bio sensors – Introduction, definition and types; enzyme therapy (Streptokinase).

Applications of enzymes - Application of enzymes in diagnostics: Uses of SGPT, SGOT, creatine kinase and alkaline phosphatases in diagnosis of liver function and assessment of treatment; Cardiac markers - troponin C CK-MB (STAT); enzyme immunoassay (Thyroid stimulating hormone using Immunoturbidimetry principle),

SUGGESTED READINGS

1. Nelson, D.L. and Cox, M.M., (2017). Lehninger: Principles of Biochemistry 7th ed., W. H. Freeman & Company (New York).

2. Donald, V. and Judith G.V., (2011). Biochemistry 4th ed., John Wiley & Sons Asia Pvt. Ltd. (New Jersey), ISBN: 978-1180-25024.
3. Nicholas C.P., and Lewis S., (1999). Fundamentals of Enzymology 3rd ed., Oxford University Press Inc. (New York), ISBN:0 19 850229 X.
4. Trevor Palmer (2004). Enzymes Biochemistry, Biotechnology, Clinical Chemistry; First Edition; East West Press Pvt., Ltd. New Delhi.

Semester II

21BCU202 **BIOANALYTICAL TECHNIQUES** **4H-4C**

Instruction hours/ week: L:4 T:0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

Equip the students:

- To understand various techniques used in the clinical laboratory.
- To provide the skills to equip the students to acquire downstream processing skills
- On the strength of concentrated acids
- On serial dilution of concentrated solutions
- The basic chemical methods used for protein separation
- The principle, working and applications of different chromatographic techniques for protein characterization

Course Outcomes (CO's)

After successful completion of the course, the student will:

1. Acquire skills to execute research ideas
2. Acquire job opportunity in the clinical laboratory sector
3. Acquire job opportunity in the downstream processing industries
4. Obtain UV spectrum for a given compound
5. Quantify nucleic acids using spectrophotometer
6. Assess the purity of nucleic acids

Unit I: GLP & Centrifugation

Good laboratory practices: Quality concepts, personal protective equipment (PPE). Do's and don'ts in the laboratory, General safety-biological safety, chemical safety and fire safety. Principles of GLP; Basic requirements to setup a laboratory. **Centrifugation**: Principles and techniques of preparative and analytical centrifuge. Svedberg constant. Types of Rotors- Fixed angle and swinging bucket. Types of the centrifuges: bench top centrifuges, differential centrifugation and ultracentrifugation.

Unit II: Colorimetric and spectrophotometric techniques

Colorimetry: Colour and absorption spectra. Beer and Lamberts Law – Deviation from Beer's law. Working with single cell photoelectric colorimeter. Measurement of extinction. Calibration curve. **Spectrophotometer:** Principle, instrumentation and applications of UV-visible and fluorescence, FT-IR, NIR, Nuclear Magnetic Resonance (NMR) spectroscopy. Spectroscopy in clinical diagnosis, Raman spectra in clinical diagnosis.

Unit III: Chromatography and Electrophoresis

Chromatography: Principles and techniques of the preparative and analytical centrifuge.Gel exclusion Chromatography- Principle, instrumentation and applications of gel exclusion chromatography, data analysis advantages and disadvantages. Affinity, Ion exchange chromatography – Principle, Instrumentation, and applications. HPLC and FPLC.

Electrophoresis: Polyacrylamide gel electrophoresis- Principle, instrumentation and

applications of PAGE. Gel polymerization using APSand TEMED., SDS, running gel, stacking gel, electrophoresis buffer, Separation and determination of molecular weight of proteins, different staining processes of the gel – CBB/silver stain/SYPRO ruby, determine the protein bands by comparing to the molecular weights standards.

Unit IV Protein Purification tools

Salting in and salting out- Principle, Debye-Huckel theory, Hofmeister series,Ionic strength, Ammonium sulfate precipitation, applications. Dialysis- Principle and types- Hemodialysis, pediatric, intestinal and peritoneal dialysis. Dialyzable substances. Medical applications.

Separation and determination of molecular weight of proteins, different staining processes of the gel – CBB/silver stain/SYPRO ruby, determine the protein bands by comparing to the molecular weight standards were added.

Unit V: Radioisotopes

Radioactive decay, units of radioactivity, detection and measurement of radioactivity – GM counter, Scintillation counter, Autoradiography, biochemical and biomedical applications of radio isotopes. X-ray diffraction, Circulur dichorism, Fluorimetry- Principle, techniques and applications

SUGGESTED READINGS

1. Jayaraman, J., (2007). Laboratory Manual in Biochemistry, New Age International Publishers, New Delhi.

2. Sadasivam, S.,and Manickam, A., (2009). Biochemical Methods, New Age, International Publishers, New Delhi.

3. Sheehan, D., (2010). Physical Biochemistry: Principles and Applications 2nd ed., Wiley Blackwell (West Sussex), ISBN:978-0-470-85602-4 / ISBN:978-0-470-85603-1.

4. Plummer D. T., (2006). An Introduction to Practical Biochemistry 3rd ed., Tata McGraw Hill Education Pvt. Ltd. (New Delhi), ISBN:13: 978-0-07-099487-4 / ISBN:10: 0-07-099487-0.

5. P. Palanivelu (2016). Analytical biochemistry and separation techniques. - a laboratory manual for B. Sc., M. Sc., & M. Phil students V edition. Twentyfirst Century Publications CHIL-SEZ IT Park Road, Keeranatham, Coimbatore - 641 035

21BCU203 **CHEMISTRY-II** **4H-4C**

Instruction hours/week: L:4 T:0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course Objectives

Equip the students:

- To be conversant with the extraction of metals
- About coordination chemistry
- On the preparation, properties, uses and structure of naphthalene and heterocyclic compounds
- To acquire knowledge on electrochemistry, biological functions of amino acids and proteins
- To acquire knowledge on thermodynamic laws, entropy, enthalpy change and the principles of electroplating.
- To acquire knowledge on aromatic and heterocyclic compounds

Course Outcomes (CO's)

After successful completion of the course, the student will understand:

1. The metallurgy of metals and the theories of coordination compounds and
2. The industrial importance of EDTA, haemoglobin and chlorophyll.
3. The concept of aromaticity and preparation of aromatic compounds including heterocyclic compounds.
4. The preparation, classifications and properties of amino acids, proteins and carbohydrates.
5. The concepts of first and second laws of thermodynamics
6. The fundamentals of electrochemistry

Unit I: Metals and Coordination Chemistry

Metals: General methods of extraction of metals-methods of ore dressing-types of furnaces-reduction methods-electrical methods-types of refining-Van Arkel process-Zone refining.

Coordination Chemistry: Nomenclature-theories of Werner, Sidgewick and Pauling-chelation and its industrial importance-EDTA-haemoglobin-chlorophyll-applications in qualitative and quantitative analysis.

Unit II: Aromatic Compounds and Heterocyclic Compounds

Aromatic Compounds: Aromaticity-Huckel's (4n+2) rule- aromatic electrophilic substitution in benzene- mechanism of nitration, halogenation, alkylation, acylation and sulphonation. Naphthalene: Isolation, preparation, properties and structure. **Heterocyclic Compounds:** Preparation and properties of pyrrole, furan, thiophene and pyridine.

Unit III: Alkenes and Alkynes

General methods of preparation, physical and chemical properties of alkenes and alkynes, Mechanism of E1, E2, E1cb reactions. Saytzeff and Hofmann eliminations.

Electrophilic additions and their mechanisms (Markownikoff/ Anti Markownikoff addition).

Unit IV: Energetics

Type of systems-processes and their types - isothermal, adiabatic, reversible, irreversible and spontaneous processes-statement of first law of thermodynamics-need for the second law of thermodynamics-heat engine-Carnot cycle-efficiency-Carnot theorem-thermodynamics scale of temperature-Joule-Thomson effect- Enthalpy-Entropy and its significance-Free energy change.

Unit V: Electrochemistry

Kohlrausch law-conductometric titrations-hydrolysis of salts-galvanic cells-E.M.F.-standard electrode potentials-reference electrodes- electrochemical series and its applications-buffer solution-buffer solution in the biological systems-pH and its determination-principles of electroplating.

SUGGESTED READINGS

1. Veeraiyan, V., & Vasudevan, A.N.S. (2012). *Text Book of Allied Chemistry*(II Edition). Chennai: Highmount Publishing House.

2. Puri, B.R., Sharma, L. R., & Kalia, K. C. (2017). *Principles of Inorganic Chemistry* (33rd Edition). Jalandar: Vishal Publishing Company.

3. Bahl, A., & Bahl, B.S. (2015). *A Textbook of Organic Chemistry* (21st Revised Edition). New Delhi: S.Chand& Company Pvt. Ltd.

4. Puri, B. R., Sharma, L. R. &Pathania, M. S. (2014). *Elements ofPhysical Chemistry* (46th Edition). Jalandhar: Vishal Publishing Company.

5. Gopalan, R., &Sundaram, S. (2013). *Allied Chemistry* (III Edition). New Delhi: Sultan Chand & Sons.

Semester II

21BCU211 **BIOANALYTICAL TECHNIQUES PRACTICAL** **4H-2C**

Instruction hours/week: L:0 T:0 P:4 Marks: Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course Objectives

To impart hands-on training:

- On the percentage preparation of concentrated acids
- On serial dilution of concentrated solutions
- How to determine the molar extension coefficient?
- How to obtain UV spectrum for a given compound?
- How to quantify nucleic acids using spectrophotometer?
- How to estimate the purity of nucleic acids

Course Outcomes (CO's)

After successful completion of the course, the student will:

1. Know the strength of laboratory acids and bases
2. Prepare serial dilution of concentrated solutions
3. Determine the molar extension coefficient
4. Obtain UV spectrum for a given compound
5. Quantify nucleic acids using spectrophotometer
6. Assess the purity of nucleic acids

Experiments

1. Preparation of a molar, normal and ppm solutions
2. Serial dilution and Preparation of dilute acids from concentrated acids
3. Conversion of milli equivalent solution to milli molar equivalent solution (eg- KCl, $MgSO_4$)
4. Preparation of a buffer of given pH and molarity.
5. Determination of the absorption maxima and molar extinction coefficient (of a relevant organic molecule) and Measurement of UV spectrum of compounds .
6. Determination of concentration of a protein solution by Lowry/BCA method.
7. Determination of nucleic acid concentration and purity
8. Dialysis of protein
9. Gel filtration chromatography
10. Thin- layer chromatography.
11. Electrophoresis-Native/SDS PAGE/Agarose.

EQUIPMENTS USED:

1. Colorimeter
2. Thin layer chromatography chamber
3. Spectrophotometer

SUGGESTED READING

1. Jayaraman, J., (2007). Laboratory Manual in Biochemistry, New Age International Publishers, New Delhi.

2. Sadasivam, S.,and Manickam, A., (2009). Biochemical Methods, New Age, International Publishers, New Delhi.

3. Plummer D. T., (2008). An Introduction to Practical Biochemistry 3rd ed., Tata McGraw Hill Education Pvt. Ltd. (New Delhi), ISBN:13: 978-0-07-099487-4 / ISBN:10: 0-07-099487-0.

4. P. Palanivelu (2016). Analytical biochemistry and separation techniques. - a laboratory manual for B. Sc., M. Sc., & M. Phil students V edition. Twentyfirst Century Publications CHIL-SEZ IT Park Road, Keeranatham, Coimbatore - 641 035

Semester II

21BCU212 **CHEMISTRY PRACTICAL-II** **3H-1C**

Instruction Hours/week: L: 0 T: 0 P: 3 Marks: Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

To impart hands-on training on:

- Estimation of sodium carbonate and sodium hydroxide
- Estimation of sulphuric acid
- Estimation of potassium permanganate
- Estimation of ferrous sulphate using permanganometry
- Estimation of oxalic acid using permanganometry
- Estimation of calcium using permanganometry

Course Outcomes (CO's)

After successful completion of the course, the student will:

1. Estimate sodium carbonate and sodium hydroxide using standards
2. Estimate sulphuric acid using standard oxalic acid
3. Estimate potassium permanganate by alkalimetry method
4. Estimate ferrous sulphate using stand Mohr's salt
5. Estimate oxalic acid using standard ferrous sulphate
6. Estimate calcium using direct method

Experiments

Volumetric analysis

A. Acidimetry & Alkalimetry

1. Estimation of sodium carbonate using standard sodium hydroxide.
2. Estimation of sodium hydroxide using standard sodium carbonate.
3. Estimation of sulphuric acid using standard oxalic acid.
4. Estimation of potassium permanganate using standard sodium hydroxide.

B. Permanganometry

1. Estimation of ferrous sulphate using standard Mohr's salt.
2. Estimation of oxalic acid using standard ferrous sulphate.
3. Estimation of calcium-direct method.

SUGGESTED READINGS

1.Thomas, A.O. (2012). *Practical Chemistry for B.Sc. Main Students.* Cannanore: Kerala, Scientific Book Centre.

2. Ramasamy, R. (2011). *Allied Chemistry Practical Book*.Karur: Priya Publications.

3. Venkateswaran, V., Veeraswamy, R., & Kulandaivelu A. R. (2015). *Basic Principles of Practical Chemistry* (2nd edition). New Delhi: S. Chand Publications.

21AEC201 **ENVIRONMENTAL STUDIES** **3H-3C**

Instruction hours/week: L: 3 T:0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course Objectives

Equip the students:

- To understand the concepts and components of ecosystem
- To understand the significance of eco components and measures to maintain ecosystem
- To teach the ethical and legal perspectives on ecosystem management
- To understand the undesired effects of environmental pollution
- To devise a strategy to avoid environmental pollution
- To understand the concept of conservation

Course Outcomes (COs)

1. Master core concepts and methods from ecological and physical sciences and their application in environmental problem solving.
2. Master core concepts and methods from economic, political, and social analysis as they pertain to the design and evaluation of environmental policies and institutions.
3. Understand the ethical, cross-cultural, and historical context of environmental issues and the links between human and natural systems.
4. Understand the transnational character of environmental problems and ways of addressing them, including interactions across local to global scales.
5. Apply systems concepts and methodologies to analyze and understand interactions between social and environmental processes.
6. Reflect critically about their roles and identities as citizens, consumers and environmental actors in a complex, interconnected world.

Unit I: Introduction - environmental studies & ecosystems

Environment Definition, Scope and importance; Ecosystem, Structure and functions of ecosystem. Energy flow, Food chains and food webs, Ecological succession. Classification of ecosystem. Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).

Unit II: Natural resources - renewable and non-renewable resources

Natural resources - Renewable and Non – Renewable resources. Land resources and land use change, Land degradation, soil erosion and desertification. Forest resources - Deforestation: Causes and impacts due to mining, dam building on the environment, forests, biodiversity and tribal populations. Water resources- Use and over-exploitation of surface and ground water, floods, droughts, conflicts over water. Use of alternate energy sources, growing energy needs, case studies. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.

Unit III: Biodiversity and its conservation

Levels of biological diversity - genetic, species and ecosystem diversity. Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value. Bio-geographical classification of India. Biodiversity patterns (global, National and local levels).Hot-spots of biodiversity. India as a mega-diversity nation. Endangered and endemic species of India. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Conservation of biodiversity: in-situ and ex-situ conservation of biodiversity.

Unit IV: Environmental pollution

Definition, causes, effects and control measures of Air pollution, Water pollution, Soil pollution, Noise pollution. Nuclear hazards and human health risks. Solid waste management and control measures of urban and industrial wastes. Role of an individual in prevention of pollution. Case studies.

Unit V: Social issues and the environment

Environment Laws (Environment Protection Act, Air Act, Water Act, Wildlife Protection Act, Forest Conservation Act). International agreements (Montreal and Kyoto protocols). Resettlement and rehabilitation of project affected persons. Disaster management (floods, earthquakes, cyclones and landslides). Environmental Movements (Chipko, Silent valley, Bishnois of Rajasthan). Environmental ethics: Role of Indian and other religions and cultures in environmental conservation. Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi). Human population growth: Impacts on environment, human health and welfare.

SUGGESTED READINGS

1. Anonymous. 2004. A text book for Environmental Studies, University Grants Commission and Bharat Vidypeeth Institute of Environmental Education Research, New Delhi.

2. AnubhaKaushik., and Kaushik, C.P. 2004. Perspectives in Environmental Studies. New Age International Pvt. Ltd. Publications, New Delhi.

3. Arvind Kumar. 2004. A Textbook of Environmental Science. APH Publishing Corporation, New Delhi.

4. Mishra, D.D. 2010. Fundamental Concepts in Environmental Studies. S.Chand&CompanyPvt. Ltd., New Delhi.

5. Rajagopalan, R. 2016.Environmental Studies: From Crisis to Cure, Oxford University Press**.**

6. Sing, J.S., Sing. S.P. and Gupta, S.R. 2014. Ecology, Environmental Science and Conservation. S. Chand & Publishing Company, New Delhi.

7. Singh, M.P., Singh, B.S., and Soma, S. Dey. 2004. Conservation of Biodiversity and Natural Resources.Daya Publishing House, New Delhi.

8. Tripathy. S.N., and Sunakar Panda. (2004). Fundamentals of Environmental Studies (2nd ed.). Vrianda Publications Private Ltd, New Delhi.

9. Verma, P.S., and Agarwal V.K. 2001. Environmental Biology (Principles of Ecology).S. Chand and Company Ltd, New Delhi.

10. Uberoi, N.K. 2005. Environmental Studies. Excel Books Publications, New Delhi.

Semester III

21BCU301 MACROMOLECULAR METABOLISM 4H-4C

Instruction hours/week: L:4 T:0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course Objectives

Equip the students:

- To give an insight on various human metabolic pathways.
- To understand the pathways related to energy production through catabolism of carbohydrates.
- To understand the importance of lipids as storage molecules and as a structural component of bio membranes.
- To recognize the protein anabolic pathways and catabolism of aminoacids
- To know the glucose homeostasis mechanism
- To understand the pathways related with energy production through catabolism of carbohydrates and lipids

Course Outcomes (CO's)

The students are able to

1. Understand the breakdown of macromolecules like carbohydrate and lipids
2. Acquire the concept of anabolism, catabolism and role of high energy compounds in the cell.
3. Acquire knowledge related to the regulation of various pathways, understand the synthesis and breakdown of macromolecules like carbohydrate and lipids and energy production
4. Interpret the central role of TCA cycle in energy metabolism
5. Students will be exposed to the fact that perturbations in the carbon metabolism can lead to various disorders such as diabetes and cancer.
6. Understand the energy requirement and energy balance through glucose homeostasis

Unit I: Basic design of metabolism and carbohydrate metabolism

Metabolic pathways – catabolism and anabolism, ATP as energy currency, reducing power of the cell. **Glycolysis:** Reactions of glycolysis, fates of pyruvate, feeder pathways for glycolysis **Glycogenesis and glycogenolysis:** Reactions and importance **Citric acid cycle:** Production of acetyl CoA, reactions of citric acid cycle, anaplerotic reactions, amphibolic role, glyoxalate pathway. **Gluconeogenesis and pentose phosphate pathway:** Synthesis of glucose from non-carbohydrate sources, pentose phosphate pathway and its importance. Glycogen storage diseases.

Unit II: Fatty acid oxidation

Fatty acid transport to mitochondria, β oxidation of saturated, unsaturated, odd and even numbered and branched chain fatty acids, peroxisomal oxidation, ω oxidation, ketone bodies metabolism, ketoacidosis. **Fatty acid synthesis:** Fatty acid synthase

complex. Synthesis of saturated, unsaturated, odd and even chain fatty acids and regulation. Synthesis of prostagladins, leukotrienes and thromboxanes. Synthesis of cholesterol. **Biosynthesis of membrane lipids:** Synthesis of membrane, biosynthesis of triacylglycerol, biosynthesis of plasmalogens, sphingolipids and glycolipids
Lipid storage disease

Unit III: Overview of amino acid metabolism
Nitrogen cycle, incorporation of ammonia into biomolecules. Metabolic fates of amino groups. Nitrogen balance, glucose-alanine cycle, urea cycle and inherited defects of urea cycle. **Biosynthesis of amino acids -** Overview of amino acid synthesis. Biosynthesis of non-essential amino acids and its regulation. **Catabolism of amino acids:** Catabolic pathways of individual amino acids. Transamination - role of pyridoxal phosphate, oxidative deamination, Transamination, decarboxylation. Glucogenic and ketogenic amino acids. Metabolism of one carbon units.

Unit IV: Biosynthesis of purine and pyrimidine nucleotides
De novo synthesis of purine and pyrimidine nucleotides, regulation and salvage pathways. Biosynthesis of deoxyribonucleotides and its regulation, conversion to triphosphates, biosynthesis of coenzyme nucleotides. Degradation of purine and pyrimidine nucleotides. Inhibitors of nucleotide metabolism. Disorders of purine and pyrimidine metabolism – Gout, SCID, adenosine deaminase deficiency.

Unit V: Integration of metabolism
Integration of metabolic pathways (carbohydrate, lipid and amino acid metabolic pathways), tissue specific metabolism (brain, muscle, and liver). Role of leptin in metabolism. **Starve-feed cycle -** Well-fed state, early fasting state, fasting state, early re-fed state, energy requirements, reserves and caloric homeostasis, five phases of glucose homeostasis.

SUGGESTED READING

1. Nelson, D.L. and Cox, M.M., (2013). Lehninger: Principles of Biochemistry 6th ed., W.H. Freeman and Company (New York), ISBN:13:978-1-4641-0962-1 / ISBN:10:1-4641-0962-1.

2. Devlin, T.M., (2011). Textbook of Biochemistry with Clinical Correlations 7th ed., John Wiley & Sons, Inc. (New Jersey), ISBN:978-0-470-28173-4.

3. Berg, J.M., Tymoczko, J.L. and Stryer L., (2012). Biochemistry 7th ed., W.H. Freeman and Company (New York), ISBN:10:1-4292-2936-5, ISBN:13:978-1-4292-2936-4.

21BCU302 **HUMAN PHYSIOLOGY** **4H-4C**

Instruction hours/week: L: 4 T:0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

Equip the students:

- On the concept of homeostasis
- On the physiological functioning of cardiovascular system
- On the physiological functioning of respiratory system
- On the physiological functioning of renal system
- On the physiological functioning of gastro-intestinal system
- On the physiological functioning of reproductive system

Course Outcomes (CO's)

After successful completion of the course, the student will:

1. Understand the concept of homeostasis
2. Understand the physiological functioning of cardiovascular system
3. Understand the physiological functioning of respiratory system
4. Understand the physiological functioning of renal system
5. Understand the physiological functioning of gastro-intestinal and hepatic system
6. Understand the physiological functioning of reproductive system

Unit I: Homeostasis and the organization of body fluid compartments

Intracellular, extracellular and interstitial fluid. Homeostasis, control system and their components. Plasma as an extracellular fluid, RBC, molecular mechanism of blood coagulation, role of vitamin K in coagulation, anticoagulant and fibrinolytic systems. Anemias, polycythemia vera, clotting disorders, haemophilia and thrombosis.

Unit II: Cardiovascular physiology and Respiration

Pressure, flow and resistance. Anatomy of heart. Physiology of the cardiac muscle, automacity of the cardiac muscle contraction, excitation contraction coupling, relationship between cardiac cycle, heart sound, ventricular volumes and the ECG, control of cardiac function and output. The arterial system, venous system, the microcirculation and mechanics of capillary fluid exchange. Control of blood flow to the tissues. Portal circulations. Arterial pressure and its regulation. Cardiovascular diseases.

Respiration: Organization of the pulmonary system. Mechanics of respiration, pulmonary ventilation and related volumes, pulmonary circulation. Principles of gas exchange and transport. Regulation of respiration. Centers of respirations. Respiratory disorders.

Unit III: Renal physiology

Anatomy of the kidney and the nephron. Regulation of renal blood flow. Cell biology of the Bowmans' capsule. Physiology of glomerular filtration and GFR. Tubular processing of the glomerular filtrate. Micturition reflex and voluntary control of micturition. Regulation of ECF electrolyte and water content, blood volume and long

term blood pressure. Blood buffer systems, renal and pulmonary control of blood pH, renal clearance. Assessment of kidney function. Acidosis and alkalosis. Glomerular nephritis, acute/chronic renal failure, dialysis and diuretics.

Unit IV: Gastrointestinal and hepatic physiology

Structure of Gastrointestinal tract. Propulsion and motility of food and digested material. Enteric reflexes, secretory functions of the GI tract, digestion and absorption of nutrients. Structure and functions of pancreas, peptic ulcer disease (PUD), tropical sprue, celiac disease, IBD (Crohn disease/ulcerative colitis), GERD, diarrhea, dysentery and constipation. Anatomy of the hepatic lobule and blood flow into the liver. Formation and secretion of bile. Gall bladder, enterohepatic cycle, Gut microorganisms. metabolic importance of liver. Liver diseases.

Unit V: Reproductive physiology

Sex determination and differentiation. Development of female and male genital tracts. Spermatogenesis, capacitation and transport of sperm, blood-testis barrier. Ovarian function and its control. Uterine changes, fertilization, implantation. and formation of the fetus and mechanisms for single births and multiple births; fetal development, gestation and parturition.

Neurochemistry and neurophysiology: Central Nervous system. Peripheral Nervous system. Blood-brain barrier and CSF. Synaptic transmission. Neurotransmitters. Sensory receptors and neural pathways. Somatic sensation, EEG, sleep, coma, learning and memory**.**

SUGGESTED READING

1. Chatterjee, C.C., (2016). Human Physiology, 13 th edition, CBS Publishers & Distributors Pvt. Ltd., India.

2. Saradha, S., (2010). A Textbook of Human Physiology, S. Chand and Company, New Delhi. ISBN-13: 978-8121902168.

3. Guyton, C., and Hall, J.E., (2010). Textbook of Medical Physiology, 12th Editon. Prism Indian edition, W.B. Saunders Company, New Delhi.

4. Murray, R.K., Bender, D.A., Botham, K.M., and Kennelly, P.J., (2012).Harper's illustrated Biochemistry, 29th edition.. McGraw-Hill Medical. London.

5. John E. Hall (2019). Guyton and Hall Textbook of Medical Physiology Second South Asia Edition 2019. Prism Indian edition, W.B. Saunders Company, New Delhi. ISBN-13: 978-1455770052.

Semester III

21BCU303 HORMONES: BIOCHEMISTRY AND FUNCTIONS 4H-4C

Instruction hours/week: L: 4 T:0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course Objectives

Equip the students on:

- The fundamentals of hormones and receptors
- Different mechanisms of hormonal actions
- Understanding of physiological and biochemical actions of hypothalamic, thyroid and pituitary hormones
- The role and applications of gastrointestinal hormones
- Understanding the clinical significance of adrenal and gonadal hormones
- Understanding of various endocrine disorders

Course Outcomes (CO's)

After successful completion of the course, the student will:

1. Gain knowledge on functions, classification and transport of hormones
2. Understand the role of secondary messengers, effector systems and protein kinases, tyrosine kinases in hormonal action
3. Have knowledge on the biochemical action and regulation of various endocrine hormones
4. Understand the role and applications of gastrointestinal hormones
5. Have knowledge on the role and functions of adrenal and gonadal hormones
6. Be able to identify an endocrine disorder if symptoms are available

Unit I: Introduction to hormones and receptors

Functions of hormones and their regulation. Chemical signaling - endocrine, paracrine, autocrine, intracrine and neuroendocrine mechanisms. Chemical classification of hormones, transport of hormones in the circulation and their half-lives. Hormone therapy. General introduction to Endocrine methodology. Hormone receptors - extracellular and intracellular. Receptor - hormone binding, Scatchard analysis. G protein coupled receptors, G proteins

Unit II: Mechanisms of hormonal actions

Second messengers - cAMP, cGMP, IP_3, DAG, Ca^{2+}, NO. Effector systems - adenylate cyclase, guanylate cyclase, PDE, PLC.Protein kinases (PKA, PKB, PKC, PKG). Growth factor signaling, PDGF, EGF, IGF-II, and erythropoietin.Receptor tyrosine kinases - EGF, insulin, erythropoietin receptor; ras - MAP kinase cascade, JAK - STAT pathway. Steroid hormone/ thyroid hormone receptor mediated gene regulation. Receptor regulation and cross talk.

Unit III: Hypothalamic, pituitary and thyroid hormones

Hypothalamic - pituitary axis. Study the physiological and biochemical actions of hypothalamic hormones, pituitary hormones - GH, prolactin, TSH, LH, FSH, POMC peptide family, oxytocin and vasopressin, feedback regulation cycle. Endocrine disorders - gigantism, acromegaly, dwarfs, pigmies and diabetes mellitus, insipidus. Thyroid gland.

Biosynthesis of thyroid hormone and its regulation; its physiological and biochemical action. Pathophysiology - Goiter, Graves disease, cretinism, myxedema, Hashimato's disease.

Unit IV: PTH, calcitonin and gastrointestinal hormones

PTH, Vitamin D and calcitonin. Mechanism of Ca^{2+} regulation and pathways involving bone, skin, liver, gut and kidneys. Pathophysiology - rickets, osteomalacia, osteoporosis. Regulation of release of insulin, glucagon, gastrin, secretin, CCK, GIP, adipolectin, leptin and ghrelin. Summary of hormone metabolite control of GI function. Physiological and biochemical action. Pathophysiology - diabetes type I and type II.

Unit V: Adrenal and gonadal hormones

Aldosterone, renin angiotensin system, cortisol, epinephrine and norepinephrine. Fight or flight response, stress response. Pathophysiology – Addison's disease, Conn's syndrome, Cushing syndrome. Male and female sex hormones. Interplay of hormones during reproductive cycle, pregnancy, parturition and lactation. Hormone-based contraception.

SUGGESTED READING

1. Nelson, D.L. and Cox, M.M., (2013). Lehninger: Principles of Biochemistry 6th ed., W.H. Freeman & Company (NewYork), ISBN:13: 978-1-4641-0962-1 / ISBN:10-14641-0962-1.

2. Widmaier, E.P., Raff, H., and Strang, K.T., (2008). Vander's Human Physiology 11th ed.,. McGraw Hill International Publications, ISBN: 978-0-07-128366-3.

3. Hadley, M.C., and Levine, J.E., (2007). Endocrinology 6th ed., Pearson Education (New Delhi), Inc. ISBN: 978-81-317-2610-5.

4. Cooper, G.M., and Hausman, R.E., (2009). The Cell: A Molecular Approach 5th Ed. ASM Press & Sunderland, (Washington DC), Sinauer Associates. (MA). ISBN:978-0-87893-300-6.

21BCU311 PROTEINS AND ENZYMES PRACTICAL 4H-2C

Instruction hours/week: L:0 T:0 P:4 Marks: Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course Objectives

By taking up this course the student will be able to

- Understand the quantitative analysis of proteins and its purification and characterization.
- Learn the sources of enzymes and study the extraction and partial purification of enzyme acid phosphatase
- Standardize the optimum pH, optimum substrate concentration required for the maximum activity of acid phosphatase
- Analyse the inhibition pattern by various competitive inhibitors for the enzyme acid phosphatase purified from germinated mung bean
- Assay the activity of Lactate dehydrogenase
- To enrich the biological significance of proteins

Course Outcomes (CO's):

After completing this course the student will be able to

1. Extract and purify proteins from sources and to determine the quantity.
2. Understand the purification process of enzyme.
3. Analyze the optimum pH, substrate concentration for the maximum enzyme activity.
4. Gain hands on training in the assay of enzymes acid phosphatase and Lactate dehydrogenase
5. Understand the three-dimensional structure of proteins using computational tools
6. Identify the biological significance of proteins

EXPERIMENTS

1. Estimation of proteins using Lowry/Bradford method.
2. Isoelectric pH of casein.
3. Ammonium sulphate fractionation of serum proteins and separation of albumin from serum using anion-exchange chromatography.
4. SDS-PAGE analysis of proteins-Banding pattern
5. Partial purification of acid phosphatase from germinating mung bean.
6. Assay of enzyme activity and specific activity, e.g. acid phosphatase.
7. Effect of pH on enzyme activity
8. Determination of Km and Vmax using Lineweaver-Burk graph.
9. Enzyme inhibition - calculation of Ki for competitive inhibition.
10. Assay the activity of lactate dehydrogenase.

EQUIPMENTS USED:

1. Column Chromatography
2. Electrophoresis-Horizontal and Vertical
3. UV Spectroscopy, Colorimeter

SUGGESTED READING

1. Sadasivam, S., and Manickam, A., (2009). Biochemical Methods, New Age International Publishers, New Delhi.

2. Jayaraman, J. (2007). Laboratory Manual in Biochemistry, New Age International Publishers, New Delhi.

3. Wilson, K., and Walker, J., (2010). Principles and Techniques of Biochemistry and
Molecular Biology, 7th Low Price Edition, Cambridge University Press, India.

4. Singh, S.P., (2009). Practical Manual of Biochemistry, CBS Publishers, New Delhi.

Semester III

21BCU312 MACROMOLECULAR METABOLISM PRACTICAL **4H-2C**

Instruction hours/week: L:0 T:0 P:4 Marks: Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

Equip the students:

- To understand the quantitative analysis of enzymes involved in carbohydrate metabolism
- To understand the quantitative analysis of enzymes involved in lipid metabolism
- lipid derivatives.
- On different quantitative methods to estimate glucose
- To understand the end products of amino acid and nucleic acid metabolism.
- To know about liver markers and kidney markers in humans and normal values.

Course Outcomes (CO's)

After successful completion of the course, the student will:

1. Explain the quantitative estimations of the macromolecules like carbohydrate, enzymes and lipids present in various samples and interpret the results
2. Identify the normal levels of liver and kidney markers and their disturbances.
3. Depth of understanding about the disturbance of amino acid and nucleic acid metabolism through case studies
4. Understand the quantitative analysis of enzymes involved in carbohydrate metabolism
5. Isolate lipid from the given sample
6. Estimate enzymes involved in lipid metabolism

Experiments

1. Estimation of blood glucose-GOD-POD Method
2. Assay of salivary amylase.
3. Isolation of lecithin and its estimation.
4. Isolation of cholesterol from egg yolk and its estimation.
5. Assay of serum transaminases – SGOT
6. Assay of serum transaminases – SGPT.
7. Estimation of serum urea.
8. Estimation of serum uric acid.
9. Estimation of serum creatinine.
10. Estimation of serum Bilirubin.
11. Case studies-Analysis of kidney disorder cases; liver function assay samples.

EQUIPMENTS REQUIRED:

UV Spectroscopy, Colorimeter

SUGGESTED READING

1. Rajan, S., (2012) Manual for Medical laboratory technology, First edition. Anjana Book House, Chennai.
2. Rao, B.S. and Deshpande, V., (2005). Experimental Biochemistry: A Student Companion IK International Pvt. Ltd. (New Delhi), ISBN:81-88237-41
3. Sadasivam, S., and Manickam, A., (2009). Biochemical Methods, New Age International Publishers, New Delhi.
4. Jayaraman, J. (2007). Laboratory Manual in Biochemistry, New Age International Publishers, New Delhi.

Semester III

21BCU313 HUMAN PHYSIOLOGY AND ENDOCRINOLOGY PRACTICAL 4H-2C

Instruction hours/week: L:0 T:0 P:4 Marks: Internal: **40**External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

To impart hands-on training on:

- Counting of different cell types using microscopy
- Estimation of haemoglobin in the given blood sample
- Determination of the group of the given blood sample
- Separation of isoenzymes by electrophoresis
- Measurement of blood pressure using sphygmomanometer
- Fixing and staining of microtome sections of tissues for histopathology observations

Course Outcomes (CO's)

After successful completion of the course, the student will:

1. Count of different cell types (RBC, WBC) using microscopy
2. Perform the estimation of haemoglobin in the given blood sample
3. Perform and identify the grouping (ABO and Rh) of the given blood sample
4. Separate isoenzymes by electrophoresis
5. Perform blood pressure measurement using sphygmomanometer
6. Perform fixing and staining of microtome sections of tissues for histopathology observations

Experiments

1. Hematology.
   a. RBC and WBC counting
   b. Differential leucocyte count.
   c. PT and APTT (Demonstration)
2. Estimation of haemoglobin.
3. Determination of blood groups
4. Separation of plasma proteins (Group Experiment).
5. Determination of total iron binding capacity.
6. Pulmonary function tests, spirometry and measurement of blood pressure.
7. Separation of isoenzymes by electrophoresis (Group Experiment).
8. Histology of connective tissue, liver and/ brain - permanent slides.
9. Case studies (Creatinine clearance, eGFR, anion gap and osmolality).
10. Visit to a hospital and demonstration of physiology using models.

EQUIPMENTS REQIRED:

1. Haemocytometer
2. Sphygmomanometer
3. Stethoscope
4. ECG
5. UV Spectroscopy, Colorimeter

SUGGESTED READING

1. Rajan, S., (2012) Manual for Medical laboratory technology, First edition. Anjana Book House, Chennai.

2. Rao, B.S. and Deshpande, V., (2005). Experimental Biochemistry: A Student Companion IK International Pvt. Ltd. (New Delhi), ISBN:81-88237-41

Semester III

21BCU304A **PLANT TISSUE CULTURE** **3H-3C**

Instruction hours/week: L: 3 T:0 P:0 **Marks:** Internal: **40** External: **60 Total**: **100**
End Semester Exam: 3 Hours

Course Objectives

Equip the students:

- To study plant growth promoting hormones, nutrients and their role in plant growth.
- To understand the importance of plant tissue culture and its applications.
- To learn the plant transformation techniques and their applications in health and disease.
- To understand the basic knowledge about tissue culture tools, medium, sterilization and techniques of tissue culture.
- To Learn about the production of Synthetic seeds & significance
- To Study about the role of tissue culture in crop improvement.

Course Outcomes (CO's)

After successful completion of the course, the student will:

1. Have a clear understanding of the nutrients required for plant growth
2. Have an understanding of plant tissue culture and the conditions provided to plant tissue Culture,
3. Have an understanding about various transformation methods and application.
4. To gain a wide knowledge about plant growth substances,
5. To gain a wide knowledge about plant nutrition and photo morphogenesis.
6. Have a clear understanding about the role of plant hormones in growth & development

UNIT I: Growth and Development

Role of Plant Hormones in growth & development. Structure and metabolism and functions of auxins, gibberellins and cytokinins. Plant Nutrition - Effect of soil pH on mineral availability, uptake & assimilation of minerals and their physiological role. Impact of macro, micro, vitamins in plant growth development. Allelopathic effect.

UNIT II: Introduction to plant tissue culture

Totipotency, Tissue culture media (Composition and preparation). Types of medium: MS medium, Gamborg's medium. Nutritional components of basal tissue culture media. Basic concepts of aseptic cultures and its uses in different areas and applications of plant tissue culture. Plant tissue culture facility, design and infrastructure requirements and dos and don'ts of a PTC lab.

UNIT III: Basic techniques in tissue culture

Types of culture, Initiation of callus and suspension cultures, micropropagation, Organogenesis, Somatic Embryogenesis, meristem culture, Rapid clonal propagation, Embryo Culture, anther and Pollen culture. Cell suspension culture. Hardening, vermicompost and maintenance of plants green house. Production of haploids and their application, Storage of plant genetic resources and Cryopreservation.

UNIT IV: Plant transformation technology

Ti &Ri Plasmid and their transfer mechanisms, Use of Ti &Ri as vectors, Binary vectors, Use of 35s & other promoters genetic markers- methods of nuclear transformation, viral vectors & their applications, Use of reporter gene, Particle bombardment, electroporation, Microinjection, Chloroplast transformation-transplastomics, Transformation of monocots, Transgene stability & gene silencing in Plant transformation.

UNIT V: Plant tissue culture and its applications

Transgenic plants - for– biotic (weeds, insects, viruses, fungi and bacteria) and abiotic (drought, salt, temperature, poor soil quality and oxidative) stress tolerance. Production of secondary metabolites. Molecular farming (improvement in protein, lipids, carbohydrates). Plant antibodies, vaccines, therapeutic proteins and active principles. Biofortification of important crops (rice and banana).

SUGGESTED READING

1. Davies, K., (2004). "Plant pigments and their manipulation" – Annual plant revies, vol 14 Blackwell Publication, UK
2. Slater, A., Scott, N.W., Fowler, M.R., (2008) "Plant Biotechnology: the genetic manipulation of plants" Oxford Press, UK
3. Altman, A., Hasegawa, P.M., (2012) "Plant Biotechnology and agriculture. Prospect for the 21st century" Academic Press, USA.
4. Brown, T. A., (2010). "Gene Cloning and DNA Analysis: an introduction", 6th edition, Wiley-Blackwell Publisher, UK.
5. Chawla, H.C., (2009) " Introduction to plant biotechnology 3rd Edition", Oxford & IBH publication Pvt .Ltd, New Delhi.
6. Primrose, S.B., and Twyman, R.M., (2003). "Principles of Genome Analysis". Blackwell Publishing, Oxford.
7. Winnacker, E., (2003). "From Gene to Clones; Introduction to gene technology", 4th edition, Panima Publisher, India

Semester III

21BCU304B **FOOD PROCESSING TECHNIQUES** **3H-3C**

Instruction hours/week: L: 3 T:0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course Objectives

To impart the students

- To learn the cold Preservation and freezers of food materials.
- To get the clear knowledge in freezing mechanisms
- To get the clear understanding of Chemical and Physical deterioration of frozen foods
- To acquire knowledge in dehydration and irradiation.
- To study the importance of Food Packaging.
- To acquire knowledge in packaging requirements of various foods

Course Outcomes (CO's)

After successful completion of the course, the student will:

1. Discuss on the importance of preservation
2. Understand the various preservation techniques
3. Describe the freezing mechanism
4. Understand about food irradiation.
5. Explain the drawbacks of uncovered food
6. Know the importance of packaging

UNIT 1 - Cold preservation

Freezing: requirements of refrigerated storage - controlled low temperature, air circulation and humidity, changes in food during refrigerated storage, progressive freezing, changes during freezing – concentration effect and ice crystal damage, freezer burn. Refrigeration load, factors determining freezing rate-food composition and non compositional influences.

UNIT 2 - Freezing Mechanism and freezers

Freezing methods - direct and indirect, still air sharp freezer, air blast freezer, fluidized freezer, contact freezers, liquid nitrogen immersion bath, brine freezer, impingement freezer, flat product freezers, plate/block freezer, spiral belt freezer, and cryogenic freezing. Chemical and Physical deterioration of frozen foods.

UNIT 3 - Dehydration

Normal drying curve, effect of food properties on dehydration, change in food during drying, drying methods and equipments air convection dryer, tray dryer, tunnel dryer, continuous belt dryer, fluidized bed dryer, spray dryer, drum dryer, vacuum dryer, freeze drying, foam mat drying.

UNIT 4 - Food Irradiation and Microwave Heating

Ionizing radiation and sources, unit of radiations, direct and indirect radiation effects, safety and wholesomeness of irradiated food. Microwave heating and applications. Effect of irradiation on microorganisms, food nutrients, benefits and drawbacks of food irradiations.

UNIT 5 - Packaging of foods

Packaging: Properties of packaging material, factors determining the packaging requirements of various foods and brief description of packaging of frozen products, dried products, fats and oils and thermally processed foods.

SUGGESTED READING

1. Desrosier NW and Desrosier JN (2004). The Technology of Food Preservation, CBS Publication, New Delhi.
2. Paine FA and Paine HY (1992). Handbook of Food Packaging, Thomson Press India Pvt Ltd, New Delhi.
3. Potter NH (1998), Food Science, CBS Publication, New Delhi.

21BCU314A PLANT TISSUE CULTURE - PRACTICAL 3H-1C

Instruction hours/week: L:0 T:0 P:3 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

The students are able to

- Build up the knowledge of the students in medicinal plant phytochemical screening.
- Open up the students to detailed plant physiological studies to pave way for plant tissue culture techniques.
- To learn the culture media preparation and callus induction.
- To understand the basic knowledge about tissue culture tools, medium, sterilization and techniques of tissue culture.
- To Learn about the production of Synthetic seeds & significance
- To Study about the role of tissue culture in crop improvement.

Course Outcomes (CO's)

1. The students are able to perform plant tissue culture techniques,
2. To study detail on plant physiological properties.
3. Have a clear understanding of the nutrients required for plant growth
4. Have an understanding of plant tissue culture and the conditions provided to plant tissue Culture,
5. Have an understanding about various transformation methods and application
6. To gain a wide knowledge about plant nutrition.

Experiments

PLANT TISSUE CULTURE (Group experiment)

1. Preparation of tissue culture media.
2. Surface sterilization.
3. Induction of meristem culture.
4. Callus induction.
5. Regeneration of shoot from callus culture.
6. Regeneration of root from callus culture.

EQUIPMENTS REQUIRED:

1. Autoclave
2. Tissue Culture Lab

SUGGESTED READING

1. Wagner, H., and Bladt, S., (1996). Plant drug analysis. Springer Science & Business media 2nd edition

2. Lindsey, K. (2013). Plant Tissue Culture Manual-Supplement 7: Fundamentals and Applications. ed., Springer Science & Business Media.

3. Reinert, J. and Yeoman, M.M., (2012). Plant cell and tissue culture: a laboratory manual. Springer Science & Business Media.

Semester III

21BCU314B **FOOD PROCESSING TECHNIQUES PRACTICAL** **3H-1C**

Instruction hours/week: L:0 T:0 P:3 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

To impart the students:

- To learn the cold preservation and freezers of food materials.
- To acquire knowledge in dehydration and irradiation.
- To study the importance of food packaging.
- To get the clear knowledge in freezing mechanisms
- To get the clear understanding of Chemical and Physical deterioration of frozen foods
- To acquire knowledge in dehydration and irradiation.

Course Outcomes (CO's)

After successful completion of the course, the student will

1. Discuss the importance of preservation.
2. Describe the freezing mechanism and food irradiation.
3. Understand the various preservation techniques
4. Understand about food irradiation.
5. Explain the drawbacks of uncovered food
6. Know the importance of packaging.

Experiments

1. Comparison of conventional and microwave processing of food
2. Preservation of food by the process of freezing
3. Drying of food using Tray dryer/other dryers
4. Preservation of food by canning (fruit/vegetable/meat)
5. Cut-out analysis of canned food
6. Osmotic dehydration
7. Minimal processing
8. Testing of packaging material

EQUIPMENTS REQIRED:

1. Hot air oven
2. Dryer
3. Aluminium foil and packing materials

SUGGESTED READING

1. Ramaswamy H, Marcott M, (2006). Food Processing Principles and Applications CRC Press.
2. Rao PG, (2010). Fundamentals of Food Engineering, PHI Learning Pvt Ltd, New Delhi.
3. Toledo Romeo T, (1999). Fundamentals of Food Process Engineering, Aspen Publishers.

Semester IV

21BCU401 **MOLECULAR BIOLOGY** **4H-4C**

Instruction hours/week: L:4 T:0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course Objectives

Equip the students:

- To understand about gene structure, replication, transcription, translation recombination mechanisms of DNA.
- To know the regulation of the synthesis of DNA, RNA and protein.
- To enlighten the students with the genome organization of DNA
- To study the mechanism of replication DNA in both prokaryotes and eukaryotes
- To understand the mechanism of recombination and transposition of DNA
- To understand DNA damage, mutation and DNA repair process

Course Outcomes (CO's)

After completing this course the student will be able to

1. Understand the gene structure and compaction of DNA
2. Recognize the basic difference between prokaryote and eukaryotic replication
3. Interpret the role of transposable elements and mutation in evolution
4. Explain the causes of DNA damage and the repair system that operate to rectify the damages.
5. Students can understand the background of gene structure and the flow of genetic information from DNA to RNA.
6. Explain the mutation and DNA repair process

UNIT I: Genome Organization and Replication of DNA

Genes and genomic organization - Definition of a gene, organization of genes in viruses, bacteria, animals and plants. Nucleosome structure and packaging of DNA into higher order structures. **Replication of DNA in prokaryotes and eukaryotes -** The chemistry of DNA synthesis, DNA polymerase, the replication fork, origin of replication, enzymes and proteins in DNA replication, various modes of replication, stages of replication of *E. coli* chromosome, the relationship between replication and cell division. DNA replication in eukaryotes, Comparison of replication in prokaryotes and eukaryotes. Inhibitors of DNA replication and applications in medicine.

UNIT II: Mutation, DNA repair, Recombination and transposition of DNA

Molecular basis of mutations and DNA repair: Importance of mutations in the evolution of species. Types of mutations - transition, transversions, frame shift mutations, mutations induced by chemicals, radiation, Ames test. Various modes of DNA repair - Replication errors and mismatch repair system, repair of DNA damage, direct repair, base excision repair, nucleotide excision repair, recombination repair. **Recombination and transposition of DNA**: Homologous recombination, proteins and enzymes in recombination, site-specific recombination, serine and tyrosine recombinases, biological roles of site-specific recombination. Transposons: Classes and importance.

UNIT III: Transcription in prokaryotes and eukaryotes

RNA polymerases, bacterial promoters, identification of DNA binding sites by DNA footprinting, the three stages of RNA synthesis - initiation, elongation and termination, Inhibitors of transcription and applications as anti-microbial drugs. Transcription by RNA polymerase II, RNA polymerase II core promoters, general transcription factors, various types of RNA processing, transcription by RNA polymerase I and III. Comparison of fidelity of transcription and replication. **RNA splicing-** Chemistry of RNA splicing, the spliceosome machinery, splicing pathways, group I and group II introns, alternative splicing.

UNIT IV: Biosynthesis of proteins

The genetic code-Degeneracy of the genetic code, wobble in the anticodon, features of the genetic code, nearly universal code. Biosynthesis of proteins- Messenger RNA, transfer RNA, attachment of amino acids to tRNA, the ribosome - initiation, elongation and termination of translation, regulation of translation. Comparison of prokaryotic and eukaryotic protein synthesis. Use of antibiotics in understanding protein synthesis and applications in medicine. Protein targeting and degradation – Post-translational modifications, glycosylation, specialized systems for protein degradation.

UNIT V: Regulation of gene expression in prokaryotes and eukaryotes

Regulation of gene expression in prokaryotes - Principles of gene regulation, negative and positive regulation, concept of operons, regulatory proteins, activators, repressors, DNA binding domains, regulation of lac operon and trp operon, induction of SOS response, synthesis of ribosomal proteins, regulation by genetic recombination, transcriptional regulation in λ bacteriophage. **Regulation of gene expression in eukaryotes** – Histone acetylation and deacetylation. Regulatory RNAs, Nuclear transcription factors and gene replication, RNA interference.

SUGGESTED READINGS

1. Watson, J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M. and Losick, R., (2008). Molecular Biology of the Gene 6th ed., Cold Spring Harbor Laboratory Press, Cold spring Harbor (New York), ISBN:0-321-50781 / ISBN:978-0-321-50781-5.
2. Nelson, D.L. and Cox, M.M., (2017). Lehninger: Principles of Biochemistry 7th ed., W. H. Freeman & Company (New York).
3. Snustad, D.P., and Simmons, M.J., (2010). Principles of Genetics 5th ed., John Wiley & Sons Asia, ISBN:978-0-470-39842-5.

Semester IV

21BCU402 **CLINICAL BIOCHEMISTRY** **4H-4C**

Instruction hours/week: L:4 T:0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

- To understand the functions of the hepatic, renal and cardiovascular system
- To evaluate the functions of the hepatic, renal and cardiovascular system
- To understand the glucose metabolism
- To get the clear knowledge about the disease associated with glucose metabolism
- To understand the significance of cholesterol
- To get the clear understanding about the cardiovascular disease

Course Outcomes (CO's)

1. Students acquire the basis behind the assessment of vital organ functioning through liver function, kidney function and cardiac biomarker assessment.
2. Able to differentiate normal and abnormal functioning of the human body.
3. Able to understand the basic life support
4. Get to know about the safety regulations and first aid in laboratories
5. Understand the clinical significance behind the disease
6. Know to use the diagnosis to assess organ functioning

Unit I: Introduction

Organization of clinical laboratory, Introduction to instrumentation and automation in clinical biochemistry laboratories safety regulations and first aid. General comments on specimen collection, types of specimens for biochemical analysis. Precision, accuracy, quality control, precautions and limitations. Basic life support and requirement to setup a clinical lab (Demonstration).

Unit II: Assessment of glucose metabolism in blood

Normal blood glucose levels-Hypoglycemia and hyperglycemia-cause and consequences. Clinical significance of variations in blood glucose. Diabetes mellitus. Oral glucose tolerance test. Qualitative (reducing sugar test in urine) and quantitative assessment of glucose- one touch method. Pre diabetic status and monitoring sugar control in diabetes. HbA1c analysis by HPLC. Glycemic index. Low glycemic index foods for diabetes. Glycogen storage disease- Von Gierke's disease, Galactosemia, renal threshold, Glycosuria.

Unit III: Lipid profile

Definition of lipids- Triglycerides-transport proteins-HDL, LDL, VLDL, chylomicrons. Role of LDL direct measurement in high TGL patients. Composition and functions of lipoproteins. Clinical significance of elevated lipoprotein. Cholesterol transportation and significance. Disorders associated with impaired levels of lipids-atherosclerosis, angina pectoris, myocardial infarction. Lipid storage disease-Taysach disease, Gangliosidosis. Steatorrhoea (greasy stool)

Unit IV: Liver, Renal, Gastric and Thyroid function test

Basic hepatic function test- Bilirubin estimation (conjugation), hippuric acid test (detoxification function). **S**erum enzymes in liver disease- Serum transaminases (SGOT and SGPT), and phosphatases. Bile acids and bile pigments. **Renal function tests -** Introduction, clinical significance of GGT in kidney function. Renal function (BSP) test, Inulin clearance test, serum urea, uric acid and creatinine, hemoglobin levels in blood. Urine protein – Creatinine ratio as a renal damage indicator; Urine routine – presence of glucose, protein, urobilinogen and ketones, sub-clinical hypo and hyperthyroidism. Gastric function test- Porridge meal method- Achlorhydria, hypochlorhydria and achylia gastrica, Pancreatic – amylase & Intestinal function. **Urine analysis** - Physical examination of urine. Thyroid function test- Serum T3, T4, TSH. Sub clinical Hypo and Hyperthyroidism.

Unit V: Tests for cardiovascular diseases

Tests for cardiovascular diseases– ECG**,** Involvement of enzymes in diagnostics of heart disease including aspartate transaminase, isoenzymes of creatine kinase and lactate dehydrogenase and troponin. Treadmill. Tumour markers for diagnosing various cancers – AFB. CEA, CA125, CT scanning, EGFR. TNM grading, histopathology- Immunohistochemistry

SUGGESTED READING

1. Mukherjee, K.L., (2010). Medical Laboratory Technology - A Procedure Manual for Routine Diagnostic Tests Vol. I (2010), Tata Mc Graw–Hill Publishing Company Limited (New Delhi). ISBN:9780070076594 / ISBN:9780070076631

2. Mukherjee, K.L. (2010). Medical Laboratory Technology - A Procedure Manual for Routine Diagnostic Tests VoI. II, Tata Mc Graw – Hill Publishing Company Ltd. (New Delhi), ISBN: 9780070076648.

3. Rana Shinde, Chatterjea MN (2012). Textbook of Medical Biochemisty, 8th Edition, Jaypee Brother Medical Publilshers (P) Ltd, New Delhi, India

4. Devlin TM (2010). Textbook of Biochemistry with Clinical Correlations, 7th Edition. Wiley Publishers, ISBN: 978-0-470-28173-4

5. Rao, B.S. and Deshpande, V., (2005). Experimental Biochemistry: A Student Companion IK International Pvt. Ltd. (New Delhi), ISBN:81-88237-41-8.

6. Varki A, Cummings RD, Esko JD (2017). Essentials of Glycobiology. 3rd edition. Cold Spring Harbor (NY): Cold Spring Harbor Laboratory Press; 2015-2017. ISBN 978-1621821328

Semester IV

21BCU403 **BIOINFORMATICS** **4H-4C**

Instruction hours/week: L:3 T:1 P:0 Marks: Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course Objectives

Equip the students:

- To understand basis and importance of bioinformatics and computer aided drug design
- To get exposed to different types of biological databases
- To look at a biological problem from a computational point of view
- To find out the methods for analyzing the expression, structure and function of proteins, and understanding the relationships between species
- To get knowledge on different methods for construction of a phylogenetic tree
- About the basics and importance of Proteomics and Genomics

Course Outcomes (CO's)

After successful completion of the course, the student will:

1. Understand the basics of computer aided drug design
2. Perform experiment pair wise and multiple sequence alignment and will analyze the secondary and tertiary structures of protein sequences
3. Understand the data structure (databases) used in bioinformatics and interpret the information
4. Perform search on protein and metabolic pathway databases
5. Perform BLAST to identify the sequence of amino acids
6. Construct a phylogenetic tree using bioinformatics

Unit I: Introduction to bioinformatics

Computer fundamentals - programming languages in bioinformatics, the role of supercomputers in biology. Historical background. Scope of bioinformatics - genomics, proteomics, computer- aided drug design (structure based and ligand based approaches) and Systems Biology. Applications of bioinformatics.

Unit II: Biological databases and data retrieval

Introduction to biological databases - primary, secondary and composite databases, NCBI, nucleic acid databases (GenBank, EMBL, DDBJ, NDB), protein databases (PIR, Swiss-Prot, TrEMBL, PDB), metabolic pathway database (KEGG, EcoCyc, and MetaCyc), small molecule databases (PubChem, Drug Bank, ZINC, CSD). Structure viewers (RasMol, J mol), file formats.

Unit III: Sequence alignment

Similarity, identity and homology. Alignment – local and global alignment, pairwise and multiple sequence alignments, alignment algorithms, amino acid substitution matrices (PAM and BLOSUM), BLAST and CLUSTALW.

Unit IV: Phylogenetic analysis

Construction of phylogenetic tree, dendrograms, methods of construction of phylogenetic trees - maximum parsimony, maximum likelihood and distance methods.

Unit V: Protein structure prediction analysis and gene prediction

Levels of protein structure. Protein tertiary structure prediction methods –homology modeling, fold recognition and *ab-initio* methods. Significance of Ramachandran map. Introduction to genomics, comparative and functional genomics, gene structure in prokaryotes and eukaryotes, gene prediction methods and tools.

SUGGESTED READING

1. Mount, D.W., (2001). Bioinformatics: Sequence and Genome Analysis 1st ed., Cold Spring Harbor Laborator Press (New York), ISBN: 0-87969-608-7.

2. Pevsner, J., (2003). Bioinformatics and Functional Genomics, 1st ed., John Wiley & Sons, Inc. (New Jersey), ISBN: 0-47121004-8.

3.Baxevanis, A.D., and Ouellette, B.F., (2005). Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, 3rd ed., John Wiley & Sons, Inc. (New Jersey), ISBN: 0-47147878-4.

4.Ghosh, Z., and Mallick, B., (2008). Bioinformatics – Principles and Applications, 1st ed. Oxford University Press (India), ISBN: 9780205692303.

21BCU411 MOLECULAR BIOLOGY - PRACTICAL 4H-2C

Instruction hours/week: L:0 T:0 P:4 **Marks:** Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course Objectives

Equip the students:

- To gain practical skill on DNA and RNA extraction
- To determine DNA and RNA content.
- To gain skills in isolation of mRNA and cDNA synthesis.
- To assess the expression of a particular gene of interest using RT-PCR
- To understand the Molecular structure, functions of cells, molecules such as DNA, RNA, proteins.
- To understand the principles of animal cell culture and its application.

Course Outcomes (CO's)

After completing this course, the students would have developed the skills of

1. Isolating DNA and RNA content from plant or animal source
2. Having a better understanding and importance of these molecules
3. Performing restriction digestion of DNA and PCR techniques.
4. Performing expression studies of a particular gene of interest using RT-PCR
5. To demonstrate knowledge and understanding of the molecular machinery of living cells, cell and tissue culture to manipulate.
6. Exploring the genomes of animals for ways to improve the livestock for food production and biomedical purpose as well as and to analyse, interpret, and participate in reporting to their peers on the results of their laboratory experiments.

Experiments

1. Extraction of DNA from plant tissue.
2. Extraction of RNA from animal tissue.
3. Determination of DNA and RNA concentration by A260nm.
4. Determination of the melting temperature and GC content of DNA.
5. Verification of Chargaff's rule by paper chromatography.
6. Isolation of mRNA from yeast by affinity chromatography.
7. cDNA synthesis.
8. Assessment of gene expression using RT-PCR.

EQUIPMENTS REQUIRED

1. Cooling Centrifuge
2. Thermal cycler
3. Electrophoretic system

SUGGESTED READING

1. Michael R Green and Joseph Sambrook. (2012). Molecular Cloning: A Laboratory Manual (Fourth Edition). Cold Spring Harbour Laboratory Press, New York.

2. Shad Arif Mohammed & Hawnaz Othman Najmalddin. (2017). Molecular Biology Laboratory Manual

3. Julie B. Wolf. (2011). Molecular Biology Lab Manual; Department of Biological Sciences, UMBC; IHC World, Life Science Products and Services.

4. P V G K Sarma. (2017). Molecular Biology A Practical Manual; MJP Publishers, India.

Semester IV

21BCU412 CLINICAL BIOCHEMISTRY - PRACTICAL 4H-2C

Instruction hours/week: L:0 T:0 P:4 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

Equip the students:

- To teach students on phlebotomy, serum and/or plasma collection.
- To impart skills to assess various biomolecules to diagnose the functioning of vital organs.
- To know the analytical methods commonly used in the clinical laboratory.
- To know how can contribute the clinical laboratory to assess the health status of individuals.
- To understand the pathophysiology and molecular basis of the most prevalent diseases.
- To understand the principles behind Dipstick method for fast diagnosis

Course Outcomes (CO's)

After successful completion, the students will understand

1. How to collect and process serum/plasma samples
2. How to collect and process urine samples
3. The Assessment of liver function
4. The Assessment of renal function
5. Principles behind Dipstick method for fast diagnosis
6. Students acquire the skills to perform phlebotomy and to estimate biomarkers to assess the vital organ functions.

Experiments

1. Collection of blood procedures, color codes of vacutainer tubes and its uses
2. Separation and storage of serum
3. Estimation of blood glucose by glucose oxidase peroxidase method.
4. Estimation of triglycerides.
5. Estimation of bilirubin (direct and indirect).
6. Quantitative determination of serum creatinine and urea.
7. Estimation of creatine kinase.
8. Physical Examination of urine - Colour, pH, Specific gravity.
9. Use of urine strip / dipstick method for urine analysis.
10. ESR, Westergren method – determination of sedimentation rate, POCT hospital visit and procedures for master health checkup
11. Colorimetric measurement of Haemoglobin

EQUIPMENTS REQUIRED

1. Autoanalyzer
2. Cooling Centrifuge

SUGGESTED READING

1. Mukherjee, K.L., (2010). Medical Laboratory Technology - a Procedure Manual for Routine Diagnostic Tests Vol. I Tata Mc Graw–Hill Publishing Company Limited (New Delhi). ISBN:9780070076594 / ISBN:9780070076631
2. Mukherjee, K.L., (2010). Medical Laboratory Technology - a Procedure Manual for Routine Diagnostic Tests. VoI. II, Tata Mc Graw – Hill Publishing Company Ltd. (New Delhi), ISBN: 9780070076648.
3. Baynes, J.W., and Dominiczak, M.H., (2005). Medical Biochemistry, 2nd ed., Elsevier Mosby Ltd. (Philadelphia), ISBN:0-7234-3341-0.
4. Rao, B.S., and Deshpande, V., (2005). Experimental Biochemistry: A Student Companion IK International Pvt. Ltd. (New Delhi), ISBN:81-88237-41-8.

Semester IV

21BCU413 BIOINFORMATICS - PRACTICAL 4H-2C

Instruction hours/week: L:0 T:0 P:4 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

To impart hands-on training on:

- Sequence retrieval from NCBI database
- Searching Protein and DNA structure from PDB
- Different molecular file formats for saving a protein/DNA sequence
- Different sequence alignment databases.
- Applying the statistical approaches and models for phylogenetic analysis and tree reconstruction.
- Different protein structure prediction databases

Course Outcomes (CO's)

After successful completion of the course, the student will:

1. Be able to retrieve a sequence from NCBI database
2. Be able to search a protein from PDB
3. Understand the different molecular file formats for saving a protein/DNA sequence
4. Apply different sequence alignment databases such as BLAST and CLUSTALW.
5. Apply the statistical approaches and models for phylogenetic analysis and tree reconstruction.
6. Analyze and predict the protein structure using structure prediction databases

Experiments

1. **Biological databases and data retrieval**
   Sequence retrieval (protein and gene) from NCBI.
   Structure download (protein and DNA) from PDB.
   Molecular file formats - FASTA, GenBank, Genpept, GCG, CLUSTAL, Swiss-Prot, FIR.
   Molecular viewer by visualization software.
2. **Sequence alignment**
   BLAST suite of tools for pairwise alignment.
   Multiple sequence alignment using CLUSTALW.
3. **Phylogenetic analysis**
   Generating a phylogenetic tree using PHYLIP.
4. **Protein structure prediction and analysis**
   Primary sequence analyses (Protparam).
   Secondary structure prediction (GOR, nnPredict, SOPMA).
   Tertiary structure prediction (SWISSMODEL).
   Protein structure evaluation - Ramachandran map (PROCHECK).
5. **Gene structure prediction and analysis**
   Gene prediction using GENSCAN and GLIMMER.

6. Data analysis

Mean, Median, standard deviation (MS excel)

SOFTWARE REQUIRED

1. SEESAR

2.Online free software

SUGGESTED READING

1.Mount, D.W., (2001). Bioinformatics: Sequence and Genome Analysis 1st ed., Cold Spring Harbor Laborator Press (New York), ISBN: 0-87969-608-7.

2.Pevsner, J., (2003). Bioinformatics and Functional Genomics 1st ed., John Wiley & Sons, Inc. (New Jersey), ISBN: 0-47121004-8.

3.Baxevanis, A.D., and Ouellette, B.F., (2005). Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins 3rd ed., John Wiley & Sons, Inc. (New Jersey), ISBN: 0-47147878-4.

4.Ghosh, Z., and Mallick, B., (2008). Bioinformatics – Principles and Applications 1st ed. Oxford University Press (India), ISBN: 9780205692303.

Semester IV

21BCU404A **ANIMAL TISSUE CULTURE** **3H-3C**

Instruction hours/week: L:3 T:0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

Equip the students:

- To impart the knowledge on basic tissue culture techniques,
- To get knowledge about chemically defined and serum- free media
- To understand the animal cell cultures and their maintenance
- Describe the equipment's used in animal and plant tissue culture.
- Understand the safety procedures need for tissue culture.
- Understand techniques used in tissue culture.

Course Outcomes (CO's)

After successful completion of the course, the student will:

1. Students will learn to demonstrate foundational knowledge of Cell culture techniques and competence in laboratory techniques.
2. Students can set up a tissue culture lab to carry out research based on cell lines.
3. To convey knowledge on various types of cultures- suspension cultures, continuous flow cultures, immobilized cultures; somatic cell fusion; cell cultures as a source of valuable products; organ cultures.
4. Understand the cell culture preservation techniques.
5. Be able to culture on a long-term basis primary and secondary cells
6. Be able to apply tissue culture techniques in different fields of biology

UNIT I: Introduction to cell culture

Introduction, importance, history of cell culture development, different tissue culture techniques including primary and secondary culture, continuous cell lines, suspension culture, organ culture, advantages and limitations medical/pharmaceutical products of animal cell culture-genetic engineering of animal cells and their applications. Risks in a tissue culture laboratory and safety - biohazards.

UNIT II: Different types of cell culture media

Different types of cell culture media, growth supplements, serum free media, balanced salt solution, other cell culture reagents, culture of different tissues and its application. Facilities for animal cell culture-infrastructure, equipment, culture vessels. Biology and characterization of cultured cells-cell adhesion, proliferation, differentiation, morphology of cells and identification.

UNIT III: Types of cell culture techniques

Primary cell culture techniques - mechanical disaggregation, enzymatic disaggregation, separation of viable and non-viable cells. Mass culture of cells - manipulation of cell

line selection - types of cell lines -maintenance of cell lines - immobilization of cells and its application - synchronization of cell cultures and cell division - production of secondary metabolites - biotransformation - Induction of cell line mutants and mutations - cryopreservation – germplasm conservation and establishment of gene banks.

UNIT IV: Animal cell culture scale- up

Animal cell culture scale up: Scale up in suspension - stirrer culture, continuous flow culture, air-lift fermentor culture; Scale up in monolayer - Roller bottle culture, multi surface culture, multi array disks, spirals and tubes - monitoring of cell growth. Organ culture - whole embryo culture - specialized culture techniques - measurement of cell death.

UNIT V: Tissue engineering

Tissue engineering: Design and engineering of tissues - tissue modeling. Embryonic stem cell engineering - ES cell culture to produce differential cells - Human embryonic stem cell research. Transgenic animals-transgenic animals in xenotransplantation. Outline of 3D printing technology

SUGGESTED READINGS

1. Darling, D.C., and Morgan, S.J., (1994). Animal Cells Culture and Media, BIOS Scientific Publishers Limited.
2. Ranga, M.M., (2000). Animal Biotechnology. Agrobios, India.
3. Satyanarayana, U., (2006). Biotechnology, Books and Allied (P) Ltd. India.
4. Mathur, J.P., and David Barnes, D., (1998). Methods in Cell Biology, Volume 57, Animal Cell Culture Methods Academic Press.
5. Aschner, M., & Costa, L. (Eds.). (2019). Cell Culture Techniques. Neuromethods.

Semester IV

21BCU404B **NANOBIOLOGY** **3H-3C**

Instruction hours/week: L:3 T:0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course Objectives

To make the students

- To understand the biological basis of Nanotechnology.
- To acquire the knowledge about bionanomaterials and its applications
- To identify the structural and functional characteristics of Nanomaterials.
- To learn the Nanomaterials applications in various fields of interest.
- To provide the basic knowledge in nanotechnology.
- To understand the fundamental concepts behind the interaction between drug and nanomaterials.

Course Outcomes (CO's)

The students shall be able to

1. Explain the importance of Nanomaterials in the biological system.
2. Discuss dietary macro and micro nutrients and Nanomaterials.
3. Explain the structural and functional characteristics of Nanomaterials
4. Describe the applications of Nanomaterials in different fields of interest.
5. Discuss the Inorganic Nanoparticles for Drug Delivery
6. Understand the applications of Nanomaterials in Biological and Eco-systems

Unit I: Preparation and Characterizations of Bionanoparticles

Magnetic, Electrical and Electrochemical, Spinning, Vortex, sonication, ultrasonication. Optical (UV-Vis/Fluorescence), X-ray diffraction (XRD), Imaging and size (FESEM, HRTEM, light scattering, Zeta-potential), Surface and composition (ECSA, EDAX, AFM/STM etc), Vibrational (FT-IR and RAMAN), SERS.

Unit II: Interaction between Drug and Nanomaterials

Proteins - Lipids - RNA and DNA, Protein Targeting - Small molecule/Nanomaterials - Protein Interactions, Nanomaterials - Cell interactions - Manifestations of Surface Modification (Poly-valency).

Unit III: Nanomaterials and Diagnostics/Drug Delivery and Therapeutics

MRI-Imaging, Surface modified nanoparticles, MEMS/NEMS based on Nanomaterials, Peptide/DNA Coupled nanoparticles, Lipid Nanoparticles for Drug Delivery, Inorganic Nanoparticles for Drug Delivery, Metal/Metal Oxide nanoparticles (antibacterial/anti fungal/anti viral), Anisotropic and Magnetic Particles (Hyperthermia).

Unit IV: Nanomaterials and Toxicity Evaluation

Nanotubes, Nano-baloons, Nano-carriers, Nano-particles, Nano-balls, Nano-cubes, etc., Cytotoxicity, Genotoxicity, *In-vivo* tests/assays, *In-vitro* tests/assays, *In-silico* tests/assays.

Unit V: Applications of Nanomaterials in Biological and Eco-systems

Application in the biological systems, Medical management, Environmental resources - wastewater management, solid waste management, electronical-waste management, food packing, cosmetics.

SUGGESTED READING

1. Yubing Xie., (2017). The Nanobiotechnology Handbook. 1st Edition., CRC Press, United States.
2. Maria Benelmekki., (2015). An introduction to nanoparticles and nanotechnology, Morgan & Claypool Publishers.

21BCU414A ANIMAL TISSUE CULTURE PRACTICAL 3H-1C

Instruction hours/week: L:0 T:0 P:3 **Marks:** Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course Objectives

Equip the students:

- To understand the principles of animal cell culture and its application.
- To impart the knowledge on basic tissue culture techniques,
- To get knowledge about chemically defined and serum- free media
- To understand the animal cell cultures and their maintenance
- Describe the equipment's used in animal and plant tissue culture.
- Understand the safety procedures need for tissue culture.

Course Outcomes (CO's)

After successful completion of the course, the student will:

1. To demonstrate knowledge and understanding of the molecular machinery of living cells, cell and tissue culture to manipulate.
2. To explore the genomes of animals for ways to improve the livestock for food production and biomedical purpose
3. To analyse, interpret, and participate in reporting to their peers on the results of their laboratory experiments.
4. Students will learn to demonstrate foundational knowledge of Cell culture techniques and competence in laboratory techniques.
5. Students can set up a tissue culture lab to carry out research based on cell lines.
6. Be able to apply tissue culture techniques in different fields of biology

ANIMAL TISSUE CULTURE (Demonstration)

1. Preparation and Sterilization of media
2. Cell lines and maintenance -Trypsinisation, Passaging, Staging
3. Cell counting and cell staining
4. Cell viability determination – Tryphan blue exclusion.

EQUIPMENTS REQUIRED

1. Cooling Centrifuge
2. CO_2 Incubator
3. Auto clave
4. Laminar Airflow Hood

SUGGESTED READINGS

1. Freshney, R. I., (2010). Culture of Animal Cells - A Manual of Basic Techniques, 6^{th} edition, John Wiley and Sons, Inc, Publication, New York.
2. Jayaraman, J., (2007). Laboratory Manual in Biochemistry, New Age International Publishers, New Delhi.

3. Kannan, N., (2003). Laboratory Manual in Microbiology, Panima Publishing Corporation, Bangalore.
4. Sadasivam, S., and Manickam, A., (2009). Biochemical Methods, New Age International Publishers, New Delhi.
5. Singh, S.P., (2009). Practical Manual of Biochemistry, CBS Publishers, New Delhi.
6. Talib, V.H., (2003). A Handbook of Medical Laboratory Technology, CBS Publishers, New Delhi.

Semester IV

21BCU414B **NANOBIOLOGY PRACTICAL** **3H-1C**

Instruction hours/week: L:0 T:0 P:3 **Marks:** Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course Objectives

To impart hands-on training:

- To understand the biological basis of Nanotechnology.
- To identify the structural and functional characteristics of Nanomaterials.
- To learn the Nanomaterials applications in various field of interest.
- To acquire the knowledge about bionanomaterials and its applications
- To provide the basic knowledge in nanotechnology.
- To understand the fundamental concepts behind the interaction between drug and nanomaterials.

Course Outcomes (CO's)

After successful completion of the course, the student will:

1. Explain the importance of Nanomaterials in the biological system.
2. Discuss on dietary macro and micro nutrients and Nanomaterials.
3. Describe the applications of Nanomaterials in different field of interest.
4. Explain the structural and functional characteristics of Nanomaterials
5. Discuss the Inorganic Nanoparticles for Drug Delivery
6. Understand the applications of Nanomaterials in Biological and Eco-systems

Experiments

1. Preparation of nanoparticles
2. Synthesis of Metal-oxide Nanocomposites
3. Synthesis of Magnetic nanoparticles
4. Characterization of different types of Nanomaterials
5. Sonication and Ultrasonication of Nanomaterials
6. Microscopy of Nanomaterials
7. X-Ray Diffractometer for particle size (Demo)
8. Zeta-potential and Zeta sizer of the Nanomaterials
9. Field Emission Scanning Electron Microscopy (FESEM) (Demo)
10. Higher Resolution Transmission Electron Microscopy (HRTEM) (Demo)

EQUIPMENTS REQUIRED

1. Micro wave oven
2. Ultra sonicator
3. Muffle Furnace
4. Trinocular Microscope

SUGGESTED READING

1. Yubing Xie., (2017). The Nanobiotechnology Handbook. 1st Edition., CRC Press Published March 29, 2017.
2. Maria Benelmekki., (2015). An introduction to nanoparticles and nanotechnology., Morgan & Claypool Publishers.

Semester V

21BCU501 **IMMUNOLOGY** **4H-4C**

Instruction hours/week: L:3 T:1 P:0 Marks: Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course Objectives

Equip the students with:

- Organs involved in immunity
- Acquired and innate arms of immune system
- The significance of humoral and cell mediated immunity during infection
- Various immunodeficiency diseases and hypersensitive reactions
- Structure and function of various immune cells and their role to combat infection
- Principles of vaccination

Course Outcomes (CO's)

After successful completion, the students will understand

1. Organs involved in immunity
2. Acquired and innate arms of immune system
3. The significance of humoral and cell mediated immunity during infection
4. Various immunodeficiency diseases and hypersensitive reactions
5. Structure and function of various immune cells and their role to combat infection
6. Principles of vaccination

Unit I: Introduction to immune system and components

Introduction and breakthrough discoveries in immunology. Organs, tissues and cells of the immune system. Barrier immunity, innate immunity, antimicrobial peptides, soluble molecules and membrane-associated receptors (PRR), Complement activation and regulation, deficiencies, Toll-like receptors, Phagocytosis – Oxygen-dependent and oxygen independent, inflammation, interferons, acute-phase response, cell adhesion molecules, cytokines, chemokines, leukocyte extravasation, localized and systemic response, herd immunity.

Unit II: Antigens, antibodies and receptor diversity

Antigens and haptens, factors determining immunogenicity, B and T cell epitopes. Clonal selection theory, Structure and distribution of classes of immunoglobulins (Ig), functions of antibody, antigenic determinants on Ig and Ig super family. Multigene organization of Ig locus, V(D)J rearrangement, generation of antibody diversity.

Unit III: Biology of B and T cells and antigen presentation

B-cell and T cell development, antigen-independent phase of B cell maturation and selection, humoral responses – T-dependent and T-independent response. Structure and role of T cell and B cell receptors, and co-receptors. General organization and inheritance of MHC, structure, distribution and role of MHC class I and class II proteins, linkage disequilibrium, pathways of antigen processing and presentation.

Unit IV: Adverse immune responses – Hypersensitivity and autoimmune diseases

General properties of effector T cells, cytotoxic T cells (Tc), natural killer cells; NKT cells and antibody-dependent cellular cytotoxicity (ADCC). Gell and Coombs classification, Type I-IV hypersensitivity reactions. Organ-specific and systemic autoimmune diseases, possible mechanisms of autoimmunity,

Unit V: Adverse immune responses – Immunodeficiency and Transplantation immunology

Immunodeficiency – Congenital and acquired immunodeficiency disorders, Immunological basis of graft rejection, GVHD, clinical manifestations, immunosuppressive therapy and privileged sites. Vaccines - active and passive immunization, types of vaccines.

SUGGESTED READING

1. Kuby., (2007). Immunology; 6th ed., Kindt, T.L., Goldsby, R.A. and Osborne, B.A., W.H Freeman and Company (New York), ISBN:13: 978-0-7167-8590-3 / ISBN: 10:0-7617-8590-0.
2. Coico, R., and Sunshine, G., (2009). Immunology: A Short Course 6th ed., John Wiley & sons, Inc (New Jersey), ISBN: 978-0-470-08158-7.
3. Murphy, K., Mowat, A., and Weaver, C.T., (2012). Janeway's Immunobiology 8th ed., Garland Science (London & New York), ISBN: 978-0-8153-4243-4.
4. Peter J. Delves, Seamus J. Martin, Dennis R. Burton, Ivan M. Roitt., (2017). Roitt's Essential Immunology: 6th ed., Wiley Blackwell (New Jersey), ISBN: 978-1-118-41577-1

21BCU502A **PLANT BIOCHEMISTRY** **3H-3C**

Instruction hours/week: L:3 T:0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course Objectives

This module makes the students:

- To understand the photosynthetic process in higher plants.
- To learn the biology of carbon fixation and nitrogen assimilation.
- To acquire knowledge on plant tissue culture techniques and applications.
- To understand and explain secondary metabolites and their potential therapeutic and nutritional uses.
- To understand the Microenvironment for plant growth
- To understand the Biosynthesis of secondary metabolites by plants

Course Outcomes (CO's)

At the end of the course students would be able to:

1. Explain the photosynthetic mechanism in higher plants.
2. Understand the electron transport happening in plants.
3. Apply their understanding of plant tissue culture fundamentals in entrepreneurship development and apply the same in the improvement of agriculture.
4. Apply the significance of secondary metabolites for better health.
5. Lay foundation as a work force in the emerging Phytopharmaceutical industries.
6. Understand the difference between Animal and Plant cell structure

UNIT I: Plant cell structure and Photosynthesis

Introduction to photosynthesis, the ultrastructure of chloroplast, Photosynthetic pigments, types of chlorophylls, photosynthesis in cyanobacteria using far -infrared light (Chlorophyll F). Mechanism of Photosynthesis - Structure of PSI and PSII complexes, Light reaction, Cyclic and non cyclic photophosphorylation, Z scheme.

UNIT II: Carbon assimilation and Plant Respiration

Carbon assimilation - Calvin cycle (C3) and regulation; C4 cycle and Crassulacean acid metabolism (CAM). Respiration - Overview of glycolysis, Alternative reactions of glycolysis, Regulation of plant glycolysis, Translocation of metabolites across mitochondrial membrane, TCA cycle, Alternative NAD(P)H oxidative pathways; Cyanide resistant respiration and Photorespiration.

UNIT III: Nitrogen metabolism

Biological Nitrogen fixation by free-living and in symbiotic association, structure and function of enzyme Nitrogenase. Nitrate assimilation: Nitrate and Nitrite reductase. Primary and secondary ammonia assimilation in plants; ammonia assimilation by Glutamine synthetase- glutamine oxoglutarate amino transferase (GS-GOGAT) pathway. Seed storage

proteins in legumes and cereals.

UNIT IV: Regulation of plant growth and Plant tissue culture

Introduction to plant hormones, Classification of plant hormones: Auxins, Gibberellins and Cytokinins. The effect of plant hormones on plant growth and development, regulation of plant morphogenetic processes by light. Plant tissue culture – Introduction to plant tissue culture, surface sterilization, Cell and tissue culture techniques, types of cultures: organ and explants culture, callus culture, meristem culture, micropropagation, cell suspension culture and protoplast culture. Plant regeneration pathways: organogenesis and somatic embryogenesis. Hardening, Applications of cell and tissue culture, somoclonal variation. Plant tissue culture facility and laboratory requirements, do's and don'ts in plant tissue culturing.

UNIT V: Plant Secondary metabolites

Major classes of secondary metabolites; Biosynthesis, classification, functions and pharmacological properties of Classes of secondary metabolites: terpenoids, essential oils, phenolics, flavonoids, tannins, glycosides, saponins, quinones, coumarins. Human's use of secondary metabolites as medicines, flavorings, pigments, and recreational drugs. Phytopharmaceuticals: Introduction to Phytopharmaceuticals in India.

SUGGESTED READING

1. Bowsher, C., Steer, M., Tobin, A., (2008). Plant Biochemistry. Garland science ISBN 978-0-8153-4121-5.
2. Biochemistry and molecular Biology of plant-Buchanan. (2005) 1st edition. Publisher: I K International. ISBN-10: 8188237116, ISBN-13: 978-8188237111.
3. Dey, P.M., and Harborne, J.B., (1997). Plant Biochemistry. Academic Press ISBN-10:0122146743, ISBN-13:978-0122146749.
4. Hans-Walter Heldt and Birgit Piechulla (2010). Plant Biochemistry, 4th edition. Academic Press, ISBN-13: 978-0123849861.
5. Rajan Katoch (2018). Fundamentals of Plant Biochemistry and Biotechnology (As per new ICAR Syllabus). Kalyani Publications, India. ISBN-13: 978-9327279610.
6. Akhtar Inam (2012). A Laboratory Manual of Plant Physiology, Biochemistry and Ecology. Agrobios, India. ISBN (13): 978-81-7754-458-9.

Semester V

21BCU502B **GENETICS AND GENOMICS** **3H-3C**

Instruction hours/week: L:3 T:0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

Equip the students to:

- Understand about the genome organization and basic knowledge of genomics
- Know the regulation of general features of genomes and genetic mobile elements
- To enlight the students with genome organization of DNA
- To study the mechanism of mapping of genome and genome project.
- To understand the structural, functional and comparative genomics.
- Know the concepts of different types of mutations (inversions, deletions, duplications and translocations)
- Understand the structure-function relationship of a specific gene

Course Outcomes (CO's)

After successful completion of the course, the student will:

1. Understand the basic knowledge of the organization of genome and skills to mapping of genome.
2. Recognize the basic difference between eukaryotic and prokaryotic genetic elements.
3. Interpret the role of mapping genomes.
4. Explain the causes of modern genomics, structural and genome project.
5. Students can understand the pattern of genome evolution and comparative genomics.
6. Understand the principles and concepts of genetics

UNIT I: Organization of genomes

Introduction: Genome, Genomics, Omics and its importance. Prokaryotes - Bacteriophages, Bacteria, Viruses Eukaryotic organelle genomes - Chloroplast and Mitochondria.

UNIT II: Genomes

Eukaryotic nuclear genomes General features, C-value paradox, types of coding and noncoding sequences and Split Genes. Mobile genetic elements in Prokaryotes (bacteria) and Eukaryotes (*Drosophila*, maize and humans).

UNIT III: Mapping of genomes

Genetic mapping- Cross breeding and pedigree analysis; DNA markers - RFLPs, SSLPs, SNPs. Physical mapping - Restriction mapping, Fluorescent *in situ* hybridization, Radiation hybrid mapping and Sequence tagged site mapping.

UNIT IV: Genome projects

The Human genome project, HapMap Project, The 1000 genome project, and The ENCODE Project.

Structural genomics: (a) Assembly of a contiguous DNA sequence- shotgun method, clone contig method, and whole –genome shotgun sequencing. (b) Understanding a genome sequence: locating the genes in a genome sequence and chromosome diversity determining the functions of individual genes

Functional genomics: Study of transcriptome (By sequence analysis, and Microarray analysis) and Proteome (Interacting proteins by phage display and Yeast two hybrid system)

Comparative genomics: Bacteria (*H. influenzae*), organelles, eukaryotes (Yeast, *Caenorhabditis elegans*, *Drosophila*, *Arabidopsis*, Human).

UNIT V: Pattern of genome evolution

The origin of genomes- Origin of macromolecules,

RNA world and DNA world. Acquisition of new genes (By gene duplication) and Gene families (Types, Pseudogenes, Origin of gene families (lateral gene transfer, allopolyploidy).Synthetic genomes and their applications.

SUGGESTED READING

1. Brown T. A. (2007), Genomes 3. Garland Science Publishing, New York.
2. Dunham, I., (2003). Genome Mapping and sequencing. Horizon Scientific
3. Graur, D and W H Li, 2000. Fundamentals of molecular evolution. Sinauer Associates.
4. Hartwell, L.H., L. Hood, M.L. Goldberg, A.E. Reynolds, L.M. Silver and R.G. Veres. (2004). Genetics from Genes to Genomes. McGraw Hill.
5. Lewin B. (2003). Genes VIII. Oxford University Press. Oxford.
6. Lewin B. (2014). Genes XI. Oxford University Press. Oxford.

Semester V

21BCU503A MICROBIOLOGY AND INFECTIOUS DISEASES 4H-4C

Instruction hours/week: L:4 T:0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course Objectives

Equip the students:

- Understand the science of microbiology, its development and importance in human welfare and to describe historical concept of spontaneous generation and the experiments performed for disproval
- Compare the structure and functions of microbes, and to determine the factors affecting microbial growth
- Recognize the general methods used in the study of microorganisms and cause by diseases
- Understand the economic importance of microorganisms
- Know the steps involved in the infection of a pathogenic parasites
- Understand the methods to prevent/treat infections

Course Outcomes (CO's)

After successful completion of the course, the student will:

1. To explain the impact of microorganisms on agriculture, environment, ecosystem, energy, and human health, including biofilms
2. To identify unique structures, capabilities, and genetic information flow of microorganisms
3. To analyze the range of metabolic diversity exhibited by microorganisms, the impact of metabolic characteristics on growth, and control of growth
4. Apply microbes in the betterment of agriculture and industrial process
5. To explain the process of infection by pathogenic parasites
6. Students will know how to prevent/treat infections

Unit I: Diversity of Microbial world

Binomial Nomenclature, Whittaker's five kingdom and Carl Woese's three kingdom classification systems and their utility. Difference between prokaryotic and eukaryotic microorganisms. General characteristics of different groups: acellular microorganisms (Viruses, Viroids, Prions) and Cellular microorganisms (Bacteria, Algae, Fungi and Protozoa) with emphasis on distribution and occurrence, morphology, mode of reproduction and economic importance.

Unit II: Viruses, viroids, prions and Bacteria

An introduction to viruses with special reference to the structure and replication of the following: Coronavirus, Poxvirus, Poliovirus, HIV, HBV, HCV, H1NI, T4 and λ phage, lytic and lysogenic cycles. **Bacteria** - An account of typical eubacteria, chlamydiae & rickettsiae (obligate intracellular parasites), mycoplasma, and archaebacteria (extremophiles). Applications of bacteria in industry, environment and food.

Unit III: Classification of infectious agents

Bacteria, viruses, protozoans and fungi. Past and present emerging and re-emerging infectious diseases and pathogens. Source, reservoir and transmission of pathogens, Antigenic shift and antigenic drift. Host-parasite interactions, types of infections associated with parasites. Overview of viral and bacterial pathogenesis - Infection and evasion.

Unit IV: Overview of diseases caused by bacteria, Viruses

Bacteria - Detailed study of tuberculosis: History, causative agent, molecular basis of host specificity, infection and pathogenicity, diagnostics, therapeutics, inhibitors and vaccines. Drug resistance and implications on public health. Other bacterial diseases including typhoid, *H. pylori*, diphtheria, pertussis, tetanus, syphilis and pneumonia. **Viruses -** Detailed study of viral diseases including hepatitis, dengue, influenza, rabies, chikungunya and polio. HIV - History, causative agent, pathogenesis, diagnostics, drugs and inhibitors. Hepatitis B, hepatitis C, swine flu, SARS-CoV, SARS-CoV2 (Covid19).

Unit V: Overview of diseases caused by Parasites

Parasites - Detailed study of malaria, history, causative agents, vectors, life cycle, diagnostics, drugs and inhibitors, resistance, vaccine development. Other diseases including leishmaniasis, amoebiasis. **Other organisms -** Fungal diseases, General characteristics. Medical importance of major groups, pathogenesis, treatment.

SUGGESTED READING

1. Powar, C.B., and Dahinwala, H.F., (2010). General Microbiology, Himalaya Publishing house, Mumbai.
2. Prescott, L.J., and Klein, D., (2017). Microbiology, 7th edition McGraw Hill Publishers, London.
3. Pelzar, A., (2010). Microbiology, McGraw Hill Publishers, London
4. Atlas, R.M., (2017). Principles of Microbiology. 2nd edition. W M.T. Brown Publishers
5. Mandell, Douglas and Bennett, S., (2014). Principles and practices of Infectious diseases, 7th edition, Volume, 2. Churchill Livingstone Elsevier.
6. Kenneth, J., Ryan, C., Ray, G., (2014). Sherris Medical Microbiology: An Introduction to Infectious Diseases by Publisher: McGraw-Hill
7. Patrick R. Murray, Ken S. Rosenthal, Michael A., (2014). Medical Microbiology Elsevier Health Sciences

Semester V

21BCU503B MOLECULAR BASIS OF NON-INFECTIOUS DISEASES **4H-4C**

Instruction hours/week: L:4 T:0 P:0 Marks: Internal: **40** External: **60** Total: **100**

Course Objectives

Equip the students:

- Elucidate contemporary biochemical principles and cutting-edge approaches,
- To improve critical thinking and literature analysis in the context of human disease.
- Understand the biochemical causes of the diseases discussed
- Understand the current and future opportunities for biochemical-based therapeutics.
- To equip the students to understand, critically evaluate, analyze and interpret the basics of non-infectious diseases
- To develop skills in the interpretation of biochemical data used in the investigation and diagnosis of non-infectious disease

Course Outcomes (CO's)

After successful completion of the course, the student will:

1. Students will know how to collect and process serum/plasma samples
2. Students will know how to collect and process urine samples
3. Gains knowledge of intermediary metabolism of the above and regulation of individual metabolism.
4. Possess knowledge of the impairment of metabolism, including inborn errors of metabolism
5. Understand the role of nutrition in health and disease
6. Students acquire the skills to perform phlebotomy and to estimate biomarkers to assess the vital organ functions.

UNIT I: Specimen Collection

Specimen collection and processing (blood, urine and faeces). Anti-coagulants and preservatives for blood and urine. A brief review of units and abbreviations used in expressing concentrations, standard solutions and clinical values. Electrolytes and acid base balance. Maintenance of acid base balance by the respiratory and renal mechanism. Acidosis and alkalosis. Preanalytical errors.

UNIT II: Inborn errors and Nutritional diseases

Inborn errors of metabolism

Alkaptonuria, Phenylketonuria, Glycogen and Lipid storage diseases, SCID, Clotting disorders.

Nutritional deficiency-based diseases

Kwashiorkar, Marasmus, Beri-beri, Scurvy, Pellagra, Anaemia, Night blindness, Rickets, Osteomalacia, Osteoporosis, Wilson's disease.

UNIT III: Lifestyle-associated disorders

Disorders of liver, kidney and heart: Jaundice, fatty liver, functions of liver and kidney. Diagnostic enzymes – enzymes in health and diseases. Renal calculi, Cardiac arrest and management, atherosclerosis. Inflammatory bowel disease (IBD).

Hormonal Imbalances

Outline of hormone action and imbalances leading to disease - precocious puberty, hyper and hypopituitarism. Hyper and hypothyroidism.

UNIT IV: Autoimmune diseases

Concepts in immune recognition - self and non-self-discrimination, organ-specific autoimmune diseases – Hashimoto's thyroiditis, Grave's disease, myasthenia gravis. Systemic diseases - SLE, rheumatoid arthritis.

Diseases caused due to misfolded proteins

Alzheimer's, Huntington's disease, Kuru, Creutzfeldt-Jakob disease, Sickle cell anaemia, Thalessemia.

UNIT V: Cancer

Cancer – properties of cancer cells, etiology of cancer, carcinogenic agents, biochemistry of metastasis, tumor markers. Gall stones, prenatal diagnosis and postnatal diagnosis, duodenal ulcer.

SUGGESTED READING

1. Devlin, T.M., (2011). Textbook of Biochemistry with Clinical Correlations. John Wiley & Sons, Inc. (New York), ISBN: 978-0-4710-28173-4.
2. Coico, R., and Sunshine, G., (2009). Immunology: A Short Course. 6th ed., John Wiley& sons, Inc (New Jersey), ISBN: 978-0-470-08158-7.
3. Berg, J.M., Tymoczko, J.L. and Stryer, L., (2012). Biochemistry. 7th ed., W.H Freeman and Company (New York), ISBN: 13:978-1-4292-7635-1.
4. Snustad, D.P. and Simmons, M.J., (2012). Genetics. 6th ed., John Wiley & Sons. (Singapore), ISBN: 978-1-118-09242-2.

Semester V

21BCU504A **FOOD BIOCHEMISTRY** **4H-4C**

Instruction hours/week: L:4 T:0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course Objectives

Equip the students:

- To enable students understand the basics of food biochemistry
- Outline the important aspects of food relating to nutrition
- Summarize the diets suitable for managing specific nutritional disorders
- Categorize the nutrients for different age groups, and sportspeople
- To understand the basic concepts and importance of nutrition
- To understand about the malnutrition and its problems

Course Outcomes

After successful completion of the course, the student will:

1. To understand the basic concepts and importance of nutrition
2. Outline the biochemistry process, basic concept of human nutrition and the relationship of the consumption of foods to nutritional status and health
3. Students will be able to apply their knowledge in Food Biochemistry in designing with improved nutritional characteristics
4. Evaluate the biological functions of foods for health in addition to nutritional values
5. Report the dietary management system for nutrition and disorder with organs
6. Design and develop a new range of food products and nutritional supplements for different age group people, pregnancy and others.

Unit I: Concepts of Nutrition

Basic concept of nutrition. Importance of nutrition. Food intake and regulations, Food groups, Utilization of nutrients and digestion process, calorific value of food, dietary need and recommended dietary allowances, Vegetarian diet, health, problems and advantages. Assessment of nutritional status energy value of carbohydrates, proteins and fats. Determination of energy value, balanced diet. Recommended dietary intake. Acceptable dietary intake. Protein efficiency ratio. Net protein utilisation and their determinations.

Unit II: Specialized Nutrition

Vitamins. Definition of Vitamin, Types of Vitamins. Fat and water soluble Vitamins. Nutrition for specialized purposes. Pediatric nutrition. Geriatric nutrition. Pregnancy and lactation. Sports nutrition, Nutrition during pregnancy. Functional foods. Digestibility, Carbohydrates in food and dietary fibre. Elements. Definition of elements. Types of elements. Major and minor elements.

Unit III Malnutrition

Malnutrition and its problems. Nutrient supplementation, fortification, Nutritional labeling and its importance and Basal Metabolic Rate. Goitre, Selenium deficiency (Keshan disease), Cu deficiency (Retarded growth) and Haemophilia.

Unit IV: Nutritional disorders

Dietary management. Pyrexia, Overweight, under weight, obesity. Anorexia nervosa and Bulimia. Nutrition and disorders associated with organs such as muscle, brain, liver and kidney. Antinutritional factors. Naturally occurring anti-nutritional factors Cyanogens, lectins, enzyme inhibitors, phytoallexins and phytates.

Unit V: Metabolic disorders

Ageing. Theories of ageing. Nutrition and ageing. Age-related metabolic disorders. Nutrition in the treatment of age-related disorders like hypertension, diabetes, glucose metabolism, hyperlactemia, Porphyrias and Cachexia. Food allergy, Intolerance and sensitivity and Nutrigenomics.

SUGGESTED READING

1. Nelson DL and Cox MM. (2017). Lehninger Principles of Biochemistry. 7th Edition. W.H. Freeman Company.
2. Voet D, Voet JG and Pratt CW. (2016). Fundamentals of Biochemistry Life at the Molecular Level. 5thEdition.John Wiley and Sons.
3. Eastwood. M. (2003). Principles of Human Nutrition. 2nd Edition. Blackwell Publishing Company. ISBN 978-1-4899-3025-5
4. Sunetra Roday. (2012). Food Science and Nutrition. 2nd Edition. Oxford Higher Education/ Oxford University Press.
5. Shubhangini AJ. (2015). Nutrition and Dietetics. 4th Edition. McGraw Hill education.

21BCU504B MEMBRANE BIOLOGY AND BIOENERGETICS 4H-4C

Instruction hours/week: L:4 T:0 P:0 **Marks:** Internal: **40**External: **60** Total: **100**
End Semester Exam: 3 Hours

Course Objectives

Equip the students:

- To understand the basis of membrane proteins (intrinsic and extrinsic)
- To understand the basis of membrane lipids (phospholipids and glycolipids)
- To understand the basis of membrane carbohydrates
- To understand the basis of membrane model system for drug delivery
- To understand the transport of biomolecules across membranes
- To understand the role of membrane components on energy production

Course Outcomes (CO's)

After successful completion of the course, the student will:

1. Understand the basis of membrane proteins (intrinsic and extrinsic)
2. Understand the basis of membrane lipids (phospholipids and glycolipids)
3. Understand the basis of membrane carbohydrates
4. Understand the basis of membrane model system for drug delivery
5. Understand the transport of biomolecules across membranes
6. Understand the role of membrane components on energy production.

UNIT I: Biomembranes, membrane structures and membrane dynamics

Composition of biomembranes- prokaryotic, eukaryotic, neuronal and sub-cellular membranes. Study of membrane proteins. Fluid mosaic model with experimental proof. Monolayer, planer bilayer and liposomes as model membrane systems. Polymorphic structures of amphiphilic molecules in aqueous solutions- micelles and bilayers. CMC, critical packing parameter. Membrane asymmetry. Macro and micro domains in membranes. Membrane skeleton, lipid rafts, caveolae and tight junctions. RBC membrane architecture. Lateral, transverse and rotational motion of lipids and proteins. Techniques used to study membrane dynamics - FRAP, TNBS labeling etc. Transition studies of lipid bilayer, transition temperature. Membrane fluidity, factors affecting membrane fluidity.

UNIT II: Membrane transports

Thermodynamics of transport. Simple diffusion and facilitated diffusion. Passive transport- glucose transporter, anion transporter and porins**.** Primary active transporters- P type ATPases, V type ATPases, F type ATPases. Secondary active transporters- lactose permease, Na^+-glucose symporter.ABC family of transporters- MDR, CFTR. Group translocation. Ion channels- voltage-gated ion channels (Na^+/K^+ voltage-gated channel), ligand-gated ion channels (acetyl choline receptor), aquaporins, bacteriorhodopsin. Ionophores - valinomycin, gramicidin.

UNIT III: Vesicular transport, membrane fusion and bioenergetics

Types of vesicle transport and their function- clathrin, COP I and COP II coated vesicles.

Molecular mechanism of vesicular transport. Membrane fusion. Receptor mediated endocytosis of transferrin. Laws of thermodynamics, state functions, the equilibrium constant, coupled reactions, energy charge, ATP cycle, phosphorylation potential, phosphoryl group transfers. Chemical basis of high standard energy of hydrolysis of ATP, other phosphorylated compounds and thioesters. Redox reactions, standard redox potentials and Nernst equation. Universal electron carriers.

UNIT IV: Oxidative phosphorylation

Mitochondria. Electron transport chain- its organization and function. Inhibitors of ETC and uncouplers. Peter Mitchell's chemiosmotic hypothesis. Proton motive force. Fo-F1 ATP synthase, structure and mechanism of ATP synthesis. Metabolite transporters in mitochondria. Regulation of oxidative phosphorylation. ROS production and antioxidant mechanisms. Thermogenesis. Alternative respiratory pathways in plants.

UNIT V: Membrane in cell signaling

Signaling molecules- neuro transmitters, peptide, steroid hormones and growth factors. Cell surface receptors – G-protein coupled receptors, Receptor protein-tyrosine kinase, nonreceptor protein-tyrosine kinase, cytokine receptors and receptors linked to enzyme activities

Signal transduction - second messengers-cAMP. cGMP, phospholipds and Ca^{2+} Pathways of intracellular signal transduction- PI3kinase/ akt and TOR pathways, MAP kinase pathways, JAK/STAT and TGFβ / Semad pathways, NF-κB signaling, Hedgehog, Wnt and Notch pathways

REFERENCES

1. Nelson, D.L. and Cox, M.M., W.H. Freeman., Lehninger: Principles of Biochemistry (2013) 6th ed., and Company (New York), ISBN:13: 978-1-4641-0962-1 / ISBN:10:1-4641-0962-1.

2. Lodish, H., Berk, A., Kaiser, C.A., Krieger, M., Bretscher, A., Ploegh, H., Amon, A. and Scott, M.P., Molecular Cell Biology (2013) 7th ed., W.H. Freeman & Company (New York), ISBN:13: 978-1-4641-0981-2.

3. Garret, R. H. and Grisham, C.M., Biochemistry (2010) 4th ed., Cengage Learning (Boston), ISBN-13: 978-0-495-11464-2.

4. Voet, D.J., Voet, J.G. and Pratt, C.W., (2008) Principles of Biochemistry 3rd ed., John Wiley & Sons, Inc. (New York), ISBN:13: 978

Semester V

21BCU511 **IMMUNOLOGY PRACTICAL** **4H-2C**

Instruction hours/week: L:0 T:0 P:4 **Marks:** Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course Objectives

To impart hands-on training on:

- Isolation of lymphocytes
- Purification of immunoglobulins using protein A
- Immunodiffusion techniques (Single and Double)
- Agglutination techniques
- Blood grouping
- ELISA technique

Course Outcomes (CO's)

After successful completion, the students will:

1. Perform isolation of lymphocytes
2. Purify immunoglobulins using protein A
3. Perform Immunodiffusion techniques (Single and Double)
4. Perform agglutination techniques
5. Carry out blood grouping
6. Conduct ELISA experiments

Experiments

1. Isolation of lymphocytes from blood and macrophages from peritoneal cavity or spleen.
2. Purification of immunoglobulins.
3. Assays based on precipitation reactions - Ouchterlony double diffusion (ODD) and Mancini radial immunodiffusion.
4. Assays based on agglutination reactions – Blood group typing (active) & passive agglutination.
5. Enzyme linked immune-sorbent assay (ELISA).
6. Blot Assay – Food allergen (Hypersensitivity test)

SUGGESTED READING

1. Kuby, J., (2007) Immunology; 6th ed., Kindt, T.L., Goldsby, R.A. and Osborne, B.A., W.H Freeman and Company (New York), ISBN:13: 978-0-7167-8590-3 / ISBN: 10:0-7617-8590-0.

2. Coico, R., and Sunshine, G., (2009). Immunology: A Short Course 6th ed., John Wiley& sons, Inc (New Jersey), ISBN: 978-0-470-08158-7.

3. Murphy, K., Mowat, A., and Weaver, C.T., (2012). Janeway's Immunobiology 8th ed., Garland Science (London & New York), ISBN: 978-0-8153-4243-4.

Semester V

21BCU512A **PLANT BIOCHEMISTRY PRACTICAL** **3H-1C**

Instruction hours/week: L:0 T:0 P:3 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

To impart hands-on training on

- Preparation of plant tissue lysates
- Estimation of enzymes during germination
- Extraction of enzymes from plant source
- Separation of plant metabolites using TLC
- PTC media preparation, culturing techniques
- Vitamin assessments

Course Outcomes (CO's)

After successful completion, the students will understand

1. Preparation of plant tissue lysates
2. Estimation of enzymes during germination
3. Extraction of enzymes from plant source
4. Separation of plant metabolites using TLC
5. PTC media preparation, culturing techniques
6. Vitamin assessments

Experiments

1. To estimate the activity of nitrogenase
2. To estimate the activity of α-amylase, catalase, peroxidase enzymes
3. To measure nitrate reductase activity (NRA)
4. Extraction and assay of Urease from Jack bean.
5. Preparation of crude alcoholic extract by maceration method.
6. Preparation of aqueous extract by decoction method.
7. Estimation of /phenols/tannins/flavonoids present in plant extract.
8. Separation of phytoconstituents by Column chromatography, thin-layer chromatography.
9. Culture of plants (explants).
10. Callus culture, meristem culture, cell suspension culture, embryonic culture.

EQUIPMENT REQUIRED:

1. Colum chromatography
2. Autoclave

SUGGESTED READING

1. Bowsher, C., Steer, M., and Tobin, A., (2008). Plant Biochemistry, Garland science ISBN 978-0-8153-4121-5.
2. Biochemistry and molecular Biology of plant-Buchanan. (2005) 1 edition. Publisher: I K International. ISBN-10: 8188237116, ISBN-13: 978-8188237111.
3. Akhtar Inam (2012). A Laboratory Manual of Plant Physiology, Biochemistry and Ecology. Agrobios, India. ISBN (13): 978-81-7754-458-9.

Semester V

21BCU512B **GENETICS AND GENOMICS PRACTICAL** **3H-1C**

Instruction hours/week: L:0 T:0 P:3 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

- This course teaches about isolate and recombinant DNA and restriction, digestion and electrophoresis
- To learn Isolation of mRNA, cDNA conversion and quantification
- To learn Physical mapping the bacteriophage genome
- To analyze homology sequence, identify gene feature and primer designing
- To understand Construction of phylogenetic tree analysis
- On understanding the structure-function relationship of a specific gene

Course Outcomes (CO's)

1. Isolation of recombinant DNA, Restriction digestion
2. Isolation of mRNA, cDNA conversion and quantification of a gene.
3. Genetic mapping by RFLP analysis.
4. Physical mapping of bacteriophage genome / recombinant DNA clone by restriction mapping.
5. Homology sequence analysis using Blast and FASTA.
6. Identifying gene features through DNA sequence analysis and primer designing phylogenetic tree construction.

List of experiments

1. Isolation of DNA from Blood (Human) and Tissue by phenol-chloroform extraction method.
2. In vitro DNA synthesis by PCR method and cloning by TA cloning method (Ligation, competent cell preparation and Transformation)
3. Isolation of recombinant DNA, Restriction digestion, and electrophoresis.
4. Isolation of Blood mRNA, quantification, cDNA conversion and quantification of GAPDH gene.
5. Genetic mapping by RFLP analysis.
6. Physical mapping of bacteriophage genome / recombinant DNA clone by restriction mapping.
7. Homology sequence analysis using Blast (Blast n, Blast p, Blast x), and FASTA.
8. Identifying gene features through DNA sequence analysis and primer designing (gDNA, cDNA and miRNA).
9. Multiple sequence alignment and phylogenetic tree construction.
10. Whole genome/exome sequence analysis.
11. Protein 3D structure visualization.
12. Performing protein 3D structure modeling and docking.

Software Required:

1. SeeSAR
2. software

SUGGESTED READING

1. Lewin B. 2014. Genes XI. Oxford University Press. Oxford.
2. The Human Genome 2001, Nature Vol. 409.
3. The *Drosophila* Genome. 2000, Science Vol. 267.
4. The *Caenorhabditis elegans* genome 1998. Science Vol.282.
5. The Arabidopsis Genome 2000 Nature vol. 408.
6. Primrose, S. B., and R. M. Twyman. 2006. Principles of gene manipulation and Genomics, Blackwell Publishing MA.USA.

Semester V

21BCU513A MICROBIOLOGY AND INFECTIOUS DISEASES PRACTICAL **4H-2C**

Instruction hours/week: L:0 T:0 P:4 Marks: Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

- To explain the safety measures to handle the microorganism without contamination
- To identify the morphology of microbes that prevails in the environment.
- To teach the methods for isolation and characterization of microbes.
- Understand the economic importance of microorganisms.
- Know the steps involved in the infection of a pathogenic parasites
- Understand the methods to prevent/treat infections

Course Outcomes (CO's)

1. Explain the safety measures of microorganism handling - without contamination.
2. Interpret the morphological difference among the microbes isolated and identify their characteristic features
3. Analyze the reports of the staining and specificity of the microbes.
4. Apply microbes in the betterment of agriculture and industrial process
5. To explain the process of infection by pathogenic parasites
6. Students will know how to prevent/treat infections

Experiments

1. To study the principle and applications of important instruments (biological safety cabinets, autoclave, incubator, BOD incubator, hot air oven, light microscope, pH meter).
2. Preparation and sterilization of culture media for bacterial cultivation.
3. Study of different shapes of bacteria, fungi, algae, protozoa using permanent slides/pictographs.
4. Staining of bacteria using Gram stain.
5. Isolation of pure cultures of bacteria by streaking method.
6. Estimation of CFU count.
7. Permanent slides of pathogens. *Mycobacterium tuberculosis, Leishmania, Plasmodium falciparum*
8. WIDAL test
9. Acid- fast staining
10. PCR based diagnosis (Demo)
11. Dot Blot ELISA

EQUIPMENT REQUIRED:

ELISA, PCR

SUGGESTED READING

1. Atlas, R.M., (2007). Principles of Microbiology. 2nd edition. W M.T.Brown Publishers.
2. Pelczar, M.J, Chan, E.C.S., and Krieg, N.R., (1993). Microbiology. 5th edition. McGraw Hill Book Company.
3. Kannan, N., (2017). Laboratory Manual in Microbiology, Panima Publishing Corporation, Bangalore

Semester V

21BCU513B **MOLECULAR BASIS OF NON-INFECTIOUS DISEASES PRACTICAL** **4H-2C**

Instruction hours/week: L:0 T:0 P:4 **Marks:** Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course Objectives

Students will be able

- To study the biochemical principles and approaches practically.
- To analyze the context of human diseases and to get a clear idea on the biochemical-based treatments.
- Understand the biochemical causes of the diseases discussed
- Understand the current and future opportunities for biochemical-based therapeutics.
- To equip the students to understand, critically evaluate, analyze and interpret the basics of non-infectious diseases
- To develop skills in the interpretation of biochemical data used in the investigation and diagnosis of non-infectious disease

Course Outcomes (CO's)

After successful completion of the course, the student will:

1. Apply biochemical knowledge in normal and diseased states and have knowledge regarding the analysis of biological fluids for its chemical constituents and correlating the same in health and diseases.
2. Develop skills of performing biochemical and interpreting the data.
3. Gains knowledge of intermediary metabolism of the above and regulation of individual metabolism.
4. Possess knowledge of the impairment of metabolism, including inborn errors of metabolism
5. Understand the role of nutrition in health and disease
6. Students acquire the skills to perform phlebotomy and to estimate biomarkers to assess the vital organ functions.

Experiments

1. Glucose tolerance test – GCT and GTT
2. Lipid profile: triglycerides and total cholesterol, HDL, LDL Direct method, correlation.
3. Obesity parameters.
4. RBC counting and haemoglobin estimation.
5. Blood pressure measurements.
6. Bone density measurements (visit to a nearby clinic). Ca, ACP in Blood
7. T_4/TSH/T3 assays in normal and thyroid disease condition comparison – A case study

EQUIPMENT REQUIRED:

1. Auto analyzer

SUGGESTED READING

1. Devlin, T.M., (2011). Textbook of Biochemistry with Clinical Correlations, John Wiley & Sons, Inc. (New York), ISBN: 978-0-4710-28173-4.

2. Coico, R., and Sunshine, G., (2009). Immunology: A Short Course, 6th ed., John Wiley& sons, Inc (New Jersey), ISBN: 978-0-470-08158-7.

3. Berg, J.M., Tymoczko, J.L., and Stryer, L., (2012). Biochemistry, 7th ed., W.H Freeman and Company (New York), ISBN: 13:978-1-4292-7635-1.

4. Snustad, D.P., and Simmons, M.J., (2012). Genetics, 6th ed., John Wiley & Sons. (Singapore), ISBN: 978-1-118-09242-2.

Semester V

21BCU514A **FOOD BIOCHEMISTRY PRACTICAL** **4H-2C**

Instruction hours/week: L:0 T:0 P:4 Marks: Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

To impart hands-on training:

- To analyze the content of fat, moisture and ash present in the given foods
- To experiment the lipid extraction and measure the percent in the given sample
- To practice the calculations based on measuring amino acid quality indices
- To work on equipments such as soxhlet and muffle furnace
- To estimate important metabolites in the food sample
- To assess the quality of the food sample

Course Outcomes (CO's)

1. Determine the fat, moisture and ash content in the food samples
2. Assess the calculations on lactose content from the milk
3. Estimate lycopene and carotenes
4. Determine the acidity of the given sample
5. Quantify amino acids in the given sample
6. Assess the quality of food sample

LIST OF EXPERIMENTS

1. Estimation of moisture content in food material
2. Estimation of Ash content in food material
3. Analysis of Lactose content from the Milk
4. Analysis of Fat content by Soxhlet method of edible oilseeds.
5. Estimation of lycopene in tomato
6. Estimation of carotenes in a fruit/vegetable
7. Determination of Acidity by Titrimetric method
8. Estimation of amino acid by Ninhydrin method
9. Estimation of fiber content in food

EQUIPMENT REQUIRED:

- Soxhlet and Muffle furnace

SUGGESTED READINGS

1. Nelson DL and Cox MM. (2017). Lehninger Principles of Biochemistry. 7th Edition. W.H. Freeman Company.

2. Voet D, Voet JG and Pratt CW. (2016). Fundamentals of Biochemistry Life at the Molecular Level. 5thEdition.John Wiley and Sons.

3. Eastwood. M. (2003). Principles of Human Nutrition. 2nd Edition. Blackwell Publishing Company. ISBN 978-1-4899-3025-5

4. SunetraRoday. (2012). Food Science and Nutrition. 2nd Edition. Oxford Higher Education/ Oxford University Press.

5. Shubhangini AJ. (2015). Nutrition and Dietetics. 4th Edition. McGraw Hill education.

Semester V

21BCU514B MEMBRANE BIOLOGY AND BIOENERGETICS PRACTICAL **4H-2C**

Instruction hours/week: L:0 T:0 P:4 **Marks:** Internal: **40** External: **60 Total**: **100**

End Semester Exam: 3 Hours

Course Objectives

To impart hands-on training:

- To analyze the composition of lipids in animal cell (RBC)
- To analyze the composition of lipids in plant cell
- On CMC determination and its significance
- To separate the photosynthetic pigments using TLC
- On techniques related to isolation of membrane bound enzymes
- On techniques related to quantification of membrane bound enzymes

Course Outcomes (CO's)

After successful completion of the course, the student will:

1. Analyze the composition of lipids in animal cell (RBC)
2. Analyze the composition of lipids in plant cell
3. Determine CMC for the given sample
4. Separate the photosynthetic pigments using TLC
5. Isolate membrane bound enzymes
6. Perform quantification of membrane bound enzymes

Experiments

1. Effect of lipid composition on the permeability of a lipid monolayer.
2. Determination of CMC of detergents.
3. RBC ghost cell preparation and to study the effect of detergents on membranes.
4. Separation of photosynthetic pigments by TLC.
5. Isolation of mitochondria from liver and assay of marker enzyme SDH.
6. Study photosynthetic O_2 evolution in hydrilla plant.
7. Isolation of chloroplast from spinach leaves and estimation of chlorophyll.

EQUIPMENT REQUIRED:

Thin Layer Chromatography Chamber

SUGGESTED READING

1. Nelson, D.L. and Cox, M.M., (2013) Lehninger: Principles of Biochemistry 6th ed., W.H. Freeman and Company (New York), ISBN:13: 978-1-4641-0962-1 / ISBN:10:1-4641-0962-1.
2. Lodish, H., Berk, A., Kaiser, C.A., Krieger, M., Bretscher, A., Ploegh, H., Amon, A. and Scott, M.P., (2013). Molecular Cell Biology 7th ed., W.H. Freeman & Company (New York), ISBN:13: 978-1-4641-0981-2.
3. Garret, R. H. and Grisham, (2010). Biochemistry 4th ed., C.M., Cengage Learning (Boston), ISBN-13: 978-0-495-11464-2.
4. Voet, D.J., Voet, J.G. and Pratt, C.W., (2008). Principles of Biochemistry 3rd ed., John Wiley & Sons, Inc. (New York), ISBN:13: 978

Semester VI

21BCU601 DRUG BIOCHEMISTRY AND CLINICAL TOXICOLOGY **4H-4C**

Instruction hours/week: L:3 T:1 P:0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

Equip the students with:

- Definition and classification of drugs
- Basics of Pharmacokinetics of a drug
- Basics of Pharmacodynamics in living system
- Mechanism of action of drugs
- Toxicity assessment
- Drug abuse

Course Outcomes (CO's)

After successful completion, the students will understand

1. Definition and classification of drugs
2. Basics of Pharmacokinetics of a drug
3. Basics of Pharmacodynamics in living system
4. Mechanism of action of drugs
5. Toxicity assessment
6. Drug abuse

UNIT I: Introduction to drug Biochemistry

Classification, routes of administration – factors influencing dosage and drug action, Absorption and distribution of drugs. Pharmacogenetics. Origin of a drug from plants and animals.

UNIT II: Drug metabolism

Drug Biotransformation pathways - phase I – oxidation, reduction and hydroxylation. Phase II- Conjugation, Elimination of drugs from the body system. Storage of drugs in adipose tissue. Mechanism of drug action, the combined effect of drugs. Factors modifying drug action, tolerance and dependence.

UNIT III: Pharmacodynamics

Pharmacodynamics - receptor concepts, theory, drug receptor interaction (DRI), Factors affecting DRI, Cholinergic and anticholinergic drugs, Adrenergic and adrenergic blockers, General anesthetics, Local anesthetics. Adverse reactions to drugs and common drug receptor interactions.

UNIT IV: Therapies

Principles of therapeutics: Chemotherapy of microbial diseases, Chemotherapy of fungal infections, Chemotherapy of parasitic infections, rational use of antibiotics.

Application for New Drug Discovery (NDD) according to Indian Control Authority and USFDA guidelines. Ethical considerations in utilizing human subjects for drug discovery process. Helsinki's declaration.

UNIT V: Toxicology

Toxicology: Principles of toxicology and treatment of poisoning. Heavy metals and antagonists. Non-metallic environmental toxicants. Methods involved in the development of new drugs. Preclinical toxicological studies: Calculation of LD50 and ED50.Acute, subacute and chronic toxicity studies; Irwin profile test, Pre-clinical pharmacokinetic and dynamic studies. Lipinski's rule for drug like molecule, High throughput screening (*in-vitro* and *in-vivo*) for pre-clinical pharmacokinetic and pharmacodynamic studies.

SUGGESTED READING

1. Satoskar, R.S and Bhandarkar, S.D. (2000) Pharmacology and Pharmacotherapeutics, 13th edition, Vol. I and II, Popular Prakeshan PVT Ltd, Mumbai.
2. Tripathi, K.D. (2013) Essentials of Medical Pharmacology, 7th edition, Jaypeebrothers medical publishers, New Delhi.
3. Rang, H.P., Dale, M.M., Ritter, J. and Flower, R.J. (2007) Pharmacology, 6th edition, Churchill Living Stone Elsevier.
4. Barar, F.S.K. (2013) Text Book of Pharmacology, 1st edition, S. Chand and Company Pvt. Ltd.
5. Shargel, L. et al., (2012). Applied Biopharmaceutics and Pharmacokinetics, 6th Edition, McGraw-Hill Medical.

Semester VI

21BCU602A **RECOMBINANT DNA TECHNOLOGY** **3H-3C**

Instruction hours/week: L:3 T:0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course Objectives

Equip the students with:

- Basic knowledge about vectors and their types
- The understanding of gene cloning
- The knowledge about restriction modification systems
- The knowledge about restriction enzyme types and cDNA production
- The knowledge of blotting techniques
- The knowledge for electrophoresis and genomic library

Course Outcomes (CO's)

1. Able to explain the types of vectors
2. Explain the role of restriction enzymes and its applications
3. Explain the way of construction of genomic DNA and cDNA
4. Understand the toxicity principles of drug
5. Understand the construction of genomic libraries
6. Understand the blotting methods in DNA transfer

UNIT I: Introduction to Gene Manipulation

Milestones in genetic engineering and biotechnology. Simple cloning of DNA fragments, Vectors: Definition and properties. Transformation of DNA by chemical method and electroporation. **Vectors:** Cloning Vectors- Definition and Properties. Plasmid vectors-pBR and pUC series, Bacteriophage lambda and M13 based vectors. Cosmids. Shuttle vectors. BACs, YACs, MACs.

UNIT II: Gene Cloning Vectors

Agrobacterium-mediated delivery *E. coli* strains; Yeast (*Saccharomyces cerevisiae, Pichiapastoris*); Fungi (*Penicillium, Aspergillus*); Mammalian cell lines – names and genotypes. Restriction modification systems: Types I, II and III. Mode of action, nomenclature. Application of Type II restriction enzymes in genetic engineering.DNA modifying enzymes and their applications.

UNIT III: Recombinant Techniques

Restriction endonucleases, ligases, phosphatases, methylases, kinases. Cloning vehicles, plasmids, cosmids, phage vectors, Shuttle vectors Baculovirus vector system, expression vectors, expression cassettes. Construction of genomic and cDNA libraries. Microinjection, biolistic method (gene gun), liposome and viral-mediated

delivery, *Agrobacterium*-mediated delivery Polymerase chain reaction – enzymes used, primer design.

UNIT IV: Blotting Techniques

Agarose gel electrophoresis, Southern – and Northern – blotting techniques, dot blot and colony hybridizations. Chromosome walking and jumping. DNA fingerprinting by RFLP and RAPD. SDS-PAGE and Western blotting. Phage display. Cloning PCR products. RT-PCR and principles of real time PCR.Ligation chain reaction. Gel retardation assays. DNA footprinting by DNase I, DNA microarray analysis.

UNIT V: Construction of genomic libraries

Genomic and cDNA libraries: Preparation and uses. Screening of libraries by colony hybridization and colony PCR.
DNA sequencing and product of DNA technology: Maxam-Gilbert's and Sanger's method. Automated sequencing. Human genome sequencing project. Bt transgenics-rice, cotton, brinjal, Human protein replacements-insulin, hGH and Factor VIII. Human therapies – tPA, interferon, antisense molecules.

SUGGESTED READINGS

1. Brown TA. (2012). *Gene Cloning and DNA Analysis*. 5th edition. Blackwell Publishing, Oxford, U.K

2. Primrose SB and Twyman RM. (2006). *Principles of Gene Manipulation and Genomics*, 7th edition. Blackwell Publishing, Oxford, U.K.

3. Sambrook J, Fritsch EF and Maniatis T. (2010). *Molecular Cloning-A Laboratory Manual*. 3rd edition. Cold Spring Harbor Laboratory Press.

Semester VI

21BCU602B BIOSTATISTICS AND RESEARCH METHODOLOGY 3H-3C

Instruction hours/week: L:3 T:0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

By taking up this course the student will be able to

- Study the data collection and various ways of representation of data in an easily understandable way.
- Learn various measures of central values and standard deviation.
- Understand the relationship between two variables.
- Test the significance of particular data by various parameters.
- Understand the concept of research like writing of an article
- Make them understand data analysis and motivate them to take up research in their career.

Course Outcomes (CO's)

After completing this course the student will be able to

1. Analyze and understand the appropriate methods of collection of data
2. Analyze the data and represent it in an easily understandable way.
3. Measure central tendency and standard deviation of the data.
4. Analyze the data and study the relationship between data and test the significance of data interpretation.
5. Develop skills in writing and learning of an article.
6. Equipped to pursue research as a career.

UNIT I: Introduction to Biostatistics

Definitions-Scope of Biostatistics- Variables in biology, sources of data, collection, classification and tabulation of data- Graphical and diagrammatic representation. Measures of central tendency – Arithmetic mean, median and mode. Measures of dispersion-Range, standard deviation, Coefficient of variation.

UNIT II: Correlation

Correlation – Meaning and definition - Scatter diagram –Karl Pearson's correlation coefficient. Rank correlation. Regression: Regression in two variables – Regression coefficient problems – uses of regression.

UNIT III: ANOVA

Test of significance: Testing of hypothesis, Errors in hypothesis testing, Standard errors. Tests based on means only-Both Large sample and Small sample tests. Chi square test - goodness of fit; Analysis of variance – one way and two way classification.

UNIT IV: Introduction to Research Methodology

Introduction to Research Methodology - Objectives and motivation in research. Defining the Research Problem - Selecting and defining a research problem, reviewing and conducting a literature search, developing a research plan. Research Designs – Features of good designs.

UNIT V: Scientific Writing

Writing a research article - abstract, introduction, methodology, results and discussion. Reference formatting styles, Harvard and Vancouver systems. Citation styles – APA and MLA. Introduction to journals and types of publications, research article, review article, short communication, letter to the editor. Plagiarism. Impact factor – citation index and H index. IPR, patents.

SUGGESTED READINGS

1. Jerrold H.Z., (2003). Biostatistical Analysis, Fourth Edition, Pearson Education (Pvt). Ltd., New Delhi.
2. Pillai R.S.N., and Bagavathi V., (2020). Statistics, S. Chand & Company Ltd, New Delhi.
3. Navnitham, P.A., (2004). Business Mathematics and Statistics, Jai Publications, Trichy,
4. Gupta S.P., (2012). Statistical methods, Sultan Chand & Sons, New Delhi.
5. At the Bench: A Laboratory Navigator (2005) Barker, K., Cold Spring Harbor Laboratory Press (New York), ISBN: 978-087969708-2. 51
6. Research Methodology - Methods and Techniques (2004) 2nd ed., Kothari C.R., New Age International Publishers.
7. Research Methodology: A Step-by-Step Guide for Beginners (2005) 2nd ed., Kumar R., Pearson Education.
8. Biostatistics: A Foundation for Analysis in the Health Sciences (2009) 9th ed., Daniel W.W., John Wiley and Sons Inc.
9. Statistics at the Bench: A Step-by-Step Handbook for Biologists (2010) Bremer, M. & Doerge, R.W., Cold Spring Harbor Laboratory Press (New York), ISBN: 978-0-879698- 57-7.

Semester VI

21BCU603A **BIOENTREPRENEURSHIP** **4H-4C**

Instruction hours/week: L:4 T:0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

To make the students

- To Understand the meaning, scope and importance of Entrepreneurship
- To Understand the Concept of entrepreneurship, types of entrepreneurs, entities of business, creating ideas, mobilizing funds and support from the government.
- To communicate orally and in written form the Concept of entrepreneurship, types of entrepreneurs, entities of business,
- To creating ideas, mobilizing funds and support from the government.
- To apply the understanding of entrepreneurship, types of entrepreneurs, entities of business, creating ideas, mobilizing funds and support from the government in lifelong practice.
- To understand the concept, role and functions of business incubators

Course Outcomes (CO'S)

After completing this course the student will be able to

1. Understand the Concept of entrepreneurship, entities of business, creating ideas, mobilizing funds and support from the government.
2. Communicate orally and in written form the Concept of entrepreneurship, types of entrepreneurs, entities of business, creating ideas, mobilizing funds and support from the government.
3. Apply the understanding of entrepreneurship, types of entrepreneurs, entities of business, creating ideas, mobilizing funds and support from the government in lifelong practice.
4. Students can create ideas, mobilizing funds and get support from the government.
5. Students can apply the understanding of entrepreneurship, types of entrepreneurs, entities of business, creating ideas, mobilizing funds and support from the government in lifelong practice.
6. Students can understand the concept, role and functions of business incubators

UNIT I: Introduction:

Meaning, scope and importance of Entrepreneurship - Evolution of entrepreneurial thought - Entrepreneurship as a career option - Functions of Entrepreneurs - Entrepreneurial Characteristics and Skills - Entrepreneur vs. Manager - Creativity & Creative Process - Types of Entrepreneurs (Clarence Danhoff's Classification) - Intrapreneurship – Concept and Types (Hans Schollhammer's Classification) - Entrepreneurship in different contexts: technopreneurship, cultural entrepreneurship, international entrepreneurship, netpreneurship, ecopreneurship, and social entrepreneurship

UNIT II: Types of business entities

Micro, Small and Medium Enterprises. Concept of business groups and the role of business houses and family business in India. Values, business philosophy and behavioural orientations of important family business in India. Managerial roles and functions in a small business. Entrepreneur as the manager of his business.

UNIT III: Public and private system of stimulation, support and sustainability of entrepreneurship

Public and private system of stimulation, support and sustainability of entrepreneurship. Requirement, availability and access to finance, marketing assistance, technology, and industrial accommodation, Role of industries/entrepreneur's associations and self-help groups. The concept, role and functions of business incubators, angel investors, venture capital and private equity funds

UNIT IV: Sources of business ideas and feasibility studies

Sources of business ideas and tests of feasibility. Significance of writing the business plan/ project proposal. Contents of business plan/ project proposal. Designing business processes, location, layout, operation, planning & control; preparation of project report. Project submission/ presentation and appraisal thereof by external agencies, such as financial/non-financial institutions.

UNIT V: Mobilizing resources for start-up

Mobilizing resources for start-up. Accommodation and utilities. Preliminary contracts with the vendors, suppliers, bankers, principal customers; Contract management: Basic start-up problems. Funding opportunities for start-ups.

Marketing and organizational plans-an overview. Nature of planning in small business. Organizational structure suitable for small business. Financial: preparation of budgets, integrated ratio analysis, assessing business risks (leverage analysis). Marketing: product planning & development, creating and protecting market niche, sales promotion, advertising and product costing and pricing policies. HR issues in small business.

SUGGESTED READINGS:

1. Robert Hisrich and Michael Peters and Dean Shepherd (2018), Entrepreneurship, 10th Edition, McGraw Hill, New Delhi.
2. David H. Holt (2016), Entrepreneurship, 1st Edition, Pearson Education, New Delhi.
3. Sangeetha Sharma (2017), Entrepreneurship Development, PHI Learning Pvt Ltd., New Delhi.
4. Poornima M., Charantimath (2018), Entrepreneurship Development and Small Business Enterprises, 3rd edition, Pearson Education, New Delhi
5. S.S. Khanka (2012), Entrepreneurial Development, S. Chand, New Delhi.

21BCU603B **STEM CELL AND CANCER BIOLOGY** **4H-4C**

Instruction hours/week: L:4 T:0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course Objectives

Equip the students to:

- Understand the basics of stem cells function in the body and for their usage in medical contexts
- Acquire knowledge to analyze the complexity of cancer
- To know the various modalities of cancer treatment
- To understand the distinction between normal cell and cancer cell
- Understand the methods for the development of regenerative medici**n**e
- Understand the causes and molecular changes of cancer cell

Course Outcomes (CO's)

On completion of the course, the student should be able to:

1. Acquired basic knowledge of classification, characterization, differentiation.
2. And dedifferentiation and basic culture procedures of stem cells.
3. Apply the knowledge of stem cell to cure various neurodegenerative diseases, cancer and aging.
4. Understand the cancer types, causes and molecular changes that occur in of cancer cell.
5. Explain the cell cycle disturbance and the fate of apoptosis during cancer.
6. Acquire depth analysis of cancer and its therapeutic approaches.

UNIT I: Stem cell basics

Definition, Classification, characteristics, Differentiation and dedifferentiation, Basic culture procedures – Isolation, culture methods, identification, stem cell markers, feeder layer; Instrumentations in stem cell biology.

Different kinds of stem cells –Embryonic stem cells, Embryonic Germ cells, Hematopoietic stem cell, Adult Stem cells-stem cell niche, muscle and cardiac stem cells, Umbilical cord blood stem cells, cancer stem cells, Neural stem cells, Mesenchymal stem cells, Induced pluripotent Stem cells. Cell cycle checkpoints in a changing cell cycle and their relationship to stem cells.

UNIT II: Therapeutic applications

Organ on a chip *In vitro* Synthesis of Tissues and Organs. Immune based isolation techniques, Modes of Cell and Tissue Delivery. Current stem cell therapies, stem cells and neurodegenerative disorders, stem cells and diabetes, stem cells and cardiac disorders, stem cells cancer relapse & resistance, Stem cells and aging. Hematopoietic stem cells and their clinical application. Treatment of neural diseases (Parkinson's disease, Huntington's disease and Alzheimer's disease).

UNIT III: Regenerative Therapy

Introduction to regenerative medicine. Regeneration of Bone and Cartilage, Islet Cell transplantation and Bioartificial Pancreas, Bioprinting of Organs and Tissues, Stem Cells in

Gastrointestinal, Liver, Pancreas, Kidney, Heart, Spinal Cord and Lung Regeneration Stem Cells in Eye Diseases and Disorders, Stem cell banking, Engineered Tissues and Regenerative Medicine Molecular therapy for regeneration.

UNIT IV: Cancer

Cancer- definition, hallmarks of cancer, Distinction between normal cell and cancer cell, cytological changes in cancer cells, Molecular changes in cancer cells, Genetic changes in cancer cells, Types of cancer, development of cancer, causes of cancer, properties of cancer cells.

HBV, HPV, *H. pylori* mediated oncogenesis, Role of growth factors and receptors in carcinogenesis, Retroviral oncogenes, protooncogenes, tumor suppressor genes -P53 and Rb and their functions.

Regulation of cell cycle check point kinases and the role of cyclins and CDKs.

UNIT V : Cancer therapies

Cell death: Types of cell death-apoptosis, necrosis and others. Apoptosis during the developmental process and irregular apoptosis and disease. Death causing genes – Ceds, proteins – Caspases, mechanism of programmed cell death (PCD), Pathways of apoptosis-intrinsic and extrinsic.

Tumor immunity–IL-2 & IF-γ

Treatment of cancer: Early detection of cancer, molecular diagnosis, treatment – 4 R's of radio biology, radio therapy, chemotherapy, immunotherapy and use of RNAi techniques and stem cells.

Emerging therapies --- Monoclonal antibody & tyrosine kinase inhibition Targeted delivery & Synthetic lethal approaches, CAR T-cell therapy

SUGGESTED READINGS

1. Robert Lanza, John Gearhart, Brigid Hogan (2009). Essentials of Stem cell Biology, 2nd edition, Academic Press, Cambridge.
2. Daniel R. Marshak, Richard L. Gardner, David Gottlieb Stem Cell Biology (2002). Cold Spring Harbor Laboratory Press.
3. Lodish, H., Berk, A., Kaiser, C.A., and Krieger, M., (2015). Molecular Cell Biology, 8th edition. W.H. Freeman & Company, London
4. Anthony Atala, James A. Thomson (2007). Principles of Regenerative Medicine, 1st edition Academic Press; Cambridge.
5. Atala A. (2009). Foundations of Regenerative Medicine: Clinical and Therapeutic Applications. 1st edition Academic Press, Cambridge.
6. Hossein Baharv and, Nasser Aghdami (2013). Regenerative Medicine and Cell Therapy (Stem Cell Biology and Regenerative Medicine). Humana Press
7. David L. Stocum. (2012) Regenerative Biology and Medicine, Second Edition. Academic Press, Cambridge.
8. Turdo A, Gaggianesi M, Chinnici A, Stassi G, Todaro M (2020). Cancer stem cells: From birth to death. In: cancer stem cell resistance to target therapy, Cristina M, Maltide T, Soldano F (EDS) 2020, Springer International Publishing.

Semester VI

21BCU611 **DRUG BIOCHEMISTRY AND CLINICAL TOXICOLOGY PRACTICAL** **4H-2C**

Instruction hours/week: L:0 T:0 P:4 **Marks:** Internal: **40**External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

Equip the students:

- To give insight on the emerging themes, and provides an in-depth analysis of specific drug classes, its metabolism and therapeutic approaches.
- To understand the use of animals in standardization of drugs.
- To understand the toxicity of the drug
- Handling of small experimental animals
- Enteral and parenteral route of drug administration
- Assessment of behavioral changes

Course Outcomes (CO's)

After successful completion, the students will understand

1. Demonstrate the importance of chemistry in the development and application of therapeutic drugs.
2. Develop an understanding of the physico-chemical properties of drugs.
3. Understand how current drugs were developed and how new scientific techniques will lead to the development of new drugs.
4. Handle small experimental animals such as rats, mice and rabbits
5. Learn Enteral and parenteral route of drug administration
6. Learn to assess behavioral changes

Experiments

1. Handling of small experimental animals
2. Route of drug administration – Oral and parenteral
3. Behavioural Changes upon drug Adminstration
4. Hydroxylation of the drug by liver homogenate and spectrophotometric/ spectrofluorometric detection
5. Therapeutic drug monitoring: detection of tricyclic antidepressants in serum.
6. Immunochromatographic assay for the detection of drugs of abuse.
7. Card test for drug abuse detection
8. Breath Test for Alcohol Abuse.
9. Case study of incidence, effects and management of substance abuse at the individual and at the community level (Visit to rehabilitation centre)
10. LD_{50} Determination
11. Brine shrimp assay

EQUIPMENT REQUIRED

1. Colorimeter

SUGGESTED READING

1. Hamilton, D., Philips, R.J., and Scott, D., (2010). Occupational, Industrial and Environmental Toxicology, Moshy Inc Publishers.

2. Berg, G.M.I., Hendrickson R.G., and Morocco, A., (2015). Medical Toxicology Review. McGraw Hill Medical Publishing Company.

3. Foye, W., (2012). Principles of Medicinal Chemistry, 7th edition, B.I. Wanerly Pvt. Ltd, New Delhi.

4. Grahame-Smith, D.G., and Aronson, J.K., (2002). Oxford textbook of Clinical Pharmacology and Drug Therapy: 3rd edition. Oxford University Press.

5. Tripathy, K.D., (2020). Essentials of Medical Pharmacology, Jaypee brothers medical publishers, New Delhi.

6. Goodman & Gilman's, (2018). The pharmacological basis of therapeutics, Brunton, L. L., Chabner, B., Knollmann, B. C., (Eds.), McGraw Hill Medical.

Semester VI

21BCU612A **RECOMBINANT DNA TECHNOLOGY PRACTICAL** **3H-1C**

Instruction hours/week: L:0 T:0 P:3 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

This course is planned to give hands-on training in recombinant DNA technology

- To know the Preparation of competent *E.coli* cells
- To know the isolation of genomic DNA from plant, animal cells & from bacteria
- To acquire transformation of *E. coli* with recombinant DNA.
- To perform Selection & screening of rDNA products – Antibiotic resistance, Blue white colony.
- To understand PCR amplification and blotting techniques.
- To understand Southern RAPD and RFLP.

Course Outcomes (CO's)

On completion of this course the students are able to

1. Prepare competent of *E. coli* cells
2. Acquire practical skills pertaining to Transformation of *E. coli* with recombinant DNA.
3. Selection & screening of rDNA products – Antibiotic resistance, Blue white colony.
4. PCR amplification
5. Southern blot and northernblot.
6. Perform RAPD and RFLP

List of experiments

1. Isolation of genomic DNA from plant, animal cells & from bacteria
2. Isolation of plasmid DNA from *E. coli*
3. Size analysis of plasmids by agarose gel electrophoresis
4. Restriction digestion – single & double digestion.
5. Preparation of competent *E. coli* cells
6. Transformation of *E. coli* with recombinant DNA.
7. Selection & screening of rDNA products – Antibiotic resistance, Blue white colony.
8. PCR amplification
9. Southern blot and Northern blot. (Demo)
10. RAPD (Demo)
11. RFLP (Demo)

EQUIPMENT REQUIRED

1. Thermocycler

SUGGESTED READING

1. J. Sambrook and D.W. Russel. 2001. Molecular Cloning: A Laboratory Manual, Vols 1-3.CSHL.
2. T.A. Springer. 2011. Hybridoma Technology in the Biosciences and Medicine. Plenum Press New York.
3. *Judith W. Zyskind and Sanford I. Bernstein*, Recombinant DNA Laboratory Manual. Academic press, 2014.

BIOSTATISTICS AND RESEARCH METHODOLOGY PRACTICAL

Instruction hours/week: L:0 T:0 P:3 **Marks:** Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course Objectives

By taking up this course the student will be able to

- Learn the statistical tools utilized for the interpretation of research data by using SPSS package.
- Understand the basics of research projects and to know about the patents search databases.
- Measures of central tendency
- Coefficient of variation
- Correlation analysis
- Regression analysis

Course Outcomes (CO's)

After completing this course, the student will

1. Have thorough understanding and application of SPSS package for research data interpretation
2. Be motivated and directed to continue their research in a productive way
3. Be motivated to apply projects for funding agencies
4. Be able to file patents in the respective fields.
5. Execute Correlation analysis
6. Perform Regression analysis
7. Perform RANK correlation test

EXPERIMENTS

1. Mean for individual, discrete and continuous series using SPSS Package.
2. Median for individual and discrete and continuous series using SPSS Package.
3. Mode for individual, discrete and continuous series using SPSS Package.
4. Standard deviation and Coefficient of variation for individual and discrete series using
5. SPSS Package.
6. Karl Pearson's Correlation and Rank Correlation Coefficient (Untied / tied) using SPSS Package.
7. The teacher should guide the student to identify a topic of mutual interest, collect the literature, collate the information and write the same in the form of a term paper with proper incorporations using different styling systems.
8. The student will identify the scope of research on the topic and will frame objectives to be addressed in the project through a work plan.
9. The student will write standard operating protocols (SOPs) and identify the requirement for equipment and reagents. And trained to write results, discussion and conclusion pertaining to their topic.
10. Each student will be asked to make a presentation about the project including literature available, objective sought and work plan including methodologies as described above.
11. Patent search in USPTO, Espacenet, WIPO and InPASS databases (demo).

SOFTWARE REQUIRED

1. SPSS
2. ANOVA

SUGGESTED READING

10. Jerrold H.Z., (2003). Biostatistical Analysis, Fourth Edition, Pearson Education (Pvt.,) Ltd., New Delhi.
11. Pillai R.S.N., and Bagavathi V., (2019). Statistics, S. Chand & Company Ltd, New Delhi.
12. Gupta S.P., (2012). Statistical methods, Sultan Chand & Sons, New Delhi.
13. Barker, K., (2005). At the Bench: A Laboratory Navigator: Cold Spring Harbor Laboratory Press (New York), ISBN: 978-087969708-2. 51
14. Research Methodology - Methods and Techniques (2004). 2nd ed., Kothari C.R., New Age International Publishers.
15. Research Methodology: A Step-by-Step Guide for Beginners (2005). 2nd ed., Kumar R., Pearson Education.
16. Biostatistics: A Foundation for Analysis in the Health Sciences (2009). 9th ed., Daniel W.W., John Wiley and Sons Inc.
17. Statistics at the Bench: A Step-by-Step Handbook for Biologists (2010). Bremer, M. & Doerge, R.W., Cold Spring Harbor Laboratory Press (New York), ISBN: 978-0-879698- 57-7.
18. SPSS Package version 16.0

Semester VI

21BCU613A **BIOENTREPRENURSHIP PRACTICAL** **4H-2C**

Instruction hours/week: L:0 T:0 P:4 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

To make the students

- To understand the concept of entrepreneurship, idea creation, starting up new ventures, business plan and applying for funding and patent.
- To analyse the case studies and try to apply the theoretical learning into a lifelong practice.
- To critically evaluate the appropriate alternatives available as an entrepreneur and draw a solution.
- Communicate in oral and written form and prepare a business plan and the report.
- Work in a team and exhibit leadership skills

Course Outcomes (CO'S)

Learners should be able to

1. Understand the concept of entrepreneurship, idea creation,
2. Understand the concept of starting up new ventures, business plan and applying for funding and patent.
3. Analyse the case studies and try to apply theoretical learning into a lifelong practice.
4. Critically evaluate the appropriate alternatives available as an entrepreneur and draw a solution.
5. Communicate in oral and written form and prepare a business plan and the report.
6. Work in a team and exhibit leadership skills

Experiments:

1. To select a company and Visit the Entrepreneur and collect the details regarding their Entrepreneurial Qualities like Risk taking ability, Personality qualities, Creativity and innovation initiatives in product or services. Prepare a case study or Video case on the Entrepreneur. (TEAM PROJECT 2-3 numbers)
1. To study on any one Family business house in India and enumerate on the growth.
2. To study on Generation Entrepreneurship and how they did success planning
3. To study the social entrepreneurship venture with a successful case study.
4. To study on the various association available for the support of the entrepreneurship in a particular industry
5. To study various sources of funding including venture capital and procedure to procure support.
6. Visit a bank and understand the procedure and documents for applying for corporate loan
7. Select a business Idea and Draft a Business Plan for a business idea (TEAM PROJECT 2-3 numbers)
    - Market feasibility
    - Technical feasibility
    - Management feasibility
    - Financial feasibility

8. Procedure for opening a Start ups and the government support to start- up initiatives.
9. Procedure for applying for IPR and Patent.

EQUIPMENT REQUIRED
COMPUTER

SUGGESTED READINGS:

1. Robert Hisrich and Michael Peters and Dean Shepherd (2018), Entrepreneurship, 10th Edition, McGraw Hill, New Delhi.
2. David H. Holt (2016), Entrepreneurship, 1st Edition, Pearson Education, New Delhi.
3. Sangeetha Sharma (2017), Entrepreneurship Development, PHI Learning Pvt Ltd., New Delhi.
4. Poornima M., Charantimath. (2018), Entrepreneurship Development and Small Business Enterprises, 3rd edition, Pearson Education, New Delhi
5. S.S. Khanka. (2012), Entrepreneurial Development, S. Chand, New Delhi.

Semester VI

21BCU613B **STEM CELL AND CANCER BIOLOGY PRACTICAL** **4H-2C**

Instruction hours/week: L:0 T:0 P:4 **Marks:** Internal: **40** External: **60 Total**: **100**

End Semester Exam: 3 Hours

Course Objectives

To impart hands on training on

- Basic techniques of stem cell isolation and its culturing methods
- Prevention of contamination in culture
- Histochemical analysis of cancer marker
- The applications of regenerative medicine
- Understanding the causes and molecular changes of cancer cell
- Acquiring knowledge to analyse the complexity of cancer

Course Outcomes

On completion of course the students will

1. Acquire practical skills pertaining **to** stem cell isolation and its maintenance
2. Acquaint knowledge on prevention of contamination in culture
3. Perform histology and methods of analysis of cancer
4. Differentiate normal cell and cancer cell
5. understand the importance of regenerative medicine
6. Acquired basic knowledge of classification, characterization, differentiation, dedifferentiation and basic culture procedures of stem cells.

List of experiments

1. Isolation and Culture of Hematopoietic Stem cells
2. Isolation and Culture of Mesenchymal Stem cells
3. Differentiation of Pluripotent stem cells
4. Case Reports in Regenerative Medicine applications - discussion
5. Establishment of primary cancer line
6. Histochemical analysis of cancer marker in any one cancer

EQUIPMENT REQUIRED

1. CO2 INCUBATOR
2. AUTOCLAVE

SUGGESTED READINGS

1. Robert Lanza, John Gearhart, Brigid Hogan (2009). Essentials of Stem cell Biology, 2nd edition, Academic Press, Cambridge.

2. Daniel R. Marshak, Richard L. Gardner, David Gottlieb Stem Cell Biology (2002). Cold Spring Harbor Laboratory Press.

3. Lodish, H., Berk, A., Kaiser, C.A., and Krieger, M., (2015). Molecular Cell Biology, 8th edition. W.H. Freeman & Company, London

4. Anthony Atala, James A. Thomson (2007). Principles of Regenerative Medicine, 1st edition Academic Press; Cambridge.

5. Atala A. (2009). Foundations of Regenerative Medicine: Clinical and Therapeutic Applications. 1st edition Academic Press, Cambridge.

6. Hossein Baharvand, Nasser Aghdami. (2013). Regenerative Medicine and Cell Therapy (Stem Cell Biology and Regenerative Medicine). Humana Press

7. David L. Stocum. (2012) Regenerative Biology and Medicine, Second Edition. Academic Press, Cambridge.

8. Turdo A, Gaggianesi M, Chinnici A, Stassi G, Todaro M (2020). Cancer stem cells: From birth to death. In: cancer stem cell resistance to target therapy, Cristina M, Maltide T, SoldanoF(EDS) 2020, Springer International Publishing.

Semester VI

21BCU691 **PROJECT WORK** **8H-6C**

Instruction hours/week: L:2 T:0 P:6 **Marks:** Internal: **40** External: **60** Total: **100**