KARNATAK UNIVERSITY, DHARWAD

Regulations and Syllabus (Revised) For M.Sc. Course

In

BIOCHEMISTRY (I to IV Semesters)

Under Choice Based Credit System (CBCS)

From
2019-20 onwards

Regulations Governing Post-Graduate Programmes in the Faculty of Science and Technology Under Choice-Based Credit Scheme (CBCS)
(*framed under Section 14(1)(c) of K.S.U. Act,2000)*

1.0 Title
These Regulations shall be called "Regulations "governing the Post-Graduate Programmes in the Faculty of Science & Technology under the Choice Based Credit System" in Karnatak University, Dharwad.

2.0 Commencement

These Regulations shall come into force with effect from the academic year 2018-19

3.0 Definitions

a In these Regulations, unless otherwise provided: "Academic Council" means Academic Council of the University constituted according to the *Karnatak State Universities Act, 2000.*

b " Board of Studies" means P.G. Board of Studies of the University, Adhoc/Combined and Steering Committees of International Diploma Programmes in the discipline/subjects concerned.

c. "Compulsory Course" means fundamental paper, which the student admitted to a particular Post-Graduate Programme, should successfully complete to receive the Post Graduate Degree in the concerned subject.

d Course Weightage" means number of credits assigned to a particular course.

e. "Credit means the unit by which the course work is measured. One Credit means one hour of teaching work or two hours of practical work per week. As regards the marks for the courses, 1 credit is equal to 25 marks, 2 credits are equal to 50 marks, 3 credits are equal to 75 marks and 4 credits are equal to 100 marks.

f "Cumulative Grade point Average (CCPA)" refers to the cumulative Grade Point Averages weighted across all the semesters and is carried forward from first semester to subsequent semesters.

g. "Degree" means Post-Graduated Degree.

h " Grade" is an index to indicate the performance of a student in the selected course. These Grades are arrived at by converting marks scored in each course by the candidate in both Internal Assessment and Semester-end Examinations.

i " Grade Point Average (GPA)" refers to an indication of the performance of the student in a given semester. GPA is the weighted average of all Grades a student gets in a given semester.

j. "Open Elective Course" means a paper offered by a Department to the students of other Departments.

k. "Post-Graduate Programme" means semesterised Master's Degree Programmes excluding P.G. Diploma.

l. " Specialization course means advanced paper offered by a Department that a student of that Department can opt as a special course.

m. "Student" means the student admitted to programmes under (k).

n. " University" means Karnatak University, Dharwad.

4.0 Minimum Eligibility for Admission

A candidate, who has successfully completed Bachelor's Degree programme in Science or any other Degree programme of this University or of any other University recognized as equivalent thereto by this University, shall be eligible for admission to the Post GrduateProgrammes in science provided the candidate also satisfies the conditions like the minimum percentage of marks and other eligibility conditions as prescribed by the University from time to time.

Admissions shall be as per Government of Karnatak reservation policy and the directions issued in this regard from time to time.

5.0 Durations of the Programme

The Durations of the study for the Post-Graduate programme shall extended over a period of two (three in case of MCA) consecutive academic years, each academic year comprising two semesters, and each semester comprising sixteen weeks with a minimum of ninety working days.

However, the students, who discontinue the programme after one or more semesters due to extraordinary circumstances, are allowed and complete the programme with due approval from the Registrar. Candidate shall not register for any other regular course other than Diploma and Certificate courses being offered on the campus during the durations of P.G. Programme.

6.0 Medium of Instruction and Evaluation

The medium of instruction shall be English. However, the students may write the examinations in Kannada if so provided by the concerned Board of Studies.

7.0 Programme Structure

7.1 The students of Post-Graduate programme shall study the courses as may be approved by the concerned Board of Studies. Faculty and the Academic Council of the University from time to time subject to minimum and maximum credits as outlined in these regulations.

7.2 There shall be three categories of courses namely, Compulsory Courses. Specialization courses and Open Elective Courses.

7.3 Each programme shall have a set of Compulsory Courses, as stipulated in the regulations governing the concerned programme, that a student must complete to get the concerned degree.

7.4 In those programmes that offer specialization courses, the students shall choose the prescribed number of Specialization Courses offered within the Department.

7.5 Each Department shall offer Open Elective courses for students of other Departments. The students of a Department shall choose Open Elective courses from among those prescribed by the University and selected by the Department from time to time. P.G. Centres and affiliated colleges, can offer those Open Electives Courses which are approved of prescribed by their Parent Department of the University. Such Open Elective courses shall be taught by qualified teachers approved by the University.

7.6 The credits for each of the Compulsory Courses may vary from 2 to 4: for Specialization Course, from 2 to 4 and for Open Elective Course, from 2 to 4, wherever project work/field work/practical are involved in the course, the credits may extend to 6 or as otherwise provided by concerned programme.

7.7 The minimum credits for P.G. Programme shall be 96. In the case of MCA, the minimum number of credits shall be 158 and in case of M.Sc. Computer Science the minimum credits are 116.

7.8 The students shall undertake project/field work during the programme as compulsory course or in lieu of Specialization Course or Open Elective Course if so specified by concerned Board of Studies.

7.9 The ratio between Compulsory, Specialization and Open Elective may differ from department to department

7.10 The detailed programme structure for Faculty of Science & Technology shall be as prescribed and shown in Annexure-I, Annexure-Ia& Annexure-Ib

7.11 The Open Elective Courses generally will have practical component, unless otherwise specified by the respective Board of Studies. The number of students admitted to the course shall commensurate with the availability of infrastructure.

8.0 Attendance

8.1 Each course shall be taken as a unit for the purpose of calculating the attendance.

8.2 Each student shall sign the attendance register maintained by the Department for each course for every hour/unit of teaching /practical. The course teachers shall submit the monthly attendance report to the Chairperson of the Department who shall notify the same on the notice board of the Department during the second week of the subsequent month.

8.3 Marks shall be awarded to the student for attendance as specified in the regulations concerning evaluation.

8.4 A student shall be considered to have satisfied the required attendance for each course if he/she has attended not less than 75% of the total number of instructional hours during the semester.

8.5 There is no provision for condoning shortage of attendance.

8.6 The students who do not satisfy the prescribed requirement of attendance shall not be eligible for the ensuing examination. Such candidates may seek admission a fresh to the given semester.

8.7 Such of the candidates who have participated in State/National level Sports, NSS, NCC, Cultural activities and other related activities as stipulated under the existing regulations shall be considered for giving attendance for actual number of days utilized in such activities (including travel days) subject to the production of certificates from the relevant authorities within two weeks after the event.

9.0. **Examination**

9.1 There shall be an examination at the end of each semester. The odd semester examinations shall be conducted by the respective Departments/P.G. Centres/Colleges. The even semester examinations shall be conducted by the University.

9.1.1 Unless otherwise provided, there shall be semester-end examination of 3 hours duration for 75/100 marks; 1.5 hours for 5o marks and 2/4 hours for 35/75 marks practical examination.

9.1.2 Every student shall register for each semester-end examination as per the University Notification by submitting duly completed application form through the proper channel and shall also pay the fees prescribed.

9.1.3 The Office of the Registrar (Evaluation) shall allot the Register Number to the candidate at 1st semester-end examination. That will be the Register Number of the candidate for all subsequent appearances at semester-end examinations.

9.1.4. The Answer scripts shall be in the safe custody of the University for a maximum period of six months from the date of announcement of results. These shall be disposed off after six months.

9.1.5 The programme under CBCS is a fully carry-over system. A candidate reappearing for either the odd or even semester examinations shall be permitted to take examinations as and when they are conducted (even semester examination in even semester and odd semester examination in odd semester).

9.1.6 Candidates who have failed, remained absent or opted for improvement in any course/courses shall appear for such course/courses in the two immediate successive examinations that are conducted. However, in the case of the candidates appearing for improvement of their marks, the marks secured in the previous examination shall be retained, if the same is higher.

9.1.7 Candidates who desire to challenge the marks awarded to them, in the even semester-end examinations, may do so by submitting an application along with the prescribed fee to the Registrar (Evaluation) within 15 days from the announcement of results.

9.2 Odd Semester Examination

9.2 .1 There shall be a Board of Examiners to set, scrutinize and approve question papers.

9.2 .2 The BOE shall scrutinize the question papers submitted in two sets by the paper setters and submit the same to the office of the Registrar (Evaluation)

9.2.3 The office of the Registrar Evaluation shall dispatch the question papers to the Departments/P.G. Centres/Colleges who shall conduct the Examinations according to the Schedule announced by the University.

9.2.4 The Chairperson of the Department/Administrator of the P.G. Centre/Principal of the College shall appoint one of their fulltime course teachers as Post Graduate Programme (PGP) Coordinator who shall conduct the examinations and arrange for evaluation of answer scripts.

9.2.5 Answer scripts shall be valued by the examiners appointed by the University. However, in those centers where an examiner for a particular course is not available, then the answer scripts of that course shall be dispatched to the office of the Registrar (Evaluation) who shall arrange for valuation of the same.

9.2.6 There shall be single valuation. The examiners (Internal or External) shall value the answer scripts and shall indicate the marks awarded to each question on the answer script.

9.2.7 The Marks List, a copy of the Examination Attendance Sheet and the sealed bundles of the answer scripts shall be dispatched by PGP Coordinator to the Registrar (Evaluation)'s Office at the conclusion of the valuation at the respective centres.

9.2.8 The Office of the Registrar Evaluation shall process and announce the results.

9.3 Even Semester

9.3.1 There shall be a Board of Examiners to set, scrutinize and approve question papers.

9.3.2 As far as practicable, it will be ensured that 50% of the paper setters and examiners are from other Universities/Research Institutes.

9.3.3. Each answer script of the semester-end examination (theory and project report) shall be assessed by two examiners (one internal and another external). The marks awarded to that answer script shall be average of these two evaluations. If the difference in marks between two evaluations exceeds 20% of the maximum marks, such a script shall be assessed by a third examiner. The marks allotted by the third examiner shall be averages with nearer award of the two evaluations.

Provided that in case of the number of answer scripts to referred to the third examiner in a course exceeds of 5 or 20% of the total number of scripts, at the even semester-end examinations, such answer scripts shall be

valued by the Board of Examiners on the date to be notified by the Chairperson of the Board of Examiners and the marks awarded by the Board shall be final.

9.3.4. Wherever dissertation/project work is prescribed in the even semesters of a programme, the same shall be evaluated by both internal and external examiners. The evaluation shall be as prescribed by the concerned Board of Studies.

9.3.5 In Case of programmes with practical examination details of maximum marks, credits or duration may vary from Department to Department as specified by the concerned Board of Studies.

9.4. **Evaluation**

9.4.1. Each Course shall have two evaluation components- Internal Assessment (IA) and the Semester End Exams.

9.4.2. The IA Component in a course shall carry 25% / 30% /50% and the Semester End Examination shall carry 75% /70% /50% respectively, as the case may be. Courses having 25% & 30% / 50% marks as internal assessment shall have 3 / 5 marks allotted to attendance. However, in case of project work, the distribution of marks for Internal Assessment and Examination shall be left to the discretion of the concerned BOS.

9.4.3. Marks for attendance shall be awarded to the students according to the following table.

For courses carrying 25% of marks for IA, the attendance marks shall be

Attendance (in percentage)	Marks
Above 90	3
Above 80 and up to 90	2
Above 75 and up to 80	1

9.4.4. Internal Assessment (IA) shall be based on written tests, practical and seminars. However, the number of IA components per course per semester shall not be less than two.

9.4.5. The IA marks list shall be notified on the Department Notice Board as and when the individual IA components are completed and the consolidated list shall be submitted to the Office of the Registrar Evaluation before the commencement of semester-end examination, or as directed by the University.

9.4.6. The tests shall be written in a separately designated book supplied by the University which shall be open for inspection by the students after evaluation.
9.4.7. There is no provision for seeking improvement of Internal Assessment marks.

9.4.8. The IA records, pertaining to Semester Examination, shall be preserved by the department/Centres/Colleges for a period of one year from the date of semester examination. These records may be called by the University or body constituted by the University as and when deemed necessary.

9.4.9. The dissertation/project work viva-voce shall be conducted by an internal and external examiner.

10.0 Maximum duration for completion of the Programme

10.1 A candidate admitted to a post graduate programme shall complete it within a period which is double the duration of the programme from the date of admission.

10.2 Whenever the syllabus is revised, the candidate reappearing shall be allowed for the examinations only according to the new syllabus.

11.0 Declaration of Results

11.1 The minimum for a pass in each course shall be 40% of the total marks including both IA and the semester-end examinations. Further, the candidate shall obtain at least 40% of the marks in the semester-end examination. There is no minimum for the IA marks.

11.2 Candidates shall secure a minimum of 50% in aggregate in all courses of a programme in each semester to successfully complete the programme.

11.3 Candidates shall earn the prescribed number of credits for the programme to qualify for the PG Degree.

11.4 For the purpose of announcing the results, the aggregate of the marks secured by a candidate in all the semester examinations shall be taken into account. However, Ranks shall not be awarded in case of the candidate has not successfully completed each of the semesters in first attempt or has not completed the programme in stipulated time (vide Regulation 5) or had applied for improvement of results.

12.0 Marks, Credit Points, Grade points, Grades and Grade Point Average

12.1 The grade points and the grade letters to candidates in each course shall be awarded as follows:

Percentage of marks	Grade points	Grade Letter
75 and above, up to 100.00 %	7.50 to 10.00	A
60 and above but less than 75%	6.00 and above but less than 07.5	B
50 and above but less than 60%	5.00 and above but less than 6.0	C
40 and above but less than 50%	4.00 and above but less than 5.00	D
Less than 40%	Less than 4.00	F

12.2 Credit Point (CP): The Credit Point for each course shall be calculated by multiplying the grade obtained by the credit of the course.

12.3 The award of Grade Point Average (GPA) for any student is based on the performance in the whole semester. The student is awarded Grade Point Average for each semester based on the Total Credit Points obtained and the total number of credits opted for. The GPA is calculated by dividing the total credit points earned by the student in all the courses by the total number of credits of those courses of the semester.

12.4 The Cumulative Grade Point Average (CGPA0 shall be calculated by dividing the total number of credit points in all the semesters by the total number of credits in all the semesters.

The CGPA to date shall calculated by dividing the total number of credit points in all the semesters to date by the total number of credits in all the semesters todate.

CGPA for the I Semester=
Sum of the CP of the I Semester+Sum of the credits of the I Semester

CGPA for the II Semester=
Sum of the CP of the Sem +Sum of the CP of II Sem +Sum of the Credits of the I Semester+II Semester

CGPA for the III and IV Semester shall be computed accordingly.

12.5 The Grade Card at each semester examination shall indicate the courses opted by the student, the credit for the course chosen by the student, the credit points obtained in

each course, the grade letter and the grade point average. No. class shall be awarded for each semester and the same would only be awarded at the end of all the semesters based on Cumulative Grade point Average.

12.6. Class shall be awarded to the successful candidates based on the Cumulative Grade Point Average (CGPA) as specified below.

Cumulative Grade Point Average (CGPA)	Class to be awarded
7.5 to 10.0	First Class with Distinction
6.0 and above but below 7.5	First Class
5.0 and above but below 6.0	Second Class

13. Miscellaneous:

a) Notwithstanding anything contained in these regulations, the semester system at Post- Graduate level is hereby repeated.

b) The provisions of any order, Rules or Regulations in force shall be inapplicable to the extent of its inconsistency with these Regulations.

c) The University shall issue such order, instructions, procedures and prescribe such format as it may deem fit to implement the provisions of this Regulations.

d) The procedural details may be given by the University from time to time.

e) Any unforeseen problems/difficulties may be resolved by the Vice Chancellor, whose decision in the matter shall be final.

Annexure-I

The Programme structure of the Master of Science Degree shall be as follows:

Semester	No. of compulsory & Specialization courses (credit s/course)	Total credits for compulsory & Specialization courses	No. of open elective course (credits/course	Total credits of open elective course	Total credits for the semester
Sem. I	Th:04(04)=16 Pra/Th*:04(02)=08	24	----	--	24
Sem.II	Th:03(04)=12 Pra/Th*:03(02)	18	Th:01(04)=04	04	22
Sem.III	Th:03(04)=12 Pra/Th*:03(02)	18	Th:01(04)=04	04	22
Sem.IV	Th:03/04** (04)=12/16 Pra/Th:03/04**(02) =06/08 Pj# 01(06)=06	24		--	24
Total	Th 13/ 04= 52 Pra 13/ 02=26 24/26 Pj 1(06)=06	82	02(04)=08	08	92

Note: Except for IV Semester, the concerned Department shall offer one each of open elective theory and practical course or two * open elective Theory courses for students of other science departments.

*Only for Mathematics; ** for Mathematics and Statistics; # except Mathematics & Statistics Abbreviations: Th=Theory; Pra=Practical;Pj=Project;

GRADE CARD

Programme: M.Sc. ( )
Name of the Candidate:…… Semester: IV
Seat No: Month & Year:

Course	Course Code	Credit	IA Marks	Theory/ Practical	Max	Marks obtained	Semester Grade point	Credit Points

			Max	Obt	Max	Obt				
Compulsory Courses										
Course-I	XXCT 4.1	04	25	15	75	45	100	60	6.00	24.00
Course-II	XXCT 4.2	04	25	15	75	59	100	74	7.40	29.60
Course-III	XXCT 4.3	04	25	15	75	28	100	43	4.30	17.20
Course-IV	XXCT 4.4	02	15	06	35	34	50	40	8.00	16.00
Course-V	XXCT 4.5	02	15	06	35	34	50	40	8.00	16.00
Course-VI	XXCT 4.6	02	15	06	35	34	50	40	8.00	16.00
Course-VII	XXCPJ# 4.7	06	25	20	125	100	150	120	8.00	48.00
	Or									*Or*
Course-VI	XXCT* 4.7	04	25	15	75	28	100	43	4.30	17.20
Course-VIII	XXCP+/CTΨ 4.8	02	15	05	35	35	50	40	8.00	16.00
Total		24					600			200.00/ 185.00

XX refers to course abbreviations, 4.1 refers to IV semester course 1; e.g. CHI CT 1.1=chemistry Inorganic compulsory theory 1.1
except for Mathematics and Statistics; * For Statistics and mathematics; + Only for Statistics; Ψ Only for Mathematics

GPA for IV Semester- CP(IV Sem)/Credits(IV Sem)=200/24.00=8.33

GPA for I Semester=CP(I Sem)/Credits (I Sem)
CGPA for I Semester=GPA for I Semester

$$\text{CGPA for II Sem} = \frac{\text{CP (ISem)+CP (IISem)}}{\text{Credits (I Sem)+ Credits (II Sem)}}$$

$$\text{CGPA for III Sem} = \frac{\text{CP (ISem)+CP (IISem)+CP (III Sem)}}{\text{Credits (I Sem)+ Credits (II Sem)+Credits (III Sem)}}$$

$$\text{CGPA for the Programme} = \frac{\text{CP (ISem)+CP (IISem)+CP (III Sem)+ CP(IV Sem)}}{\text{Credits (I Sem)+ Credits (II Sem)+Credits (III Sem)+ Credits (IV Sem)}}$$

*(*CP: Credit Points)*

KARNATAK UNIVERSITY, DHARWAD

P.G. DEPARTMENT OF STUDIES IN BIOCHEMSITRY

The Post-graduate studies in Biochemistry was started in the Karnatak University as a division in the Department of chemistry during the year 1970, and it was separated as an independent Department of Biochemistry in 1997. Since then, teaching and research in Biochemistry to train M.Sc. and Ph.D degree students have been the major thrust of department. The teaching programme is designed to give our students current awareness in the wide ranging allied subjects with in-depth study of core biochemistry. Consequently, many of our students successfully completed National Level Examination like NET of

UGC/CSIR and GATE. The excellent training given to the students has helped them to be placed in National/International Research Laboratories and Pharmaceutical companies, Medical, Dental, Agricultural colleges and Universities in the Country and Abroad. The department has several national and international collaborative research projects. The major thrust areas of research in the department include Lectins and Glycobiology, Environmental Biotechnology, Enzymology, Antiviral Protein Biochemistry and Clinical Biochemistry and Toxicology.

M.Sc. Degree in Biochemistry

The department offers two years M.Sc. course in Biochemistry of four semester with Choice Based Credit System (CBCS). The following are the Regulations governing the M.Sc. course in Biochemistry offered by Karnatak University under Choice Based Credit System (KU-CBCS) from the academic year 2008-09.

a. Course structure and scheme of Examination for M.Sc. Biochemistry semester I, II, III & IV

I SEMESTER

Sl. No.	Paper Code No. and Title Compulsory Courses and Open Elective Course	Credits	No. of Hrs/week Theory /Practical	Duration of exam in Hrs Theory/ Practical	Internal Assessment Marks Theory /Practical	Marks at the Exams	Total marks
Theory							
1	CT 1.1 Basic Biochemistry	4	4	3	25	75	100
2	CT1.2 Analytical Biochemistry	4	4	3	25	75	100
3	CT 1.3 Physiology & Nutrition	4	4	3	25	75	100
4	CT 1.4 Cell Biology	4	4	3	25	75	100
Practicals							
1	CP 1.5: Basic Biochemistry Practicals	2	4	4	10	40	50
2	CP1.6: Analytical Biochemistry Practicals	2	4	4	10	40	50
3	CP 1.7: Physiology and Nutrition Practicals	2	4	4	10	40	50
4	CP 1.8: Cell Biology Practicals	2	4	4	10	40	50

II SEMESTER

Sl. No.	Paper Code No. and Title	Credits	No. of Hrs/week Theory /Practical	Duration of exam in Hrs Theory/ Practical	Internal Assesment Marks Theory	Marks at the Exams	Total marks

					/Practical		
Theory							
1	CT 2.1 Biomolecules	4	4	3	25	75	100
2	CT 2.2 Enzymology	4	4	3	25	75	100
3	CT 2.3 Microbial Biochemistry	4	4	3	25	75	100
4	ET 2.1 Biochemical techniques	4	4	3	25	75	100
Practicals							
1	CP 2.4: Biomolecules Practicals	2	4	4	10	40	50
2	CP 2.5: Enzymology Practicals	2	4	4	10	40	50
3	CP 2.6: Microbial Biochemistry Practicals	2	4	4	10	40	50

III SEMESTER

Sl. No.	Paper Code No. and Title	Credits	No. of Hrs/week Theory /Practical	Duration of exam in Hrs Theory/ Practical	Internal Assessment Marks Theory/ Practical	Marks at the Exams	Total marks
Theory							
1	CT 3.1 Metabolism-I	4	4	3	25	75	100
2	CT 3.2 Metabolism-II	4	4	3	25	75	100
3	CT 3.3 Medical Biochemistry &Endocrinology	4	4	3	25	75	100
4	ET 3.1 Clinical Biochemistry	4	4	3	25	75	100
Practicals							
1	CP 3.4 : Metabolism-I Practicals	2	4	4	10	40	50
2	CP 3.5: Metabolism-II Practicals	2	4	4	10	40	50
3	CP 3.6: Medical Biochemistry Practicals	2	4	4	10	40	50

IV SEMESTER

Sl. No.	Paper Code No. and Title	Credits	No. of Hrs/week Theory/ Practical	Duration of exam in Hrs Theory/ Practical	Internal Assesment Marks Theory /Practical	Marks at the Exams	Total marks
Theory							
1	CT 4.1 Molecular Genetics & Immunology	4	4	3	25	75	100
2	CT 4.2 Molecular Biology	4	4	3	25	75	100
3	CT 4.3 Biotechnology	4	4	3	25	75	100
Practicals							
1	CP 4.4 Molecular Genetics & Immunology Practicals	2	4	4	10	40	50
2	CP 4.5 Molecular Biology Practicals	2	4	4	10	40	50
3	CP 4.6 Biotechnology Practicals	2	4	4	10	40	50
4	CPJ 4.7 Project /Dissertation	6	4		25	125	150

CT: Core Theory, CP: Core Practical, ET: Elective Theory, CPJ: Core Project

XI. Selection of Electives: In all the 'Science departments' number of seats available for the Electives depends on the facilities within the departments. The selection shall be done on merit-cum choice basis, based on the aggregate marks at the degree level. Candidate is required to give their Electives choice in preferential order at the time of admission.

XII. At, present, CBCS in Science Faculty is applicable on the Main campus, K.U. Dharwad only

	Departments		Electives		Intake
1	Botany	I	Biodiversity		44
		II	Medicinal Plants		
		III	Plant Biotechnology		
2	Biochemistry	I	Introduction to Biochemistry		15
		II	Biochemical Techniques		
		III	Clinical Biochemistry		
3	Biotechnology	I	Introduction to Biotechnology		15
		II	Genetic Engineering		
		III	Fermentation Technology		
4	Chemistry	I	Applied Inorganic Chemistry		50
		II	Applied- Organic Chemistry		
		III	Applied- Physical Chemistry		
5	Computer Science	I	Computer Concepts and Applications		60
		II	Programming in C-Language and Mat lab		
		III	Internet information and Web Designing		

6	Electronics	I II III	Basic Electronics Linear Integrated Circuits Communication		25
7	Geography	I II III	Economic and Commercial Geography Regional Geography of India Biogeography		30
8	Applied Genetics	I II III	Human Genetics Molecular Biology Techniques Genetic Disorders and Counseling		20
9	Geology	I II III	Paleontology History of Earth Remote sensing		20
10	Mathematics	I II III	Calculus Mathematical Methods Discrete Mathematical Structure and Mathematical Modeling		70
11	Microbiology	I II III	Basic Microbiology Microbial Biotechnology Clinical Microbiology		20
12	Physics	I II III	Instrumental Methods Elementary Quantum Mechanics Introductory Photonics	60	
13	Sericulture	I II III	Mulberry Production Technology Silkworm Rearing Technology Seri biotechnology		17

14	Statistics	I	Statistical Methods	30
		II	Bio-Statistics	
		III	Applied Statistics	
15	Zoology	I	Environmental Biology	30
		II	Animal Behavior	
		III	Economic Zoology	

XIII: Scheme of Examinations:
i) The examination will be conducted at the end of the each semester
ii) Each theory course will be have a question paper of 3 hours of duration and maximum marks of 75. Each practical course will have examination of 4 hours duration and maximum marks of 40

QUESTION PAPER PATTERN:

A) **THEORY**

There shall be a total of 7 questions of equal marks, each of 15 marks. The candidates should answer 5 questions. Question number 1 is compulsory and of the remaining 6 questions, candidates should answer any 4.

Question no. 1 shall have 7 sub questions of 3 marks each. The candidates should answer any 5 of them.

Question No. 2 to 7 should contain 2 to 3 sub questions.

The same scheme is applicable to both core and elective theory papers

B) PRACTICALS
The marks allotted for practical is 50, out of which 10 is for internal and 40 is for semester final.

The 40 marks is to be divided as follows	Marks
Principle and Procedure writing	5
Experiments	20
Viva	10
Records	5
Total	40 marks

The same scheme is applicable to both core and elective practical papers

C) PROJECT EVALUATION:

1. Internal assessment	: 25 marks
2. Evaluation of dissertation	: 75 marks
3. Viva-voce	: 50 marks
Total	:150 marks

Award of Gold medals:
The following gold medals will be awarded to the students for standing highest at the M.Sc. Biochemistry Examination

- The VamanraoKore Gold Medal
- The Dr. (Miss) Krishanabai R. Patil Gold Medal
- The Late Dr. S.M. Kurdikeri Gold Medal
- Sri R. Gundurao Gold Medal
- Principal C.S. Bennur'sSridevi Gold Medal
- Dr. Mumtaz Ahmed Khan Gold Medal

- Late (Smt) PadmabaiBalajiraoKoimattur Gold Medal
- Prof. M. Madaiah Memorial Gold medal

Co-curricular Activities:
Seminars, tutorials and group discussions will be conducted periodically. Study tours may also be arranged. However, these activities do not carry any marks.

Biochemical Society;
The Department has an active "Biochemical Society" under the auspicious of which several invited lectures by distinguished scientists and professor are organized every year. All the faculty members, research students and M.Sc. students are the members of the Biochemical Society special lectures sponsored by University are also arranged in the department. The Biochemical society also organizes educational tours, sports and cultural activities for the staff and students of the department.

The Department has also the local branch of society of Biological chemists (India) which arranges lectures by eminent scientists.

PROGRAMME SPECIFIC OUTCOMES (PSOS)

By completing their Post-Graduation Studies in Biochemistry, students are expected to have achieved the following knowledges, skills and capabilities.

- This programme is a platform to enhance active involvement in independent teaching and research through knowledge intensive, innovative thinking, creative problem solving and solution oriented base.
- Students with intellectually motivating education to acquire systematic understanding of integrated specialties of biological and biochemistry aspects through biochemical reactions.
- The programme provides understanding the biochemical concepts in the field of health and disease, food and natural resources, biotechnology, microbiology, pharmaceuticals, fertilizers, bio-fertilizers environmental sustainability, etc.
- It gives knowledge required to design, execute, and analyze the results of biochemistry experimentation in microorganisms, animal and plant model systems by evaluating and drawing conclusions that are based on qualitative and quantitative data.
- It also brings a comprehensive, detailed understanding of the molecular basis of heredity and heritable traits in families and populations with insight into cellular and molecular mechanisms.
- Preparing students to qualify national / state level examinations such as (UGC-CSIR/ /ICAR), SET, GATE, GRE, other competitive, administration, research and teaching career at reputed national and international institutions upbringing the carrier of an individual.

Paper Code and Name	PG72T101: Basic Biochemistry
COURSE OUTCOMES (COs)	
After completing this paper, the students will be able to:	
CO 1	Students will understand the basic concept of biomolecules such as carbohydrates, proteins, lipids and nucleic acids and their functions in brief.
CO 2	Students will understand molecular mechanisms behind various organic reactions and water properties.

PARTICULARS	Teaching Hours (Max. 50)
Introduction: Origin, aim and scope of Biochemistry, Chemical unity of diverse living organisms, significant contributions of scientists in the development of Biochemistry, organization of cells and their chemical composition.	**3 Hr**
2. Properties of water: Structure and properties of water, importance of water in biological systems,. Ionic product of water. Buffers: acids-bases, pH, pKa, Henderson-Hasselbalch equation, buffers, buffer action and Physiological buffer systems (Bicarbonate, Phosphate buffers).	**6 Hr**
3. Chemical bonding and Reactions: Properties of covalent bond, non-covalent bonds and their importance in biological systems. Types of biochemical reactions: oxidation-reduction, condensation, rearrangement, cleavage, group- transfer, Resonance bond, electrophilic and nucleophilic substitution reactions.	6 Hours
4. Amino acids and Proteins: Structure and physico-chemical properties of amino acids, Role of non-protein amino acids, peptides, peptides of physiological significance, peptide bond, peptide synthesis. Structural features of proteins and their biological functions.	7 Hours
5. Nucleotides and Nucleic acids: Structure and properties of nucleotides, nucleosides, purine (Adenine, Guanine) and pyrimidine (Cytosine, Thiamine, Uracil) bases. Structural features of nucleic acids (DNA & RNA) and their biological functions.	6 Hours
6. Carbohydrates: Structure and stereochemistry of monosaccharides, structure and functions of sialic acid, oligosaccharides and polysaccharides, Starch, glycogen, cellulose and chitin. Structural studies of carbohydrates: periodate oxidation, methylation and use of glycosidases O glycanase and PNGase F. Structure and functions glycoproteins, mucins, N andO linked glycans, carbohydrate binding proteins. And their biological significance). Blood group antigens and heteropolysaccharides, glycosaminoglycans, proteoglycans, lipopolysaccharides and peptidoglycan.	10 Hours
7. Lipids: Lipids and their classification, Structure, nomenclature and functions of fatty acids (PUFA),,), triacylglycerols (TAG), Waxes, phospholipids(Phospotidylserine, Lecithin, Cardiolipin, Plasmalogen and PAF), Sphingolipids (Cerebrosides, Globosides and Gangliosides) lipoproteins, glycolipids, steriods, prostaglandins and bile acids.	8 Hours
8. Porphyrins and metal ions: Role of metal ions in biological systems; Fe, Cu, Zn**,** structure and functions porphyrins, metalloporphyrins and iron-sulfur clusters with suitable examples.	**4Hr**
REFERENCES	

1. Principles of Physical Biochemistry by Van Holde, Johnson and P.S. Ho, (1998) Prentice-Hall, Inc. Jersey.
2. Organic chemistry by R.T. Morrison & R.N. Boyd, (2000) Prentice Hall of India, New Delhi.
3. Lenhinger's Principles of Biochemistry D.L. Nelson, David L and M.M. Cox, (2000) Macmillan Worth Pub. Inc. NY.
4. Introduction to Glycobiology Oxford University Press (2001) By Maureen E.Taylor& Kurt Drickamer

5. Biochemical calculations by Irvin, H. Segel, (1976) John Wiley and sons
6. Biochemistry by Voet, D. and Voet, D.J. (1999) John Wiley and sons
7. Biochemistry Geoffrey L. Zubay, (1998) MCGraw Hill
8. Biochemistry Lubertstrayer, (2001) W.H. Freeman and Co.,
9. Biochemistry J. David Rawn, Etal. (1996), Prentice Hall International, Inc,
10. Metal ions in Biochemistry by P.K. Bhatthacharya (2005) Narosa
11. Concepts in Biochemistry by Boyer 3rdEdn. (2000) John Wiley
12. Biochemistry: The Chemical reactions of living cells volumes I and II by Metzler (2004) Elsevier Science.
13. Outlines of Biochemistry; 1976, by Conn and Stumpf, John-Willey publishers

Essentials of Glycobiology, 2nd edition, AjitVarki, Richard D Cummings, ISBN-13: 9780879697709.

Paper Code and Name	PG72T102: Analytical Biochemistry
COURSE OUTCOMES (COs)	
After completing this paper, the students will be able to:	
CO 1	Students will be able to perform various analytical techniques such as chromatographic, electrophoretic, spectrophotometric and other techniques.
CO 2	Students will learn principle and procedures and their trouble shooting of various techniques in the separation of components.

PARTICULARS	Teaching Hours (Max. 50)
1. **Chromatography**: **Chromatography-** History, Principle, Partition coefficient - Nature of partition forces, Partition, Counter current distribution- Craig apparatus, Types of chromatography Planar chromatography -Paper chromatography, Thin Layer chromatography. **Paper chromatography -** Choice of solvent system, Detection – Rf Values, Applications. **Thin Layer chromatography -** Preparation, Sample application, Plate development and detection, Advantages and applications. **Column chromatography** - Columns, packing, Sample application, methods of elution, flow rate, analysis. Concept of plates - Theoretical plates, **Partition Chromatography -** Gas- liquid chromatography (GLC), Principle, Carrier gas, columns, Solid support, Liquid Phase,coating the support, Sample preparation, detectors - Flame ionization, electron capture, thermo ionic, Retention time and quality analysis, applications, GC-MS. **Gel permeation chromatography -** Principle, and partition coefficient. Types of gels –Sephadax, Poly acrylamide, agarose, TLG, Styragel, Bioglass, Procedure. Advantages and applications. **Ion exchange chromatography -** Principle, Types of ion exchange resins with examples. Preparation and choice of buffers, procedure and applications. **Affinity chromatography -** Principle, Procedure and applications. Selection criteria: Matrix ,ligands, , ligand coupling and **HPLC-** Difference between conventional and HPLC, schematic diagram, column, detectors, Applications.	14 Hours
2. **Spectrophotometry:**. UV and Visible spectroscopy **-** Principle, Instrumentation and applications**,** Principle and applications of Fluorescence spectroscopy, NMR andInfrared spectroscopy. ESI MS and MALDI-TOF. Flow cytometery	8 Hours
3. **Centrifugation**: Principle of centrifugation, Concepts of Relative Centrifugal Force (RCF) and Swedberg constant. Types of centrifuges and rotors. Differential and density gradient (Zonal and Isopycnic) centrifugation. Preparative and Analytical ultra-centrifugation, Subcellular fractionation.	5 Hours
4. **Electrophoresis:**Principle, Factors affecting paper, Cellulose acetate electrophoresis electrophoresis. Procedure and applications of polyacrylamide,. Horizontal (agarose) and vertical electrophoresis (SDS PAGE- Isotacophoresis) and their applications. Iso electro focusing, Pulse field gel electrophoresis and capillary electrophoresis - applications. Blotting techniques – Southern, Northern and Western and their detection methods.	8 Hours
5. **Dialysis:** Principles, and applications of equilibrium dialysis and ultrafiltration. Artificial membranes, semi-permeable membranes, Donnan membrane equilibrium, and biological significance of osmosis and micelles.	3 Hours
6. **Techniques in biochemical investigations**: Whole organism studies, Manometry, Tissue slice techniques, Cell and Tissue culture, Tissue homogenation. Use of metabolic inhibitors in elucidation of metabolic pathways.	3 Hours
7. **Radioisotope Techniques**: Radioactivity, stable , unstable and radioactive isotopes,	5 Hours

Units of radioactivity, half life of radioisotopes.- Measurement of radioactivities, GM and, liquid scintillation counters and autoradiography. Isotope dilution technique. Molecular imaging of radioactive material, Radiation monitoring and its hazards. Applications of radioactive tracers in biology.	
8. Microscopy: Principle and application of Light microscopy- bright field, dark field, fluorescence, Phase-contrast microscopy. Principle and applications of Electron microscopy- transmission scanning**,** and Confocal microscopy.	4 Hours

REFERENCES

1. Analytical Biochemistry: D.J. Holme and H. Pick (1983) Longman
2. Modern experimental Biochemistry by Rodney Boyer (2000), 3rd edition, Addison Wesley Longman.
3. Practical Biochemistry: Principles and Techniques, 5th edition, Edited by Keith Wilson and John Walker (2000) Cambridge University, Press.
4. Physical Biochemistry ( ) David freifielder
5. Biophysical chemistry by Cantor, C.R. &Schimmel P.R. (1980) Freeman and Co.
6. Methods in Cell Biology: Cytometry, 3rd Edition, Part B, Vol. 64 ZbigniewDarzynkiewicz, Harry A. Crissman, J.Paul Robinson, Academic Press, San Diego, October, 2000
7. Fundamentals of MALDI-ToF-MS Analysis, Hosseini, Samira, Martinez-Chapa, Sergio O, Springer Singapore, eBook ISBN-978-981-10-2356-9.

Paper Code and Name	PG72T103: Physiology & Nutrition
COURSE OUTCOMES (COs)	
After completing this paper, the students will be able to:	
CO 1	The student will learn and understand the basics of biomembrane structure functions and transport of various ions end molecules in the systems.
CO 2	The course will aid to understand the basics of physiological process of digestion, cardiovascular & respiratory system and nervous systems.
CO 3	The student will learn and understand the fundamentals of nutrition of carbohydrates and proteins, vitamins macro, micro elements etc.,
CO 4	The student with understand the special nutritional aspects during the pregnancy and lactation.

PARTICULARS	Teaching Hours (Max. 50)
1. Biomembranes: Structure and composition of biomembranes, Supra molecular organization. Models of membranes: fluid-mosaic model of membrane, techniques to study membrane organization (EM**,** NMR, Fluorescence), Membrane domains-caveolae, rafts, Membrane potential.	**5Hr**
2. **Membrane transport:** Active and passive transport, mechanism of Na^{+}-K^{+} ATPase and Ca^{2+} - ATPase, transport of sugars and amino acids, lactose permease and PTS, ionophores, porins, gap junctions and tight junctions, desmosomes.	**5Hr**
3. Digestive system: Digestion and absorption of carbohydrates, lipids and proteins in the gastrointestinal tract, role of digestive enzymes and hormones, role of gastric HCl and bile salts in digestion.	4 Hours
4. Cardiovascular and Respiratory systems: Circulatory system, cardiac cycle, blood pressure and its regulation, Mechanism of transport of O_2 and CO_2 in blood. Excretory system- nephron, and mechanism of urine formation.	5 Hours
5. Nervous system: Organization, Comparison of somatic and autonomic nervous system, Classifications structure and function, Different types of cells in the nervous system and their functions, Structure of Neuron - Dendrites, Axons, Myelin sheath, Nodes of Ranvier.	**2Hr**
6. **Endocrine system:** A brief outline of various endocrine glands, Pituitary, Pancreas, Adrenals, thyroid, parathyroid, Adrenal cortex and their physiological roles.	**1Hr**
II: Nutrition: **1. Basic concepts of nutrition and dietetics**: Nutrients and essential nutrients, food Groups, proximate analysis of foods. energy values of foods and their determination, physiological fuel valve and significance. BMR and factors affecting BMR, SDA.	**4Hr**
2. Carbohydrates- Sources and functions carbohydrates. Role of dietary fiber. Fats-Sources and functions, essential fatty acids, saturated and polysaturated fatty acids (PUFA).	**4Hr**
3. Proteins: Essential and non-essential amino acids, nutritional classification of Dietary proteins, nitrogen balance, methods for evaluation of nutritive values of dietary proteins. Protein- calorie malnutrition (PCM)-Kwashiorkor and Marasmus-, symptoms and prevention.	**5 Hr**
4. Vitamins: Sources, structure functions and deficiency symptoms of fat (A, D, E, K)and water-soluble (B-complex and C) vitamins.	**8Hours**
5. **Mineral elements:** Sources, functions and deficiency symptoms Ca, P, Na, K, Fe, I, Cu, Zn and other trace elements.	**5Hr**
6. Special aspects of nutrition during infancy, childhood, pregnancy and lactation.	**2Hr**

REFERENCES

1. Introductory Nutrition by Helen Andrews Gut**Hr**ie (3rd ed. 1975) C.V. Mosby Compnay, Saint Louis.
2. Human Nutrition and Dietetics by Stanley Davidson et.al. (8th ed. 1982) ELBS.
3. Nutrition by Chaney, Ross and Witschi (9th ed. 1979)
4. Nutrition – an integrated approach by R.L. Pika& M.L. Brown (3rd Ed. 1984) Wiley and sons Inc. NY.
5. Text book of Biochemistry with clinical correlations (2003) by T.M. Devlin
6. Text book of Human Nutrition (1996) M.S. Bamji, N. PralhadRao and V. Reddy, Oxford & IBH Publishers.
7. Modern Nutrition in Health and Diseases (7th ed. 1988) by Maurice E Skills and V.R. Young, K.M. Varghese Co. Bombay.
8. Text book of Medical Physiology (10thedn 2001) by A.G. Guyton and Hall JE, Haz court Asia.
9. Review of Medical physiology (12th ed. 1985) Ganong W.F. Lange Med. Pub.
10. Cell biology (1993) by E.S. Sedava, Jones and Barlett Publishers Boston, London
11. Cell and Molecular Biology (8thEdn. 2001) by E.D.P. de Robertis& E M F de Robertis (Jr) Lippincott Williams and Wilkins, Philadelphia.
12. Harper's Review of Biochemistry, Murray et al., (1997) End. Lange.
13. Molecular biology of the cell (1994) by J.D Watson etal, Garland Publishing Vitamins and Hormones by G. Litwack (Ed) Vol 50, 1995, Academic Press
14. Principles of Nutrition and Dietetics by M SwaminathanBapp Co, Bangalore Printing & Publicity, Co. Ltd, Bangalore.
15. Essential cell biology (1998) Bruce Alberts, Dennis Bray, Alexander Johnson, Julian Lewis, Martin Raff, Keith roberts and Peter walter. Published by Garland Publishing, Inc. New York.

Paper Code and Name	PG72T104: Cell Biology
COURSE OUTCOMES (COs)	
After completing this paper, the students will be able to:	
CO 1	Students will understand the basic concept cell and its components with their functions in details..
CO 2	Students will have comprehensive idea on molecular mechanisms involved in cancer, apoptosis and other physiological processes such as blood coagulation, biochemistry of vision and neurobiology etc.

PARTICULARS	Teaching Hours (Max. 50)
1. Cell Structure: Structural organizations of eukaryotic cells, structure and functions of sub-cellular organelles.Molecular components of cells, Stem cells-different types	**5 Hr**
2. **Cytoskeleton**: Structure and function of microfilaments, microtubules, (Actin), intermediate filaments (Lamin and Keratin) and microtubules (Centrioles and Cilia). Structure and constituent proteins of erythrocyte cytoskeleton., Cell motility-cilia and flagella.	**5 Hr**
3. **Cell cycle:** Mitosis and meiosis, cell cycle and its regulation (outline), cyclin and cyclin dependent kinases (CDKs), Apoptosis; intrinsic and extrinsic pathway.	6 Hours
4. **Carcinogenesis:** Mechanism of carcinogenesis. Characteristics of cancer cells, Types of Cancer, Benign and Malignant Tumors. Cancer metastasis, Carcinogens (Chemical, Physical and Biological), Ames test for carcinogenicity.	6 Hours
5. **Muscle contraction:** Structural organization of muscles, muscle proteins, mechanism of muscle contraction and its regulation. Sliding filament theory.	6 **Hr**
6. Blood Coagulation: Blood coagulation factors, mechanism of blood coagulation-intrinsic and extrinsic pathway, role of thrombin, platelet aggregation, , coagulation and clot dissolution. Formation of platelet plug, proteins involved in blood coagulation. Role of vitamin-K**.**Gla-containing proteins, regulation and synthesis of Gla-proteins.	**6Hr**
7. Vision: Photoreceptor cells- rods and cones, photoreceptor pigments, Cascade of biochemical reactions involved in the visual cycle, color vision.	6 **Hr**
8. Neurotransmission: Molecular basis of the resting and action potential. Membrane Potential – Action Potential, Depolarisation, Hyperpolarisation, Propagation of action potential - Voltage gated and Ligand gated Ion channels. Role of G-proteins in neurotransmission Uses of Ionophores and toxins **Neurotransmission**: Synapse, Mechanism of neurotransmission, Neurotransmitters - Excitatory and Inhibitory neurotrasnmitters - Their structure and functions. Receptors – Nicotinic, Muscurinic, Adrenergic receptors.	10 **Hr**

REFERENCES

1. Introductory N Molecular cell biology-4th edn. (2000) By Lodish,Berk, Zipursky, Matsudaira, Baltimore, Darnell.
2. The Cell, A molecular approach By Geoffrey M cooper (1997) Oxford University Press
3. Cellular Physiology of Nerve and Muscle (1998) Gary G. Mathews, Blackwell Scientific Inc
4. Cell biology (1993) by E.S. Sedava, Jones and Barlett Publishers Boston, London
5. Cell and Molecular Biology (8thEdn. 2001) by E.D.P. de Robertis& E M F de Robertis (Jr) Lippincott Williams and Wilkins, Philadelphia.
6. Biochemistry by Voet, D. and Voet, D.J. (1999) John Wiley
7. Molecular biology of the cell (1994) by J.D Watson etal, Garland Publishing.
8. Essential cell biology (1998) Bruce Alberts, Dennis Bray, Alexander Johnson, Julian Lewis, Martin Raff, Keith roberts and Peter walter. Published by Garland Publishing, Inc. New York.

Paper	

Code and Name	PG72P101: Basic BiochemistryPracticals
COURSE OUTCOMES (COs)	
After completing this paper, the students will be able to:	
CO 1	Students will understand the basic concept of biomolecules such as carbohydrates, proteins, lipids and nucleic acids and their functions in brief.
CO 2	Students will understand molecular mechanisms behind various organic reactions and water properties.

Particulars	**4 Hrs/week**
1. Measurement of pH of solutions by pH meter 2. Preparation of buffers 3. Titration curves of weak acids/amino acids and determination of pKa 4. Qualitative analysis of carbohydrates-monosaccharides and disaccharides 5. Analysis of polysaccharides-starch, glycogen and cellulose 6. Estimation of reducing sugars by Hegedorn -Jenson method 7. Estimation of carbohydrates by Folin-Wu method 8. Estimation of total sugar by phenol-sulphuric acid method **9.** Qualitative analysis of lipids **10.** Estimation of free fatty acids from oil.	
References	
1. Modern Experimental Biochemistry by Rodney Boyer (2000) Third edition, Addison Wesley Longman 2. Practical Biochemistry by David Plummer, (1992)Tata McGraw-Hill Publishing 3. Practical Biochemistry: Principles and Techniques, 5th Edition, Edited by Keith Wilson and John Walker (2000) Cambridge University, Press. 4. Experimental Biochemistry (1976)by John M. Clark and Robert L. Swizer, W.H. Freeman and Company 5. Introduction to Practical Biochemistry (2000) Edited by S.K. Sawhney&Randhir Singh, Narosa Publishing House. 6. A Biologist's Guide to Principles and Techniques in Practical Biochemistry, 3rd edition (1992) by Keith Wilson and Keneth H. Goulding, Cambridge University Press. 7. Practical Biochemistry by Robit White. 8. Practical Biochemsitry by Deshpande and Rao.	

Paper Code and Name	PG72P102: Analytical BiochemistryPracticals
COURSE OUTCOMES (COs)	
After completing this paper, the students will be able to:	
CO 1	Students will be able to perform various analytical techniques such as chromatographic, electrophoretic, spectrophotometric and other techniques.
CO 2	Students will learn principle and procedures and their trouble shooting of various techniques in the separation of components.

Particulars	**4 Hrs/week**
1. Separation of carbohydrates by paper chromatography 2. Separation of amino acids by paper chromatography (ascending, descending, circular & two-dimensional) 3. Thin layer chromatography (TLC) of Carbohydrates 4. Thin Layer chromatography of amino acids 5. Separation of lipids by TLC 6. Separation of leaf pigments by adsorption chromatography 7. Desalting of solutions by dialysis 8. Separation of amino acids by paper electrophoresis 9. Separation of serum proteins by cellulose acetate /agarose electrophoresis 10. Cell disruption and preparation of cell free extracts by centrifugation.	
References	
1. Modern Experimental Biochemistry by Rodney Boyer (2000) Third edition, Addison Wesley Longman 2. Practical Biochemistry by David Plummer, (1992) Tata McGraw-Hill Publishing 3. Practical Biochemistry: Principles and Techniques, 5th Edition, Edited by Keith Wilson and John Walker (2000) Cambridge University, Press. 4. Experimental Biochemistry (1976)by John M. Clark and Robert L. Swizer, W.H. Freeman and Company A Manual paper c**Hr**omatography and paper Electrophoresis by (1955) R.J. Block, E.L. Durrum and G. Zweig, Academic press.	

Paper Code and Name	PG72P103: Physiology & NutritionPracticals
COURSE OUTCOMES (COs)	
After completing this paper, the students will be able to:	
CO 1	The student will learn and understand the basics of biomembrane structure functions and transport of various ions end molecules in the systems.
CO 2	The course will aid to understand the basics of physiological process of digestion, cardiovascular & respiratory system and nervous systems.
CO 3	The student will learn and understand the fundamentals of nutrition of carbohydrates and proteins, vitamins macro, micro elements etc.,
CO 4	The student with understand the special nutritional aspects during the pregnancy and lactation.

Particulars	**4 Hrs/week**
1. Determination of activity of digestive enzymes (alpha-amylase & lipase) 2. Measurement of blood pressure 3. Estimation of dietary proteins and fats. 4. Estimation of vitamin C by 2,6-Dichlorophenol indophenol method 5. Estimation of calcium content in foods. 6. Determination of phosphorus by Fiske-Subbarao method 7. Estimation of iron in foods. 8. Estimation of vitamin A by spectrophotometric method	
References	

5. Hawk's Physiological chemistry, Oser (1976) 14thEdn Tata-MaGralHil
6. Modern Experimental Biochemistry by Rodney Boyer (2000) Third edition, Addison Wesley Longman
7. Practical Biochemistry by David Plummer, (1992)Tata McGraw-Hill Publishing
8. Practical Biochemistry: Principles and Techniques, 5th Edition, Edited by Keith Wilson and John Walker (2000) Cambridge University, Press.
9. Experimental Biochemistry (1976) by John M. Clark and Robert L. Swizer, W.H. Freeman and Company
10. A Manual paper c**hr**omatography and paper Electrophoresis by (1955) R.J. Block, E.L. Durrum and G. Zweig, Academic press.

A Manual paper c**Hr**omatography and paper Electrophoresis by (1955) R.J. Block, E.L. Durrum and G. Zweig, Academic press.

Paper Code and Name	PG72P104: Cell Biology Practical's

COURSE OUTCOMES (COs)

After completing this paper, the students will be able to:

CO 1	Students will understand the basic concept cell and its components with their functions in details..
CO 2	Students will have comprehensive idea on molecular mechanisms involved in cancer, apoptosis and other physiological processes such as blood coagulation, biochemistry of vision and neurobiology etc.

Particulars	**4 Hrs/week**
9. Isolation and Fractionation of Subcellular Organelles 10. Isolation of human Peripheral Blood Mononuclear Cells (PBMCs) 11. Determination of cell number using Hemocytometer. 12. Estimation of DNA by DPA method. 13. Estimation of RNA by Orcinol Method. 14. Estimation of Protein by Bradford Method. 15. Preparation of Liposomes. 16. Identification of mitotic stages in onion root tips. 17. Determination of Erythrocyte sedimentation rate (ESR). 18. Test for mutagenesis.	
References	

1. Analytical Biochemistry and separation Techniques – A lab manual for B.Sc., M. Sc., & M.Phil. Students-Vi Edition: Twenty First century publications, India ISBN
2. Practical Biochemistry: Principles and Techniques, 5th Edition, edited by Keith Wilson and John Walker (2000) Cambridge University, Press.
3. Experimental Biochemistry (1976) by John M Clark and Robert. I Swizer W H Freeman and Company

II Sem

Paper Code and Name	PG72T201: BIOMOLECULES
COURSE OUTCOMES (COs)	
After completing this paper, the students will be able to:	
CO 1	Students will understand detailed structure and functions of proteins
CO 2	Students will understand detailed structure and functions of Nucleic acid
CO 3	Students will get trained in protein and nucleic acid isolation and characterization.

PARTICULARS	Teaching Hours (Max. 50)
Introduction: classification based on source, composition, solubility and functions. Physicochemical properties of proteins.	2
Methods of isolation and purification of proteins, criteria of protein purity.	3
Structural organizations of proteins: Primary, secondary**,** tertiary and quaternary structures. Determination of primary structure of proteins. Determination of amino acid composition. N and C-terminal groups. Fragmentation of polypeptide chains by enzymatic, acid and chemical methods. Separation of cleaved fragments. Sequential degradation of Edman and modern methods of micro sequencing including solid phase sequencing methods. Assignment of disulfide bonds. Interpretation and overlapping of sequence.	5
Secondary structure of proteins: α-helix, β-pleated sheets and other secondary motifs, super secondary structure of proteins: B-bend helix turn-helix. Zinc finger, and leucine Zippers. Prediction of secondary structure, Ramachandran plot. Fibrous proteins, keratin, silk fibroin, triple helix structure of collagen.	5
Tertiary structure of proteins: Protein folding and stability, Forces involved in folding protein, denaturation and renaturation. Role of chaperones in protein folding. Methods for the determination of protein structure: X-ray NMR CD and ORD. Protein structure prediction by CD and ORD	6
Structure and function relation of proteins: 3-D conformation of myoglobin, cytochrome c, insulin, evolutionary significance of proteins.	3
Oligomeric structure of proteins: Quaternary structure of Hemoglobin. Hemoglobin as an allosteric protein, oxygen binding mechanism, of Bohr's effect. DPG binding. Differences between myoglobin and hemoglobin. Normal and abnormal hemoglobins with respect to primary structure	6
NUCLEIC ACID **Introduction:** Components of nucleic acids, major classes of nucleic acids and their biological role.	**2**
Chemical and physical properties of nucleic acids: UV absorbance of nucleic acids, hypochromism and Hyperchromism.	2
Isolation and purification of nucleic acids – DNA and RNA, estimation of nucleic acids.	2
Primary and secondary structure of DNA: Base composition of DNA, chargaff's rule, X-ray diffraction analysis of DNA, Watson-Crick model of DNA double helix, SBS model and other models, Different structural forms of DNA – A, B & Z	5
DNA sequencing: Chemical method of Maxam-Gilbert, Sanger's Dideoxy method and other recent methods, automated DNA sequencing.	2
Tertiary or Higher-order structure of DNA: DNA supercoiling, superhelix topology linking number, biological importance of DNA supercoiling, role of topoisomerases.	2
Ribonucleic acids (RNA): Structure of m-RNA, r-RNA and t-RNA, Clover leaf model and L-shaped model of t-RNA.	2
Denaturation and Renaturation of nucleic acids: Melting curves and Tm value of DNA and their significance. Renaturation kinetics – Cot curves and their significance. Nucleic acid hybridization.	3

Reference books

1. Biochemistry: David Rawn, J. (1989) Neil Patterson Publishers
2. Biochemistry: Voet D. and Voet. J.G. [Eds] (1999) 3 Ed. John Wiley and sons
3. Principles of Biochemistry (2000) by Nelson, David L. and Cox, M M. Macmillan/Worth, NY
4. Fundamentals of Biochemistry (2005) by Donald Voet, Judith G. Voet and Chariottee W. Pratt, John Wiley & Sons, NY.
5. Biochemistry (IV ed 1998) by Geoffrey L Zubay, McGraw Hill
6. Biochemistry (IV ed 1996) by LubertStryer, WH Freeman and Co., San Francisco.
7. Biochemistry by R.H. Garrett and C.M. Grisham (1999) Second edition.
8. The Biochemistry of Nucleic acids (1986) by R.L. P. Adams, J.T. Knowler& D.P. Leader.
9. Nucleic acid Biochemistry and Molecular Biology, Mainwaring et al., (1982) Blackwell scientific.
10. Principles of protein structure, function and evolution, Dickerson and Geis (1983) 2nd Edn.
11. Protein purification applications. S.L.V. Harris and Angal (1990) IRI Press.
12. Proteins 2nd Edn. (2000) Structures and Molecular Properties by Thomos Creighton, W.H. Freeman and Company N.Y.
13. Biochemistry 5th Edn. (2005) By J.M. Berg, J.L. Tymoczko&stryer L., W.H. Freeman and Company .N.Y.
14. Principles of Nucleic acid structure by W. Saenger (1984) Springer Verlog DNA structure and function by R.R. Sinden (1984) Academic Press

Paper Code and Name	**PG72T202: ENZYMOLOGY**
COURSE OUTCOMES (COs)	
After completing this paper, the students will be able to:	
CO 1	Students will understand the functional aspects of different enzymes and inhibition/ mechanism.
CO 2	Students will be able to understand the molecular mechanisms of enzyme actions, allosteric regulations and its clinical and industrial applications
CO 3	Students will get trained in enzyme kinetics, isolation and characterization.

PARTICULARS	Teaching Hours (Max. 50)
1. Introduction: Role of enzymes in living systems, nature and characteristic features of enzymes. Nomenclature and classification of enzymes. Intracellular localization of enzymes. Enzyme unit - activity, specific activity, molecular activity (turn over number).	**3**
2. Quantitative assay of enzymatic activity by different methods. Steady state methods, ion selective technique, immunoassay techniques, flow (continuous, stopped flow and quenched-flow) techniques, relaxation methods and their usefulness in the study of enzyme catalyzed reactions, energy of activation.	3
3. Enzyme kinetics: Importance, initial velocity plots, steady state approximation, evidence for ES complex formation. Kinetics of single-substrate -Michaelis- Menten equation, algebric derivation of kinetic equation for the determination of Km and Vmax parameters, and their significance. Effect of pH, temperature, substrate concentration in enzyme activity and kinetics, Methods of kinetic analysis-Lineweaver Burk, EadieHofstee, Hanes and Dixon plots.	6
4. Enzyme inhibition: Reversible and irreversible inhibition, Types of reversible inhibitors – competitive, noncompetitive, uncompetitive and mixed inhibitors. substrate inhibition.	**3**

5. **Kinetics of bisubstrateenzyme catalyzed reactions:** Sequential, ordered, random, pingpong, theoroll-chance mechanisms and their Cleland's representations with examples. Graphical analysis, King-Altman procedure for deriving kinetic equation for single substrate and two substrate reactions with and without inhibitors. Rate expressions and secondary plots. Investigations of reaction mechanisms using isotopic – exchange at equilibrium.	5
6. **Molecular basis of enzymes catalysis**: General theories and hypotheses proposed to explain enzyme specificity, lock and key, induced fit theory, contribution of structural flexibility to the specificity of enzymes.	3
7. **Factors contributing to catalytic efficiency of enzymes**: Proximity and orientation effect, acid base covalent catalysis (nucleophilic and electrophilic), metal ion catalysis, preferential binding of the transition state complex.	3
8. **Active site characterization:** Method of active site group assignment. The identification of banding sitesand catalytic sites, chemical modification of active site, amino acid side chains, active site directed reagents (irreversible inhibitors), the use of substrate analogs, pseudosubstrate, photoaffinity labelling, suicide inhibitors trapping of ES complexs, enzyme modification with proteolytic enzymes.	5
9. **3D structure of enzymes**: General aspects of 3D structural features of enzymes as revealed by X-ray and chemical studies. Mechanism of action of following enzymes: Based on physicochemical and 3-D structural data-Lysozymes, RNase and chymotrypsin, Including zymogen activation. eg. Chymotrypsinogen.	4
10. **Different forms of enzymes:** Isozymes, multienzyme complexes, multifunctional enzymes, ribozymes, coenzymes and metalloenzymes, abzymes.	4
11. **Allosteric enzymes**: Identification and their characterization co-operativity, the Hill equation, the Scatchard plot and equilibrium dialysis techniques. Sigmoidal kinetics: The MWC & KNF models with examples, significance of sigmoidal behavaiour. Regulatory features of ATCase.	5
12. **Regulatory mechanisms**: Regulation of enzymatic activity, fine control availability of substrates and cofactors, steady state fluxes, flux of metabolities t**hr**ough metabolic pathway. Types of feed-back regulations.	
13. **Applications of enzymes**: Immobilized enzymes- Clinical and Biotechnological applications of enzymes, temperature resistant enzymes.	3

References:

1. Enzymes by Paul Boyer, Vol.I& II Academic press( )
2. Lehininger's principles of biochemistry (2000) by Nelson, David L and Cox, M.M. Macmillan/Worth, NY.
3. Enzyme kinetics by Roberts D.V. (1997) Cambridge Univ. Press.
4. Enzyme kinetics by I.H. Segel (1996) Interscience-Wiley
5. Understanding of enzymes by Palmer, (2003) T. Ells &Horwood Ltd.
6. Enzymatic reaction mechanism (1979) by C**hr**istopher Wlash, Freeman Pub., San Francisco.
7. Methods in Enzymology; Colowick. S.P. et.al., [Eds]. Different volumes, Academic press.
8. Fundamentals of Enzymology, N.C. Price and Lewis (2000) Oxford University, Press.
9. Intermediary metabolism and regulation by J. Larner
10. Biochemistry (V Ed 2001) Lubertstrayer, W.H. Freeman and Co.,
11. Biochemistry (III Ed 1999) Voet, D. and Voet J.G. Jhon Wiley and Sons.
12. Biochemistry (II Ed 1996) J. David Rawn, Etal., Prentice Hall International, Inc,
13. Enzyme Engineering: protein engineering, Structure prediction and Fermentation by M.J.C. Crabbe (1990) Ellis Horwood.
14. Immobilized enzymes by M.D. Trevan (1980), John Wily and Sons.

Paper Code and Name	PG72T203: MICROBIAL BIOCHEMISTRY
COURSE OUTCOMES (COs)	
After completing this paper, the students will be able to..	
CO 1	Students will understand the properties and special aspects of microorganisms
CO 2	Students will be able to understand theapplications of microbes in the field of medicine, microbial disease and industrial importance.

PARTICULARS	Teaching Hours (Max. 50)
1. **Introduction**: Historical development and scope of microbiology and microbial Biotechnology.	1
2. **Classification of microorganisms**: Nomenclature, study of different types of microorganisms, characteristics of the main groups of microorganisms.	2
3. **Cultivation of bacteria:** Nutritional requirements for the bacteria, Growth curve ofbacteria and the factors affecting growth curve, chemostat, synch**r**onous and diauxic growth. Measurement of growth, cell number– methods of enumeration. Study of bacterial cell structures–genetic elements, ribosomes, membranes, cell envelopes, capsule, flagella, pili and endospores.	4
4. Identification of bacteria: Staining methods- Gram staining and Acid fast staining, structure and differences between Gram-negative and Gram-positive bacteria.	2
5. **Bacteriology of milk** and Flora of the normal human body.	1
6. **Bacterial toxins** – Classification: exotoxins and endotoxins, chemical nature and associated diseases.	2
7. **Viruses:** Classification and properties of viruses. Isolation, culturing and assay of viruses. Animal viruses HPV, SV40 and viral diseases**.** Replication of DNA and RNA viruses – negative strand (vsv), positive strand (Polio), retroviruses (infection cycle). Bacteriophages – Structure, mode of infections – Lytic cycle and transudation – specialized, generalized and abortive. Interferons, clinical importance of viruses – HIV, Hepatitis A and B virus, RNA & DNA tumor viruses, transformation and cancer. Vaccines in prevention of viral infection.	9
8. **Food Microbiology:** Production of cheese, single cell protein, pasteurization of milk, contamination of milk and its prevention, food spoilage, food preservation.	4
9. **Environmental microbiology and energy:** Biomass production, biogas, environmental pollution, Biodegradation, Use of microbes in pollution control, metal leaching and extraction, nonconventional energy sources.	5
10. Biotechnology and international market, brief aspects about patent laws, culture collection, data bank, ethical values, pros and con of biotechnology.	3
11. **Fermentation technology** : Unit process, Design and operation of fermenters, surface, submerged and continuous culture methods, conditions of fermentations. Down stream process, selection of organism, raw materials and fermentation media. Recovery of products, production of ethanol from molasses. Production of wine, beer. Production acetone, butanol, glutamic acid, lactic acid, citric acid. Chemistry and mode of action of antibiotics. Production of penicillin streptomycin, chloramphenicol, ampicillin and tetracyclines.	14
12. **Public health**: Production of vaccines, interferons growth hormones human plasminogen activators.	3

References:

15. Enzymes by Paul Boyer, Vol.I& II Academic press( )
16. Lehininger's principles of biochemistry (2000) by Nelson, David L and Cox, M.M. Macmillan/Worth, NY.
17. Enzyme kinetics by Roberts D.V. (1997) Cambridge Univ. Press.

18. Enzyme kinetics by I.H. Segel (1996) Interscience-Wiley
19. Understanding of enzymes by Palmer, (2003) T. Ells &Horwood Ltd.
20. Enzymatic reaction mechanism (1979) by C**hr**istopher Wlash, Freeman Pub., San Francisco.
21. Methods in Enzymology; Colowick. S.P. et.al., [Eds]. Different volumes, Academic press.
22. Fundamentals of Enzymology, N.C. Price and Lewis (2000) Oxford University, Press.
23. Intermediary metabolism and regulation by J. Larner
24. Biochemistry (V Ed 2001) Lubertstrayer, W.H. Freeman and Co.,
25. Biochemistry (III Ed 1999) Voet, D. and Voet J.G. Jhon Wiley and Sons.
26. Biochemistry (II Ed 1996) J. David Rawn, Etal., Prentice Hall International, Inc,
27. Enzyme Engineering: protein engineering, Structure prediction and Fermentation by M.J.C. Crabbe (1990) Ellis Horwood.
28. Immobilized enzymes by M.D. Trevan (1980), John Wily and Sons.

Paper Code and Name	**PG72T204A: BIOCHEMICAL TECHNIQUES.**
COURSE OUTCOMES (COs)	
After completing this paper,	
CO 1	Students will understand detailed structure and functions of proteins
CO 2	Students will understand detailed structure and functions of Nucleic acid
CO 3	Students will get trained in protein and nucleic acid isolation and characterization.

PARTICULARS	Teaching Hours (Max. 50)
1. Introduction: Analyzing and reporting of experimental data-significant figures, scientific notation, units, error analysis and precisions in estimations, tables, controls and blanks. Solutions and buffers.	6
2. Chromatographic techniques: Principles and applications of PC, TLC, GLC adsorption, Ion exchange, gel permeation, affinity chromatography and HPLC.	8
3.Spectroscopic techniques: Principles and application colorimetry, spectrophotmetry and spectrofluorimetry.	8
4.Centrifugation techniques: Cell disruption devices-homogenization and sonication application of differential and density gradient centrifugation. Dialysis and ultra filtration.	8
5. Electrophoretic techniques: Principle and application of polyacrylamide, SDS-PAGE and agarose electrophoresis. Blotting techniques-western and southern	9
6. Radio Isotope techniques: Units of radioactivity. Stable and radioactive isotopes, Liquid scintillation counter, applications in biology, Autoradiography.	8
7. Immunological techniques: RIA, ELISA.	3

References books:

1. Analytical Biochemistry: D.J. Holme and H.Pick (1983) Longman
2. Biochemical calculations, Irvin, H. Segel, (1976) John Wiley and sons
3. Biochemistry: David Rawn, J. (1989) Neil Patterson Publishers
4. Modern experimental Biochemistry by Rodney Boyer (2000), 3rd edition, Addison Wesley Longman.
5. Practical Biochemistry: Principles and Techniques, 5th edition, Editied by Keith Wilson and John Walker (2000) Cambridge University, Press.
6. Introduction to practical biochemistry (2000) Edited by S.K. Sawhney&Randhir Singh,

Narosa Publishing House.
7. Practical Immunology 4thEdn. By F.C. Hay and O.M.R. Westwood (2002) Cold spring Harbour
8. An Introduction to Practical Biochemistry by David Plummer (1992) McGraw Hill Publishing
9. Biochemical Techniques (1990) by John F Robyt and Birnard J. White waveland press inc.,

Paper Code and Name	**PG72P201: BIOMOLECULES PRACTICALS**
COURSE OUTCOMES (COs)	
After completing this paper, the students will be able to..	
CO 1	Students will get trained in protein and nucleic acid isolation and characterization.
CO 2	Students will learn quantification of protein
CO 3	Students will learn quantification of nucleic acids.

PARTICULARS	**4 hour /Week**
1. Qualitative analysis of amino acids 2. Estimation of amino acids by Ninhydrin method 3. Estimation of protein by FCR method 4. UV Absorption spectra of proteins 5. Estimation of DNA by diphenylamine method 6. Estimation of RNA by Orcinol method 7. UV Absorption of Nucleic acids 8. Molecular weight estimation by gel-permeation chromatography 9. Desalting by gel filtration chromatography 10. Effect of denaturants on enzyme activity	

References:

1. Modern Experimental Biochemistry by Rodney Boyer (2000) Third edition, Addison Wesley Longman
2. Practical Biochemistry by David Plummer, (1992) Tata McGraw-Hill Publishing
3. Practical Biochemistry: Principles and Techniques, 5th Edition, Edited by Keith Wilson and John Walker (2000) Cambridge University, Press.
4. Experimental Biochemistry (1976)by John M. Clark and Robert L. Swizer, W.H. Freeman and Company
5. Introduction to Practical Biochemistry (2000) Edited by S.K. Sawhney&Randhir Singh, Narosa Publishing House.
6. A Biologist's Guide to Principles and Techniques in Practical Biochemistyr, 3rd edition (1992) by Keith Wilson and Keneth H. Goulding, Cambridge University Press.

Paper Code and Name	**PG72P202: ENZYMOLOGY PRACTICALS**
COURSE OUTCOMES (COs)	
After completing this paper, the students will be able to:	
CO 1	Students will get trained in enzyme kinetics, isolation and characterization.
CO 2	Students will able to calculate activity, specific activity etc.,

PARTICULARS	4 hour/week
11. Qualitative analysis of amino acids	

12. Estimation of amino acids by Ninhydrin method 13. Estimation of protein by FCR method 14. UV Absorption spectra of proteins 15. Estimation of DNA by diphenylamine method 16. Estimation of RNA by Orcinol method 17. UV Absorption of Nucleic acids 18. Molecular weight estimation by gel-permeation chromatography 19. Desalting by gel filtration chromatography 20. Effect of denaturants on enzyme activity	

References:

7. Modern Experimental Biochemistry by Rodney Boyer (2000) Third edition, Addison Wesley Longman
8. Practical Biochemistry by David Plummer, (1992) Tata McGraw-Hill Publishing
9. Practical Biochemistry: Principles and Techniques, 5th Edition, Edited by Keith Wilson and John Walker (2000) Cambridge University, Press.
10. Experimental Biochemistry (1976)by John M. Clark and Robert L. Swizer, W.H. Freeman and Company
11. Introduction to Practical Biochemistry (2000) Edited by S.K. Sawhney&Randhir Singh, Narosa Publishing House.
12. A Biologist's Guide to Principles and Techniques in Practical Biochemistyr, 3rd edition (1992) by Keith Wilson and Keneth H. Goulding, Cambridge University Press.

Paper Code and Name	**PG72P203: MICROBIAL BIOCHEMISTRY PRACTICALS**
COURSE OUTCOMES (COs)	
After completing this paper, the students will be able to…	
CO 1	Students will able to perform culturing and isolation of microorganisms.
CO 2	Students will be able do the staining of microbes and identification.

Particulars	**4 hour/week**
1. Preparation of culture media 2. Sterilization by dry heat and moist heat – autoclaving. 3. Isolating pure cultures – bacteria and fungi 4. Gram staining and other staining procedures 5. Identification of bacteria by morphological and biochemical tests. 6. Antibiotic sensitivity test for microbial cultures 7. Bacterial growth curve – effect of pH, temperature, salt concentrated and nutrients on growth of bacteria. 8. Production of Wine by fermentation. 9. Identification of microorganisms in milk. 10. Identification of microorganisms involved in food spoilage.	

References:

1. Biology of Microorganisms by M.T. Modigam, J.M. Matinko& J. Oanker, 8thEdn. (1999) Prentice Hall
2. Microbes in action by H.W. Seeley and P.J. Vendomark (1975) W.H. Freeman
3. Laboratory methods in microbiology by W.F. Haccigan& M.E. Mccanca
4. Applied Microbial Physiology ; a practical approach Rhodes and Stanbury (1997) IRL Press.
5. Basic and practical microbiology, Ronald L. Atlas (1986) McMillan Publication Co.

SemIII

Paper Code and Name	PG72T301: Metabolism-I
COURSE OUTCOMES (COs)	
After completing this paper, the students will be able to:	
CO 1	Students will learn and understand the various metabolic pathway that occur in the human body and also energy production.
CO 2	The student will be able to Explain the metabolism of Carbohydrates, Lipids, Photosynthesis process.

PARTICULARS	Teaching Hours (Max. 50)
1. Introduction: Basic concepts in metabolism; Catabolism, anabolism, catabolic, anabolic and amphibolic pathways.	**2 Hr**
Metabolism of carbohydrates: Glycolysis, its energetics, Glycerol-3-phosphate and Malate Asparate shuttle. Regulation of glycolysis, role of PFK, Pasteur effect, alcoholic and lactic acid fermentation. Aerobic metabolism of carbohydrates, oxidation of pyruvate, citric acid cycle, its energetics and regulation. Anapleuratic and Amphibolic nature of citric acid cycle. Glyoxylate cycle and its significance.	**9 Hr**
Entry of sugars other than glucose, Galactose, Fructose,mannose**,** lactose and glycogen into glycolysis, Fructosuria, Galactosemia. Bio-synthesis and degradation of glycogen, glycogenolysis difference between liver and muscle glycogenolysis and their regulation**,**including hormonal control by epinephrine, insulin and glucagon. Regulation of blood glucose level, Role of glycogen phosphorylase a, glycogen storage diseases and their molecular basis. Gluconeogenosis its energetics and regulation. Fulile cycle, Cori cycle and their significance. Alternate pathways of carbohydrate metabolism pentose phosphate pathway, its multifunctional significance. Glucouronate pathway. Pertosuria and genetic diseases of impaired pentose phosphate pathway. Biosynthesis of disccharides: Maltose, Sucrose and Lactose. Regulation of lactose biosynthesis, biosynthesis of starch, cellulose and peptidogiycan. Effect of antibiotics on peptidoglycan biosynthesis.	**15 Hr**
3. **Lipid metabolism**: Intracellular hydrolysis of lipids and role of adipose tissue in storing fat as a energy fuel. Pathways for the transport of endogenous and exogenous lipids. β-oxidation of fatty acids and its energetics, oxidation of unsaturated and poly unsaturated fatty acids (PUFA). Peroxisomaloxidationof fatty acids (Phytanic acid), Refsum'sdisease., ketone body formation and their clinical significance, diabetic keto acidosis. Biosynthesis of fatty acids, chain elongation and desaturatron, regulation of fatty acids, Biosynthesis of triacyl glycerol, phoshpolipids and sphingolipids, Tay sach's and Fabry's diseases, plasma lipo proteins : classification, synthesis and their biochemical role, role of apoproteins, familial hypercholesterolemia and its molecular basis .Biosynthesis of cholesterol and its regulation, receptor mediated LDL-uptake pathway and its effect on cholesterol B.S. Catabolism of cholesterol, bile acids, and bile salts central role of acetate as a biosynthetic precursor of lipids steroids, prostaglandins and other natural products, integration of carbohydrate and lipid metabolism.	**16 Hr**
Photosynthesis: Introduction, photosynthetic organisms, pigments and accessory components,light and dark phases, photosynthetic apparatus, Hill reaction, role of	**8 Hr**

photosystem-I-and photosystem – II photosynthetic. Electron transport -non-cyclic electron flow and cyclic electron flow. Photophosphorylation, chloroplaste ATP synthase. Quantum efficiency of photosynthesis, bacterial photosynthesis, bioluminescence and its mechanism, the Calvin cycle, its regulation and Rubisco Co_2 fixation in C_4 plant Rubisco and its regulations, Hatch slack pathway, photorespiration.	

REFERENCES

Reference books:

1. Harper's Review of Biochemistry, Murray et al., (1997) Lange. 26thedn.
2. Biochemistry by Donald Voet& Judith Voet (2005)
3. Fundamentals of Biochemistry by Donald Voet, Judith Voet and Carlotte W. Pratt.(2005)
4. Biochemistry by David E. Metzler, (2003)
5. Biochemistry by R.H. Garrett and C.M. Grisham (2003)
6. Principles of Biochemistry by A.L. Lenhinger, D.L. Nelson and M.M. Cox
7. Text book of Biochemistry with Clinical correlations by T.M. Derlin, IV edn., (1997)
8. Metabolic pathways edn by Green berg, D. Academic press
9. Intermediary metabolism and regulation by J. Larner
10. Biochemistry (IV Ed 1998) Geoffrey L. Zubay, MCGraw Hill
11. Biochemistry (V Ed 2001) Lubertstrayer, W.H. Freeman and Co.,
12. Biochemistry (II Ed 1996) J. David Rawn, Etal., Prentice Hall International, Inc,
13. Text book of Biochemistry with Clinical correlations (IV Ed 1997) Thomas Devlin Wiley-Liss
14. Photosynthesis: A Comprehensive Treatise by A.S. Raghvendra (1998) Cambridge University, Press.
    1. . Bookwell, 2007
    2. http://egyankosh.ac.in/

Paper Code and Name	PG72T302: Metabolism-II
COURSE OUTCOMES (COs)	
After completing this paper, the students will be able to:	
CO 1	Students will understand the bioenergetics explaining the production of energy currencies.
CO 2	Students will learn the metabolic pathways relevant to catabolism and anabolism of nitrogen compounds and its associated disease in related enzymes or amino acids or nucleic acids.

Particular	Teaching Hours (Max. 50)
Unit 1: . Introduction: Basic concepts of bioenergetics, review of first and second law of thermodynamics, entropy, free energy, standard free energy change and equilibrium constant of reactions, ATP as universal currency of biological energy, ATP-ADP cycle of the cell, high energy phosphate compounds. Generation of ATP in living systems, substrate level phosphorylation redox potential, biological redox couples, Free energy changes in electron transfer reactions.	7 Hours
Unit 2: Electron transport in Mitochondria: Electron carriers in mitochondria, sequence of electron carriers and their mechanism of electron transfer reactions, specific inhibitors of ETC	4 HRS
Unit 3: Oxidative phosphorylation: Coupling of electron transport and ATP synthesis, mechanism of oxidative phosphorylation – Mitchell's chemiosmotic hypothesis, P/O ratios, effect of uncouplers, specific inhibitors and ionophores. Structure of mitochondrail ATP syntheis-Boyer's binding changer mechanism. Protein motive force in Halobacteria. Microsomal electron transport and cytochrome p 450.	7Hours
Unit 4 Oxygen utilizing enzymes: Monooxygenases and dioxygenases, oxygen toxicity– active oxygen species, role of superoxide dismutase, catalase and peroxidases	2 Hrs
II: Metabolism of Nitrogen Compounds: Importance of nitrogen in biological systems and metabolism of nitrogen compounds.	1 Hrs
2. Metabolism of amino acids General reactions of amino acid metabolism – transmination, deamination, decarboxylation and racemization. Role of pyridoxal phosphate in amino acid metabolism.	3 Hours
3. Catabolism of amino acids: Metabolic fate of amino nitrogen, transdeamination, Kreb's urea cycle, ketogenic and glycogenic amino acids, degradation of individual amino acids, transmethylationgenetic disorders – phenylketonuria, alcaptonuria, albinism, maple syrup urine disease.	6 Hours
Unit 4 Biosynthesis of amino acids:Essential and non-essential amino acids, regulation of glutamine synthetase and aspertate family of amino acids	5 Hrs
Unit 5. Biosynthesis of Epinephrine, Norepinephrine, dopamine, histamine, serotonin, GABA creatine and polyamines.	1 Hours
6. Non-ribosomal peptide synthesis: Glutathione and Gramicidin	1 Hours
7. Metabolism of Nucleotides: Biosynthesis of purine and pyrimidine nucleotides by De novo and Salvagepathways, Regulation of nucleotide biosynthesis, Interconversion of nucleotide mono-, di- and triphosphates. Biosynthesis of deoxyribonucleotides and deoxythymidyrate, Inhibitors of	5 Hrs

nucleotide biosynthesis – mechanism of action of azaserine, acivicin, 5-fluorouracil and methotrexate as anticancer drugs.	
Unit 8. Degradation of purine and pyrimidine mucleotides, Genetic disorders – Gout, Lesch-Nyhan syndrome,immunodeficiency disease.	2 Hrs
Unit 9. Biosynthesis of nucleotide coenzymes –NAD^+, $NADP^+$, FAD and coenzyme A.	1Hrs
Unit 10. Metabolism of Heme:Biosynthesis and degradation of hemeporphyrin, regulation and porphyrias,formation of bile pigments	2Hrs
Unit 11. Biological nitrogen fixation: Nitroen cycle, utilization of nitrate, nitrogen-fixing organisms, mechanism of nitrogen fixation-nitrogenase and its regulation symbiotic nitrogen.	3Hrs

REFERENCES

1. Biochemistry by R.H. Garrett and C.M. Grisham (1999).
2. Principles of Biochemistry by A.L. Lenhinger, D.L. Nelson and M.M. Cox(2000) M.M. Macmillan/worth NY.
3. Text book of Biochemistry with Clinical correlations by T.M. Devlin (1997)Wiely-Liss.
4. The vital Force: A study of Bioenergetics by Harold, F.M. (1980) W.H. Freeman and company
5. Bioenergetics by Nicholls,D.G. and Ferguson (1997) S.J. Academic press
6. Biochemistry (IV Ed 1998) Geoffrey L. Zubay, MCGraw Hill
7. Biochemistry (V Ed 2001) Lubertstrayer, W.H. Freeman and Co.,
8. Biochemistry (III Ed 1999) Voet, D. and Voet J.G. Jhon Wiley and Sons.
9. Biochemistry (II Ed 1996) J. David Rawn, Etal., Prentice Hall International, Inc,
10. Biochemistry 6^{th}Edn. By J.M. Berg, J.L. Tymoczko and Lubertstryer(2006) W.H. Freeman & Company, Newyork
11. Amino acid Metabolism by D.A. Bender (1985) Wiley

Paper Code and Name	PG72303: Medical Biochemistry & Endocrinology
COURSE OUTCOMES (COs)	
After completing this paper, the students will be able to:	
CO 1	The basic concepts and principles of medical biochemistry, including the process of collection, storage and tests.
CO 2	The blood groups, blood components and their disorder and diagnostic studies.
CO 3	The clinical importance of organelles enzymes and their role in diagnosis. To understanding, various physiological role of kidney, liver, cardiac, gastric tract, etc.,
	The molecular basis of diabetes and serology followed by the detailed study of endocrinology: hormones and hormones its action.

Particular	Teaching Hours (Max. 50)
1.Haematoglogy and Haematological disorders: Development and maturation of erythrocytes and leukocytes. Different types of anemias viz., microcytie, megaloblastic, nutritional, aplastic and sickle cell. 'CBC' complete blood count. Total and differential and platelet counts and their clinical significance. Blood group substances, Rhessus factor, 'Rh' typing. 'ABO' and 'Rh' incompatibility (single and combined) and the dangers involved in foetal development and subsequent measures to reduce Haemoglobinopthies, porphyries. 'ESR'(Erythrocyte sedimentation rate) determination and its importance in the diagnosis of certain diseases. Blood disorders-broad classification, blood coagulopatheis-, 'α' and 'β' Thallesemias. Plasma protein electrophoretic profile in health and disease, CSF analysis.	6 Hrs
2.**Enzymes of clinical and diagnostic importance:**Enzymes as markers in the diagnosis of diseases. Clinical significance of cholinesterase, alkaline and acid phosphatase, Lactate dehydrogenase (LDH), Creatine phosphokinase (CPK), Aspertate amino transferase (AST/SGOT), Alanine aminotransferase (ALT/SGPT).	3Hrs
3. Water, electrolyte and acid base balance: Respiratory and metabolic acidosis and alkalosis, itsregulation by lungs and kidneys, with special reference to diabetic keto acidosis and starvation. Water and electrolyte balance in health and disease with special emphasis on diarrhoeas, dysenteries and vomiting, fluid and electrolyte replacement therapy	3Hrs
4. Biochemical investigations in Kidney diseases: Kidney profile Urine analysis fornormal and abnormal constituents, urine microscopy culture, and antibiotic sensitivity test. Clearance test and their importance in the assessment of kidney function . Kidney diseases like urinary tract infection (UTI) nephritis, Urolithiasis. Dialysis and kidney transplants	3 Hrs
5: Biochemical investigations in Liver diseases: Liver profile in health and disease. Hepatocellular functions, with special emphasis on its participation in the various detoxification mechanisms. Liver function tests (LFT), and their clinical significance in the diagnosis of liver diseases like cirrhosis and jaundice. Gallbladder stone analysis and its clinical significance, Hepatatis A, B, &C infections.	2 Hrs

6. General screening procedures for inborn errors of metabolism:of proteins, carbohydrates, lipids, purines and pyrimidines and subsequent therapeutic measures with special emphasis on clinical enzymology, and special dietary restrictions. Brief idea of deficiencies caused by trace elements in metabolism.	2 Hrs`
8. Cancer: Clinical and classical signs, different types and stages, diagnostic tests, chemotherapy(Natural and synthetic drugs), kidney and liver toxicity, radiation therapy, Molecular basis of cancer, cell differentiation	5 Hrs
9. Gastric profile in health and disease: Gastric function tests**,** (gastric analysis) (mention of aspiration of gastric HCl by Levin and Rhefuss tube. Hypo (achlorhydria) and hyper acidity, with emphasis on classification and therapeutics of duodenal, peptic and gastric ulcers, tests to confirm pancreatic involvement in disease. Stetorrhea, and malabsorption syndrome, with special emphasis on stool (faeces) examination.	2 Hrs
10. Cardiac profile in health and disease: Brief mention of heart diseases	1 Hrs
11. Diabetes mellitus:regulation of blood sugar, classification, stages and diagnosis (urine analysis, GTC/GTT, Glycosylated hemoglobins and fructosamine determinations. Role of antidiabetic oral drugs and insulin therapy	2 Hrs
12. Serology: WIDAL, VDRL, malaria and filarial parasitic antigens	1 Hrs
ENDOCRINOLOGY: 1 Salient features of hormonesand their general classification	1 Hrs
2. **Brief account on structure, storage and secretion of hormones** and feed back regulation of hormone secretion of thyroid, T3 and T4, hypothalamus, stimulatory and inhibitory factors, pituitary; tropic hormones, pancreas; insulin and glucagon, adrenal, ACTH, sex hormones, Estrogens and androgens,	5 Hrs
3. Structure biosynthesis function and mechanism of action of steroid hormones.	3 Hrs
4. Molecular Endocrinology: Structure of hormone receptors, mechanism of ligand receptor interaction - Intracellular and membrane receptor mediated responses. Signaling pathways – G proteins mediated, and effect of toxins on signal transduction. Receptor tyrosine kinases, insulin receptor, MAPK pathway, nonreceptor tyrosine kinases, growth hormone receptor, Janus kinases, Role of second messenger cAMP, cGMP, Ca^{+2}, inositol triphosphate (IP_3), diacylglycerol DAG and nitric oxide (NO) and their synthesis and biological role.	11 Hrs

REFERENCES

1. Tietz text book of clinical chemistry (2ndedn) C.A. Beutis, E.R. Ashwood (eds) Saunders WB,. Co. 2058 1994

2. Robbins, Pathologic basis of disease 2/5thedn. (Robbis, Cotran, Jumar (W.B.Sauders Co) (1995)(Prism Books Bangalore)
3. Davidson's Principles and Practice of Medicine (17thedn) (1995) C.Haslett, E.R. Chilvers (Churchill- Livingstone)
4. Clinical laboratory diagnosis by S.A Levinson and R.P MACFATE 7thEdn(1969) Lea and Febigea
5. Biochemical actions of Hormones by G. Litewck (Ed) Voll-14, 1973-1987, Academic press.
6. Endocrinology by L.G. Groot (Ed). 1995, Sandeers.
7. Principles of Biochemistry by GeofferyZubay, William W. Parson, Dennis E. Vance.(latest Edn)
8. Text Books of Biochemistry with clinical correlations by T.M Devlin (1997), John Wiley and Sons.
9. Dhamdher, D.M. (2012). Operating Systems: A concept Based Approach. New Delhi: Jain Publishing.
10. Vittal, N. and Mahalingam, S. (2001). Information Technology: India's Tomorrow. New Delhi: Manas.

Paper Code and Name	PG72T304A: Clinical Biochemistry
COURSE OUTCOMES (COs)	
After completing this paper, the students will be able to	
CO 1	Students will able to understand the blood groups, blood components and their disorder and diagnostic studies.
CO 2	The clinical application of enzymes and their role in diagnosis.
CO 3	To understanding, the various physiological role of kidney, liver, cardiac, gastric tract etc.,

PARTICULARS **Paper ET-3.1: CLINICAL BIOCHEMISTRY**	**Teaching Hours (Max. 50)**
Unit.1: CLINICAL BIOCHEMISTRY	1Hr
Unit 2 Blood: Composition of blood, Blood cells, Types of Anemias. 'CBC' complete blood count. Total and differential and platelet counts and their clinical significance. Blood group substances, Rhessus factor, nature of blood group antigens and rare blood groups. Hospital- laboratory methodology in blood and 'Rh' typing. 'ABO' and 'Rh' incompatibility (single and combined) and the dangers involved in foetal development and subsequent measures to reduce. Haemoglobinopthies, porphyries. 'ESR'(Erythrocyte sedimentation rate) determination and its importance in the diagnosis of certain diseases. Blood disorders-broad classification, blood coagulopatheis-broad classification, 'α' and 'β' Thallesemias. Plasma protein electrophoretic profile in health and disease, CSF analysis, **Mechanism of blood coagulation** and its regulation	10Hrs
Clinical enzymology:-Enzymes as markers in the diagnosis of diseases (like LDH, CPK, SGOT, SGPT).	4Hrs
Water balance and factors affecting it, electrolyte balance: in health and diseases.	5Hrs
Kidney Profile in health and disease: normal and abnormal constituents; clearance test and theirimportance is assessing kidney function supported by appropriate case study.	5 Hrs
Liver profile in health and disease, detoxification mechanisms, LFT and their clinical significance indiagnosis of liver diseases	5 Hrs
Gastric profile in heath and disease; Gastric function test, hypo and hyper acidity, ulcers.	5 Hrs
Cardiac profile tests in health and disease.	3 Hrs
Diagnostic importance of serological test like the pregnancy, WIDAL, VDRL tests- Importance of lab accreditation and quality control in a clinical biochemistry lab	5 Hrs
Importance of laboratory accreditation and quality control in a clinical biochemistry Laboratory.	4 Hrs
Endocrinology: Classification of hormones, general mechanism of hormone action, role of second messengers in signal transduction.	5 Hrs

References
1. Tietz fundamentals of clinical chemistry (5thedn) C.A. Beutis, E.R. Ashwood (eds) Saunders WB,. Co.
2. Robbins, Pathologic basis of disease 5thedn. (Robbis, Cotran, Jumar (W.B. Sauders Co)
3. Davidson's principles and practice of medicine (17thedn) C.Haslett, E.R.Chilvers (Churchill- livingstone)
4. Clinical laboratory diagnosis by S.A Levinson and R.P MACFATE 7thEdn(1969) Lea and Febigea
5. Medical Biochemistry: by N. MallikarjuanRao (2002) New age International (P) Ltd., New Delhi
6. Text Books of Biochemistry: Molecular and Clinical Aspects by S. Nagini (2002) Scitech publications (India) Pvt Ltd., Chennai
7. Vitamins and Hormones by G. Litwack (Ed) Vol 50, 1995, Academic Press.
8. Biochemical Actions of Hormones by G. Litewck (Ed) Voll-14, 1973-1987, Academic press.
9. Endocrinology by L.G. Groot (Ed). 1995, Saunders.
10. Principles of Biochemistry by GeofferyZubay, William W. Parson, Dennis E. Vance.(latest Edn)
11. Text Books of Biochemistry with clinical correlation by T.M Devlin (1997), Wiley-Liss
12. Biological membranes. Their structure and function (II Edn.,) (1980) Harrsion R.
13. Cellular Physiology of Nerve and Muscle (1998) Gary G. Mathews, Blackwell Scientific Inc.

Paper Code	PG72P301: Metabolism-I Practical's

and Name	
COURSE OUTCOMES (COs)	
After completing this paper, the students will be able to:	
CO 1	Students will learn and understand the various metabolic pathway that occur in the human body and also energy production.

PARTICULARS **Paper CP-3.4: METABOLISM-I PRACTICALS**	**(4Hr/Week)**
1. Determination of blood glucose by Sasaki method 2. Isolation of cholesterol from egg yolk. 3. Estimation of cholesterol by Zak's method. 4. Estimation of ascorbic acid by 2,4, Dinitrophenylhydrazine method 5. Determination of iodine number of oils and fats 6. Determination of saponification value of oils. 7. Isolation of starch from potato 8. Acid hydrolysis of starch 9. Isolation of chlorophylls 10. Spectral characterization of chlorophylls.	

References

1. Varley's Practical Clinical Biochemistry, 6thEdn. (1996) by Alan H. Gowenlock
2. Hawk's Physiological chemistry by Oser. (14thEdn 1976) Tata McGraw Hill publishing, company Ltd.
3. Clinical Biochemistry by Warley (1980) Vol. 1 & 2, Heinemann Medical
4. Modern Experimental Biochemistry by Rodney Boyer (2000) Third edition, Addison Wesley Longman
5. Practical Biochemistry by David Plummer, (1992)Tata McGraw-Hill Publishing
6. Practical Biochemistry: Principles and Techniques, 5th Edition, Edited by Keith Wilson and John Walker (2000) Cambridge University, Press.
7. Experimental Biochemistry (1976)by John M. Clark and Robert L. Swizer, W.H. Freeman and Company
8. Introduction to Practical Biochemistry (2000) Edited by S.K. Sawhney&Randhir Singh, Narosa Publishing House.

Paper Code and Name	PG72P302: Metabolism-II Practicals
COURSE OUTCOMES (COs)	
After completing this paper, the students will be able to:	
CO 1	Students will understand the bioenergetics explaining the production of energy currencies.
CO 2	Students will learn the metabolic pathways relevant to catabolism and anabolism of nitrogen compounds and its associated disease in related enzymes or amino acids or nucleic acids.
CO 3	Students will understand the bioenergetics explaining the production of energy currencies.

PARTICULARS **Paper CP-3.5: METABOLISM-II PRACTICALS**	**(4Hr/Week)**
1. Determination of ATP in biological systems 2. Measurement of O_2 uptake in mitochondrial ETC 3. Determination of oxygenase and catalase activities 4. Determination of glutathione in animal tissues 5. Estimation of urea 6. Determination of uric acid 7. Determination of bile pigments 8. Determination of activities of aminotransferases 9. Detection of phenylketonuria Determination of nucleotide coenzymes (NAD^+/FAD)	

References

1. Varley's Practical Clinical Biochemistry, 6thEdn. (1996) by Alan H. Gowenlock
2. Hawk's Physiological chemistry by Oser. (14thEdn 1976) Tata McGraw Hill publishing, company Ltd.
3. Clinical Biochemistry by Warley (1980) Vol. 1 & 2, Heinemann Medical
4. Modern Experimental Biochemistry by Rodney Boyer (2000) Third edition, Addison Wesley Longman
5. Practical Biochemistry by David Plummer, (1992)Tata McGraw-Hill Publishing
6. Practical Biochemistry: Principles and Techniques, 5th Edition, Edited by Keith Wilson and John Walker (2000) Cambridge University, Press.
7. Experimental Biochemistry (1976)by John M. Clark and Robert L. Swizer, W.H. Freeman and Company
8. Introduction to Practical Biochemistry (2000) Edited by S.K. Sawhney&Randhir Singh, Narosa Publishing House.

Paper Code and Name	PG72P303: Medical Biochemistry & Endocrinology Practical's
COURSE OUTCOMES (COs)	
After completing this paper, the students will be able to:	
CO 1	The basic concepts and principles of medical biochemistry, including the process of collection, storage and tests.
CO 2	The blood groups, blood components and their disorder and diagnostic studies.
CO 3	The clinical importance of organelles enzymes and their role in diagnosis. To understanding, various physiological role of kidney, liver, cardiac, gastric tract, etc.,

PARTICULARS **Paper CP-3.6: MEDICAL BIOCHEMISTRY AND ENDOCRINOLOGY**	**(4Hr/Week)**
1. Urine Analysis: Urine qualitative analysis for normal and abnormal constituent and urine microscopy for cells, casts and crystals. **2. Quantitative analysisof urine** a) Total titratable acidity b) Glucose c) Inorganic phosphorus d) Proteins. e) Creatine and creatinine **3. Blood analysis** a) Complete blood counts('CBC') b) Erythrocyte sedimentation rate determination ('ESR') c) Haemoglobin percentage determination d) Plasma protein electrophoresis (demonstration) 4. **Blood /serum quantitative analysis** a) Glucose b) Bilirubin c) Cholesterol d) Acid and alkaline phosphatase. **5. Endocrinology** a) Quantitative estimation of 17 keto steroids in urine.	
References	
1. Varley's Practical Clinical Biochemistry, 6thEdn. (1996) by Alan H. Gowenlock 2. Hawk's Physiological chemistry by Oser. (14thEdn 1976) Tata McGraw Hill publishing, company Ltd. 3. Clinical Biochemistry by Warley (1980) Vol. 1 & 2, Heinemann Medical Modern Experimental Biochemistry by Rodney Boyer (2000) Third edition, Addison Wesley Longman	

Paper Code and Name	PG72T401: Molecular Genetics & Immunology
COURSE OUTCOMES (COs)	
After completing this paper, the students will be able to:	
CO 1	Students will learn how human body fights with invading microorganism and pathogens.
CO 2	Students will understand the human genetics and related components.

PARTICULARS	Teaching Hours (Max. 50)
I: Molecular Genetics:	
1. Bacterial genetics: Bacterial chromosome, plasmids, fertility, resistance, colicins, virulent, metabolic and other factors. Transposable genetic elements, transformation and conjugation in bacteria, linkage map of bacterial chromosomes, recombination in bacteria.	**6 Hr**
2. Biochemical genetics: Human material, structure of chromosomes, chromosome banding, lampbrush and polytene chromosomes, chromosomal abnormalities, chromosomal proteins, introns, exons, pseudogenes, gene clusters, spacers, mapping of human genes, nature of inheritances, sex linked inheritance, Histones and nonhistones, nucleosomes.	**5 Hr**
3. Mutations: Types, mutagens, nature of mutation, mechanism of action of mutagens, suppressor mutation, genes and their importance, Temperature sensitive mutants, isolation of auxotrophic and nutritional mutant microbes replica plating.	**3 Hr**
4. **DNA** repair: Photoreaactivation, Excision, Post-replication and Recombinational DNA repair mechanisms.	**2 Hr**
II: Immunology :Organs and cells of the Immune system. Primary (Structure of Bone-marrow and Thymus) and secondary lymphoid organs. (Spleen, lymph node, MALT etc.). Hematopoiesis (Cells of Myeloid and lymphoid lineages), Production and maturation (Ontogeny) of T (TH, TC and TREG) and B (B1 and B2) lymphocytes. Positive and Negative selection, Central and peripheral tolerance	**4 Hr**
Innate Immune Response: Mechanical barriers to infection, Physiological factors contributing to innate immunity, Inflammatory response and Phagocytic system (Role of Mononuclear phagocytes, Macrophages, Neutrophils in innate immunity). Types of infections and nature of infective agents, Alternate and classical pathway of complement system	**4Hr**
Immunogenetics: Genetic model compatible with Ig structure, Multigene organization of Ig genes, Variable-region gene rearrangements and its mechanism, Theories of antibody formation (Clonal selection and Network). Molecular basis of antibody diversity–gene recombination, somatic hypermutation, N- and P-nucleotide insertion, Class switching, Regulation of Ig-Gene Transcription.	**4 Hr**

Antigens and Antibodies: Chemical complexity and molecular property of Antigens, Haptens, Epitopes, Paratope. Epitope analysis, Basis of antigen specificity.mmunoglobulin fine structure and classes, Antigenic determinants on mmunoglobulins, Immunoglobulin superfamily, monoclonal and polyclonal antibodies and their production by hybridoma technology.	**4Hr**
Antigen-Antibody Interactions: Principles, affinity and avidity and cross reacivity. TechniquesPrecipitation, Agglutination, Radioimmunoassay, Enzyme-Linked Immunosorbent Assay, Western Blotting, , Immunofluorescence, , Immunoelectron Microscopy	**4Hr**
Adaptive immune response: Primary and secondary immune response. Nature of T and B cell surface receptors, Major Histocompatibility Complex- Molecular organization of MHC molecules (H-2, HLA), Structure of MHC molecules. Class I MHC-peptide and Class II MHC-Peptide interactions. Antigen presenting cells (APCs), Antigen processing and presentation by endo and exogenous pathways.	**5Hr**
Immune effector mechanisms – Immunological tolerance, Hypersensitivity: Immediate (type I, type II, type III) and delayed hypersensitivity reactions.	**3Hr**
Autoimmunity-Organ specific (Hashimoto's thyroiditis and Myasthenia Gravis)and systemic (Rheumatoid arthritisand Systemic lupus erythematosus) diseases. Tissue transplantation - auto, allo, iso and xenograft, , transplantation rejection, mechanism and control, immunosuppressive agents. Cancer-immunology – Tumor associated antigens, Immunological surveillance of cancer.	**4 Hr**
Cytokines: Properties and functions of lymphokines, monokines, interleukins and chemokines; Transplantation Immunology: Mechanism of graft rejection and Immunosuppressivetherapy	**2Hr**

References

1. Biochemistry (V Ed 2002) Lubertstrayer, W.H. Freeman and Co.,
2. Biochemistry (III Ed 1999) Voet, D. and Voet J.G. Jhon Wiley and Sons.
3. Molecular Cell Biology, 4th edition, (2000) by Lodish Harvey, Arnold Berk, S. Lawrence Ziursky, Paul Matsufaira, Daid Baltimore, James Durnel (W.H. Freeman and Company)
4. Genes VII Benjamin Lewin (Ed 2000) University Oxford Press
5. Microbial Biotechnology by Alexander, Glaser &ItiroslniNikaido 2ndedn Freeman and Co. (1998)
6. Molecular conning: A Laboratory manual, 3rdedn. (2001) by J. Sambrock and Russel, Spring Horbour Laboratory press.
7. Principles of Gene Manipultion 6thEdn. (2001) by S.B. Primose, R.M. Tqyman, R.W. Old, Blankwell Scientific
8. Molecular Biology of the cell by Alberts et al., (1989) Garland publications
9. DNA Clonning: A Practical approach by D.M. Gover (1985) Vol. 1. and 2, IRL press.
10. Plant cell culture by W. Horn's and K.J. Opara (1994) IRL press, Oxford University
11. Basic & Clinical Immunology (4thedn.) by Daniel P, Stabo, John D. Fudenberg H, Hugu, Wells, J. Vivian Stites (1982) Lange
12. Roitt's Essential Immunology; Ivan M. Roitt& Peter J Delves (2001) Blackwell Science
13. Immunology/Ivan Roitt, Jonathan Brostoff, David Male (6thedn.) (2001) Mosby
14. Introduction to Immunology; Kim bell (Ed) (1990) 3 Ed McMillan
15. Kuby-Immunology; Goldsby et al., (2006), W.H. Freeman & Co.

Paper Code and Name	PG72T402: Molecular Biology
COURSE OUTCOMES (COs)	
After completing this paper, the students will be able to:	
CO 1	Student will explain genes and their activities in molecular terms.
CO 2	Student will study in detail the structure & activity of genes and the experimental evidence underlying those concepts.
	The student will learn the structure & functions of DNA and entrains basic converge of DNA replication and gene expression.

PARTICULARS	Teaching Hours (Max. 50)
1. DNA replication:Semiconservative mode of replication. Experimental evidences, DNA unwinding, Topological problems, linking numbers and role of topoisomerases, direction of replication DNA polymerases I, II and III their role in DNA synthesis, Termination of replication. Nearest neighboring frequency analysis. Mechanism of E. coli replication. Single standard DNA, synthesis of phage DNA, rolling cycle model. Replication of eukaryotic and mitochondrial DNA, restriction and modification of DNA. Inhibitors of DNA replication.	**15Hr**
2. **Transcription**: Biosynthesis of RNA, role of RNA polymers, structure, properties and mechanism of transcription, Transcription factors, inhibitors of transcription, mechanism of splicing, processing of RNA's into mRNA, RNA and tRNA in eukaryotes and prokaryotes**,** RNA replicase and its role, polynucleotide phosphorylase reaction and its significance, reverse transcription and its mechanism, RNA dependent DNA polymerase, post transcriptional processing of RNAs.	**10Hr**
3. **Genetic code:** Biologicalsignificance of degeneracy, methods employed to decipher genetic code, size of the codon, triplet code studies by Khorana and Nirenberg. Feature of genetic code, wobble hypothesis coding property of tRNA, mitochondrial-genetic code.	**3Hr**.
4. **Translation and protein targeting**: Structural organization of ribosomes in prokaryotes and eukaryotes. Role of mRNA and tRNA in protein biosynthesis,. Stages in protein biosynthesis. Site and direction of protein biosynthesis. Amino acid activation. Formation of amino acyl tRNA**,** chain initiation, elongation and termination. Mechanism of synthesis of proteins. The role of various factors. Post translational modification of proteins. Inhibition of protein biosynthesis in eukaryotic	**12Hr**.

and prokaryotic system, protein targeting, synthesis of secretary and membrane proteins., signal sequence hypothesis. Mechanism of translational control.	
5. **Regulation of gene expression:** Gene regulation principles, Differences between prokaryotic and eukaryotic gene regulation, transcriptional control. Enzyme induction and repression. Jacob Monad operon model. Operon hypothesis The study of lac operon and its mechanisms of expression, as an example of + ve and – ve regulation, characteristic properties of lac repressor. Catabolite repression, role of cAMP and catabolite gene activator protein (CAP) in catabolite repression. Translational control, Si RNAs. A brief study of other operons, arabinose & tryptophan, attenuation. A brief account of regulation of gene expression in eukaryotes**.**	**12 Hr**

References:

1. Biochemistry (V Ed 2002) Lubertstryer, W.H. Freeman and Co.,
2. Biochemistry (III Ed 1999) Voet, D. and Voet J.G. Jhon Wiley and Sons.
3. Molecular Cell Biology, 4th edition, by Lodish Harvey, Arnold Berk, S.
Lawrence Ziursky, Paul Matsufaira, Daid Baltimore, James Durnel (W.H. Freeman and Company)
4. Genes VII Benjamin Lewin (Ed 2000) University Oxford Press
5. Molecular Biology of the cell by Albertsetal, (1989) Garland publications.

Paper Code and Name	PG72T403: Biotechnology
COURSE OUTCOMES (COs)	
After completing this paper, the students will be able to:	
CO 1	Explain the various tools used in rDNA, viz., plasmid, restriction enzymes
CO 2	Identify the various expression systems
CO 3	Yeast as an expression system,
CO 4	Understand the application of plant biotechnology. And cell biotechnology. Apply the bioinformatics tools and understand the various biostatics for analytical applications

PARTICULARS	Teaching Hours (Max.50)
1. **Introduction:** Scope of Biotechnology	**1 Hr**
2. Recombinant DNA technology: Basic principles of gene cloning cDNA cloning, construction of gene libraries strategies tissue specific mRNAs. Preparation of cDNA, alternative strategy of Okyama and Berg for cDNA synthesis insertion of target fragments into vectors by different methods. E.coli and other species in cloning plasmid cloning, vectors, plasmid size range, phenotypic traits, amplification, common plasmids like PBR-322, PUC, phagse vectors, lambda phage M-13 SV-40, cosmids. phagemids, shuttle vectors, identification of recombinants- direct selection immunochemical detection and protein activity method.	**13 Hr**
3. **Restriction enzymes**: classification, isolation of gene fragments using restriction endonucleases and mechanical shear, fractionation by centrifugation**,** electrophoresis**,**nucleic acid hybridization technique. Construction and design of primers, PCR chemical synthesis, blotting technique.	7 **Hr**.
4.Expression of foreign DNAcomparision of transcription initiation signals in prokaryotic and eucaryotics. Lac promoter, trp promoter, tac promoter**.** Synthesis of eukaryotic proteins on commercial scale production of insulin, construction of gene libraries, diagnostic probes of genetic diseases, site specific mutagenesis.	6 **Hr**
5. Cloning in yeast-development of yeast vectors, YIP. YEP, YAC selection and expression of clones.	2 **Hr**.
6.. Plant biotechnology – plant tissue culture, isolation of plant protoplasm's - Ti-plasmid or agrobacterium tumerfaceins and other bacteria, caulimo virus. Introduction of desirable gene in plants phage, mediated transfer. Introduction of desirable gene in plants. Phage mediated transfer, Application of transgenic plants, Salinity & drought resistant plants, insect resistant plants**,** Golden rice**,** delayed senescence**,**	7 **Hr**
7.Cell biotechnology: Animal cell culture, cloning in mammalian cells transgenic animals, methods of introducing genes into eukaryotic cells and c**hr**omosomes, reproductive and therapeutic cloning, gene therapy.	5 **Hr**
8. Biosensors: Principle of biosensors and biochipsand their applications.	**1Hr**
9.Bioinformatics and Biostatistics: Bioinformatics- Archives of biological databases, Computer Operating system, Application software, Protein Modelling, Concepts of Drug designing.**Biostatistics -** Uses, Analytical Considerations of Experimental error, selecting an analytical methods, Nature of experimental errors, Precession, Coeffienecnt of variation, Variance. Population statistics- Probability- rules of probability, binomial distribution, Normal distribution, Confidence intervals, Confidence Limits and Student's t Factor, Criteria for the rejection of outlier experimental Data. Validation of analytical method, Analysis of Standarat solution: one sample t-Test. ANOVA. P Value.	8 **Hr**

References:

1. Biochemistry (V Ed 2002) LubertStryer, W.H. Freeman and Co.,
3. Biochemistry (III Ed 1999) Voet, D. and Voet J.G. John Wiley and Sons.
4. Biochemistry (III Ed 1999) Mary. K CambellHarcocrt Brace college Publishers.
5. Molecular Cell Biology, 4th edition, (2000) by Lodish Harvey, Arnold Berk, S. Lawrence Ziursky, Paul Matsufaira, Daid Baltimore, James Durnel (W.H. Freeman and Company)
6. Principles of information technology second edn. P.F. Stanbay, and S.J. Hall, Butterwort Hiremann 1995
7. Bioinformatics-sequence, Structure and detabanks Edited by thgginstaylor. W (2001) (Oxford University Press)
8. Principles of Biotechnology by Wiseman, A surrey (1998) Oxford University Press
9. Molecular cloning: A Laboratory manual, 3rdedn. (2001) by J. Sambrock and Russel, Spring Harbor Laboratory press.
10. Principles of Gene Manipultion 6thEdn. (2001) by S.B. Primose, R.M. Tqyman, R.W. Old, Blankwell Scientific
11. DNA Cloning: A Practical approach by D.M. Gover (1985) Vol. 1. and 2, IRL Press.
12. Plant cell culture by W. Horn's and K.J. Opara (1994) IRL press, Oxford University
13. Applied and Fundamental Aspects of plant cell, Tissue and organ culture by J.R. Reinert and Y.P.S. Bajaj (1997) Narosa Publications.
14. PCR Technology: and Application for DNA Amplification by H.A Erlich (Ed) (1989) Stocketon press.
15. Recombinant DNA: A short course by J.D. Watson, J. Toose and D.T. Kurtz (1983) Scientific American Books/Freeman**.**

Paper Code and Name	PG72T404B: Project
COURSE OUTCOMES (COs)	
After completing this paper, the students will be able to:	
CO 1	After rigorous training during their project tenure, students will able to gain comprehensive hands on training in the field of various research fields such as Biodegradation, Neuorochemistry, Glycobiology and Protein Biology.
CO 2	Literature survey on the topic .
CO 3	Basics of research methodology and design of experiments.
CO 4	Preparation of manuscript for publication.
CO 5	Execution of research work by various techniques
CO 6	Presentation of research data in the conferences/seminars

Paper Code and Name	PG72P401: Molecular Genetics & Immunology Practical's
COURSE OUTCOMES (COs)	
After completing this paper, the students will be able to:	
CO 1	Students will learn how human body fights with invading microorganism and pathogens.
CO 2	Students will understand the human genetics and related components.

Paper CP-4.5: MOLECULAR BIOLOGY & IMMUNOLOGY PRACTICALS (4Hr/Week)

1. Isolation of RNA from microbial source
2. Estimation of RNA by Orcinol method
3. Characterization of RNA by spectroophotmetry
4. Preparation of polyribosomes.
5. Mutations by UV irradiation and photoreactivation
6. Designing of primers.
7. Amplification of DNA by PCR technique
8. Agarose gel electrophoresis of DNA
9. Transformation of bacteria by $CaCl_2$ method

References

1. Plant cell culture by W. Horns and K.J. Opara (1994) IRL press, Oxford University
2. Applied and Fundamental Aspects of plant cell, Tissue and organ culture by J.R. Reinert and Y.P.S. Bajaj(1997) Narosa Publications.
3. PCR Technology: and Application for DNA Amplification by H.A Erlich(Ed 1989) Stocketon press.
4. Recombinant DNA: A short course by J.D. Watson, J. Toose and D.T. Kurtz (1983) Scientific American Books/Freeman.
5. Hand book of Molecular Biology (Cold spring Harbor) Maniatis and Maniatis
6. IRL

Paper Code and Name	PG72T402: Molecular BiologyPracticals
COURSE OUTCOMES (COs)	
After completing this paper, the students will be able to:	
CO 1	• Student will explain genes and their activities in molecular terms.
CO 2	• Student will study in detail the structure & activity of genes and the experimental evidence underlying those concepts.
	• The student will learn the structure & functions of DNA and entrains basic converge of DNA replication and gene expression.

Paper CP-4.5: MOLECULAR BIOLOGY PRACTICALS (4Hr/Week)
10. Isolation of RNA from microbial source 11. Estimation of RNA by Orcinol method 12. Characterization of RNA by spectroophotmetry 13. Preparation of polyribosomes. 14. Mutations by UV irradiation and photoreactivation 15. Designing of primers. 16. Amplification of DNA by PCR technique 17. Agarose gel electrophoresis of DNA 18. Transformation of bacteria by $CaCl_2$ method
References
7. Plant cell culture by W. Horns and K.J. Opara (1994) IRL press, Oxford University 8. Applied and Fundamental Aspects of plant cell, Tissue and organ culture by J.R. Reinert and Y.P.S. Bajaj(1997) Narosa Publications. 9. PCR Technology: and Application for DNA Amplification by H.A Erlich(Ed 1989) Stocketon press. 10. Recombinant DNA: A short course by J.D. Watson, J. Toose and D.T. Kurtz (1983) Scientific American Books/Freeman. 11. Hand book of Molecular Biology (Cold spring Harbor) Maniatis and Maniatis 12. IRL

Paper Code and Name	PG72T403: Biotechnology
COURSE OUTCOMES (COs)	
After completing this paper, the students will be able to:	
CO 1	Explain the various tools used in rDNA, viz., plasmid, restriction enzymes
CO 2	Identify the various expression systems
CO 3	Yeast as an expression system,
	Understand the application of plant biotechnology. And cell biotechnology. Apply the bioinformatics tools and understand the various biostatics for analytical applications

Paper CP-4.6 BIOTECHNOLOGY PRACTICALS (4Hr/Week)

1. Isolation of DNA from bacterial cells
2. Characterization of DNA by UV Spectroscopy
3. Estimation of DNA by diphenylamine method
4. Restriction digestion of isolated DNA.
5. Induction of β-galactodidase by lactose in *E coli.*
6. Application of MS EXCEL for the calculation of Standard Deviation and Plotting the graph.
7. Introduction to SPSS, PRISM special features such as L-B Plot.
8. Exploration of Biological Databases for Literature survey
9. Comparative sequence analysis by FASTA and BLAST
10. Rosmol for analysis of Protein structure.

References

1. Biochemical Techniques-theory and practical by John T. Robert and Bernad J White
2. Biotechnology laboratory course 2nd edn. By Jeffery M. Becker, Guy A Caldwell and Eve Ann Zachicago
3. Modern Experimental Biochemistry by Rodney Boyer (2000) Third edition, Addison Wesley Longman
4. Practical Biochemistry by David Plummer, (1992) Tata McGraw-Hill Publisher
5. Practical Biochemistry: Principles and Techniques, 5th Edition, Edited by Keith Wilson and John Walker (2000) Cambridge University, Press.
6. Experimental Biochemistry (1976) by John M. Clark and Robert L. Swizer, W.H. Freeman and Company
7. Introduction to Practical Biochemistry (2000) Edited by S.K. Sawhney&Randhir Singh, Narosa Publishing House.