KARNATAK UNIVERSITY, DHARWAD
ACADEMIC (S&T) SECTION

ಕರ್ನಾಟಕ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಧಾರವಾಡ
ವಿದ್ಯಾಮಂಡಳ (ಎಸ್&ಟಿ) ವಿಭಾಗ

ಸ್ವಾತಂತ್ರ್ಯದ ಅಮೃತ ಮಹೋತ್ಸವ

Tele: 0836-2215224
e-mail: academic.st@kud.ac.in
Pavate Nagar,Dharwad-580003
ಪಾವಟೆ ನಗರ, ಧಾರವಾಡ – 580003

NAAC Accredited 'A' Grade 2014

website: kud.ac.in

No. KU/Aca(S&T)/JS/MGJ(Gen)/2024-25/436 Date: 11 NOV 2024

ಅಧಿಸೂಚನೆ

ವಿಷಯ: ರಾಷ್ಟ್ರೀಯ ಶಿಕ್ಷಣ ನೀತಿಯನುಸಾರ 2024–25ನೇ ಶೈಕ್ಷಣಿಕ ಸಾಲಿನಿಂದ ಎಲ್ಲ ಸ್ನಾತಕೋತ್ತರ ಪದವಿಗಳಿಗೆ / ಸ್ನಾತಕೋತ್ತರ ಡಿಪ್ಲೋಮಾಗಳಿಗೆ ಪಠ್ಯಕ್ರಮವನ್ನು ಪ್ರಕಟಣೆ ಕುರಿತು.

ಉಲ್ಲೇಖ: 1. ವಿದ್ಯಾವಿಷಯಕ ಪರಿಷತ್ ಸಭೆಯ ನಿರ್ಣಯ ಸಂಖ್ಯೆ: 2 ರಿಂದ 9, ದಿ: 08.11.2024.

2. ಮಾನ್ಯ ಕುಲಪತಿಗಳ ಅನುಮೋದನೆ ದಿನಾಂಕ: 11.11.2024.

ರಾಷ್ಟ್ರೀಯ ಶಿಕ್ಷಣ ನೀತಿಯನುಸಾರ 2024–25ನೇ ಶೈಕ್ಷಣಿಕ ಸಾಲಿನಿಂದ ಅನ್ವಯವಾಗುವಂತೆ, ಕರ್ನಾಟಕ ವಿಶ್ವವಿದ್ಯಾಲಯದ ಎಲ್ಲ ಸ್ನಾತಕೋತ್ತರ ಪದವಿಗಳಾದ M.A./ M.Sc / M.Com / MBA / M.Ed 1 ರಿಂದ 4ನೇ ಸೆಮೆಸ್ಟರ್‌ಗಳಿಗೆ ಮತ್ತು 1 & 2ನೇ ಸೆಮೆಸ್ಟರ್‌ಗಳ ಸ್ನಾತಕೋತ್ತರ ಡಿಪ್ಲೋಮಾಗಳಿಗೆ ವಿದ್ಯಾವಿಷಯಕ ಪರಿಷತ್ ಸಭೆಯ ಅನುಮೋದನೆಯೊಂದಿಗೆ ಈ ಕೆಳಗಿನಂತೆ ಪಠ್ಯಕ್ರಮಗಳನ್ನು ಅಳವಡಿಸಿಕೊಳ್ಳಲಾಗಿದೆ. ಕಾರಣ, ಸಂಬಂಧಪಟ್ಟ ಎಲ್ಲ ಸ್ನಾತಕೋತ್ತರ ವಿಭಾಗಗಳ ಅಧ್ಯಕ್ಷರು / ಸಂಯೋಜಕರು / ಆಡಳಿತಾಧಿಕಾರಿಗಳು / ಮಹಾವಿದ್ಯಾಲಯಗಳ ಪ್ರಾಚಾರ್ಯರುಗಳು / ಶಿಕ್ಷಕರು ಸದರಿ ಪಠ್ಯಕ್ರಮಗಳನ್ನು ಅನುಸರಿಸುವುದು ಮತ್ತು ಸದರಿ ಪಠ್ಯಕ್ರಮವನ್ನು ಕ.ವಿ.ವಿ. ಅಂತರ್ಜಾಲ www.kud.ac.in ದಲ್ಲಿ ಭಿತ್ತರಿಸಲಾಗಿದನ್ನು ಸಂಬಂಧಪಟ್ಟ ವಿದ್ಯಾರ್ಥಿಗಳಿಗೆ ಸೂಚಿಸುವುದು.

Arts Faculty

Sl.No	Programmes	Sl.No	Programmes
1	Kannada	8	MVA in Applied Art
2	English	9	French
3	Folklore	10	Urdu
4	Linguistics	11	Persian
5	Hindi	12	Sanskrit
6	Marathi	13	MPA Music
7	MVA in Painting		

Faculty of Science & Technology

Sl.No	Programmes	Sl.No	Programmes
1	Geography	10	M.Sc (CS)
2	Chemistry	11	MCA
3	Statistics	12	Marine Biology
4	Applied Geology	13	Criminology & Forensic Science
5	Biochemistry	14	Mathematics
6	Biotechnology	15	Psychology
7	Microbiology	16	Applied Genetics
8	Zoology	17	Physics
9	Botany	18	Anthropology

Faculty of Social Science

Sl.No	Programmes	Sl.No	Programmes
1	Political Science	8	Journalism m & Mass Commn.
2	Public Administration	9	M.Lib. Information Science
3	History & Archaeology	10	Philosophy
4	A.I.History & Epigraphy	11	Yoga Studies
5	Economics	12	MTTM
6	Sociology	13	Women's Studies
7	MSW		

Management Faculty

Sl.No	Programmes	Sl.No	Programmes
1	MBA	2	MBA (Evening)

Faculty of Commerce

Sl.No	Programmes	Sl.No	Programmes
1	M.Com	2	M.Com (CS)

Faculty of Education

Sl.No	Programmes	Sl.No	Programmes
1	M.Ed	2	M.P.Ed

OEC subject for PG

Sl.No	Programmes	Sl.No	Programmes
1	Russian	5	Veman Peetha
2	Kanaka Studies	6	Ambedkar Studies
3	Jainology	7	Chatrapati Shahu Maharaj Studies
4	Babu Jagajivan Ram	8	Vivekanand Studies

PG Diploma

Sl.No	Programmes	Sl.No	Programmes
1	PG Diploma in Chatrapati Shahu Maharaj Studies	2	P.G. Diploma in Women's Studies
3	P.G. Diploma in Entrepreneurial Finance		

ಕುಲಸಚಿವರು.

ಅಡಕ: ಮೇಲಿನಂತೆ

ಗೆ,

1. ಕ.ವಿ.ವಿ. ಸ್ನಾತಕೋತ್ತರ ಅಧ್ಯಕ್ಷರುಗಳಿಗೆ / ಸಂಯೋಜಕರುಗಳಿಗೆ / ಆಡಳಿತಾಧಿಕಾರಿಗಳಿಗೆ / ಮಹಾವಿದ್ಯಾಲಯಗಳ ಪ್ರಾಚಾರ್ಯರುಗಳಿಗೆ
2. ಎಲ್ಲ ನಿಖಾಯದ ಡೀನರು, ಕ.ವಿ.ವಿ. ಧಾರವಾಡ.

ಪ್ರತಿ:

1. ಕುಲಪತಿಗಳ ಆಪ್ತ ಕಾರ್ಯದರ್ಶಿಗಳು, ಕ.ವಿ.ವಿ. ಧಾರವಾಡ.
2. ಕುಲಸಚಿವರ ಆಪ್ತ ಕಾರ್ಯದರ್ಶಿಗಳು, ಕ.ವಿ.ವಿ. ಧಾರವಾಡ.
3. ಕುಲಸಚಿವರು (ಮೌಲ್ಯಮಾಪನ) ಆಪ್ತ ಕಾರ್ಯದರ್ಶಿಗಳು, ಕ.ವಿ.ವಿ. ಧಾರವಾಡ.
4. ಅಧೀಕ್ಷಕರು, ಪ್ರಶ್ನೆ ಪತ್ರಿಕೆ / ಗೌಪ್ಯ / ಜಿ.ಎ.ಡಿ. / ವಿದ್ಯಾಂಡಳ (ಪಿ.ಜಿ.ಪಿಎಚ್.ಡಿ) ವಿಭಾಗ/ ಸಿಸ್ಟಮ್ ಅನಾಲೆಸಿಸ್ಟ್ / ಸಂಬಂಧಿಸಿದ ಪದವಿಗಳ ವಿಭಾಗಗಳು, ಪರೀಕ್ಷಾ ವಿಭಾಗ, ಕ.ವಿ.ವಿ. ಧಾರವಾಡ.
5. ನಿರ್ದೇಶಕರು, ಕಾಲೇಜು ಅಭಿವೃದ್ಧಿ / ವಿದ್ಯಾರ್ಥಿ ಕಲ್ಯಾಣ ವಿಭಾಗ, ಕ.ವಿ.ವಿ. ಧಾರವಾಡ.
6. ನಿರ್ದೇಶಕರು, ಐ.ಟಿ. ವಿಭಾಗ, ಕ.ವಿ.ವಿ. ಧಾರವಾಡ ಇವರಿಗೆ ಕ.ವಿ.ವಿ. ಅಂತರ್ಜಾಲದಲ್ಲಿ ಪ್ರಕಟಿಸುವುದು.

KARNATAK UNIVERSITY, DHARWAD

Faculty of Science and Technology

Two Years PG Programme

M. Sc. in Biochemistry

Programme Structure and Syllabus

As per NEP-2020

With Effect from 2024-25

GENERAL INSTRUCTIONS

I. CREDIT, WORKLOAD AND SYLLABUS EQUIVALENCE

1. One credit is equal to 1 hour theory teaching per week.
2. One credit is equal to 2 hour practical teaching per week.
3. One credit is equal to 15 hours theory syllabus per semester (1 Unit is equal to 15 Hours)
4. One credit is equal to 30 hours practical syllabus per semester (1 credit practical is equal to 2 hours/ week)

A. Workload for theory subjects

1. There shall be 16 hours/week workload for Assistant Professor
2. There shall be 14 hours/week workload for Associate Professor/ Professor/Senior Professor.
3. There shall be 2hours/week workload relaxation for Guiding Ph. D. students

B. Workload for practical subjects

1. There shall be 20 hours/week workload for Assistant Professor
2. There shall be 18 hours/week workload for Associate Professor/ Professor/Senior Professor.
3. There shall be 2hours/week workload relaxation for Guiding Ph. D. students

C. Workload for practical batches

1. A batch of 10-12 students shall have 1 teacher

D. Workload for Project

1. Students for projects/internship shall be preferably guided by permanent faculty for atleast10 students by sharing equally among the permanent faculty. If remained excess shall be allotted to other teacher's on roll on temporary basis.
2. If there are no permanent faculty, the students shall be distributed among the temporary teachers on roll.
3. There shall be maximum of 4 hours/week workload for guiding the students for project work irrespective of number of students.

II. ALLOTMENT OF SPECIALIZATION: While allotting specialization in 3rd and 4th semester, minimum of 10 students shall have to select the specialization.

III. **ATTENDANCE:** 75% attendance is mandatory for every course (paper). No marks are reserved for attendance. If the candidates fail to fulfil 75% attendance in any one of the course (paper) in the given semester, such candidate is not eligible to appear for examination in all the papers and candidate has to get the readmission for such semester. However, up to 20% attendance may be condoned with the supportive documents for a student who represents University /State/National level sports, cultural and other events. Monthly attendance shall be displayed on notice board.

IV. CREDIT AND MARKS EQUIVALENCE

1. Generally, 20% weightage for Formative assessment and 80% weightage for Summative assessment.
2. Up to 2 credits equal to 50 marks (10 marks Formative assessment and 40 marks summative assessment).
3. 3-4 credits equal to 100 marks (20 marks Formative assessment and 80 marks summative assessment).
4. 5-6 credits equal to 150 marks (30 marks Formative assessment and 120 marks summative assessment).
5. Example for 100 marks out of which 20 marks for Formative assessment i.e., Formative Assessment shall be in two internal assessments i.e.: 10 marks I.A. for 8^{th} week and 10 marks for 14^{th}week of every semester.

V. CONDUCT OF EXAMINATION

1. Formative assessment examination shall be conducted for 1hr. There shall not be any provision for improvement. A special Formative assessment examination shall be conducted for a student who represents University/State /National level sports, cultural and other events if a schedule is overlapping.
2. 80 marks summative theory examination shall be conducted for 3 hrs and 40 marks for 1.5 hrs.
3. 80/ 40 marks Formative / Summative Practical examination shall be conducted for 4 hrs.
4. There shall be a single examiner for both even and odd semesters' Formative Practical examination.
5. There shall be a single examiner for odd semester Summative Practical examination and two examiners for even semester Summative Practical examination; one from internal and other shall be external examiner.

VI. ASSESSMENT

1. **Theory papers:** There shall be a single valuation for odd semester theory papers preferably internal examiner and double valuation for even semesters; one from internal and other shall be external examiner.
2. **Project/Internship assessment**

A) **For150 marks Project/Internship assessment (Wherever applicable)**

Project/Internship assessment

1. Formative Assessment : Project/Internship assessment carrying 30 marks out of 150 marks
Interaction with the project supervisor and submission of progress reports=30 marks

2. Summative Assessment : Project/Internship assessment carrying 120 marks out of 150 marks

(a) Internal Assessment: 30 marks

(b) Project report submission: 50 marks

(c) Presentation: 40 marks

(d) Viva-voce: 30 marks

Total 150 marks

VII. PASSING CRITERIA

1. There shall be no minimum passing marks for Formative assessment.
2. Candidate has to score minimum 40% in summative examination and fulfill 40% of the maximum marks including Formative assessment marks. For example: for 80 marks summative examination, candidate has to score minimum of 32 marks (40%) and should score cumulatively 40 marks including formative assessment in every course.

VIII. DECLARATION OF RESULT

1. Candidate has to score 40% as above in all the courses to pass the semester end examination to declare pass.
2. Percentage and Grading: Result shall be declared in terms of SGPA and at the end of four semesters as CGPA. The calculation of CGPA is as under
3. If P is the percentage of marks secured (IA + semester end score) by the candidate in a course which is rounded off to the nearest integer, the grade point (GP) earned by the candidate in that course will be given as below.

Percentage (%)	Grade(GP)	Percentage (%)	Grade(GP)
40	4.0	71-75	7.5
41-45	4.5	76-80	8.0
46-50	5.0	81-85	8.5
51-55	5.5	86-90	9.0
56-60	6.0	91-95	9.5
61-65	6.5	96-100	10.0
66-70	7.0		

Grade point of less than 4 shall be considered as fail in the course, hence, GP=0 and for the absent candidate also GP=0

4. A student's level of competence shall be categorized by grade point (GP), Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA) of the programme.
5. **Semester Grade Point Average (SGPA):** The SGPA is a ratio of sum of the number of Credit Grade Points scored from all the courses (subject) of given semester to the total credits of such semester in which the candidate studied. (Credit Grade Points of each course = Credits x GP).
6. **Cumulative Grade Point Average (CGPA):** It is calculated as below for 4 semester

programme.

CGPA=($Credit_1$ x $SGPA_1$) + ($Credit_2$ x $SGPA_2$) +($Credit_3$ x $SGPA_3$) + ($Credit_4$ x $SGPA_4$) / Total credits of programme (sum of credits of 4 semesters).

7. After studying and passing, all the credits prescribed for the programme the degree shall be awarded with CGPA score after rounding off to second decimal and class distinguishing as second class, first class, and distinction along with grade letter as under:

CGPA of the programme(Degree)	**Class obtained**	**Grade Letter**
9.5 to 10.00	Outstanding	A^{++}
7.00 to 9.49	Distinction	A^{+}
6.00 to 6.99	First Class	A
5.50 to 5.99	Second class	B^{+}
5.00 to 5.49		B
4.00 to 4.99	Pass	C
Less than 4.0	Fail/ Reappear	D

8. Each semester Grade Card shall have marks and SGPA and final Grade Card shall have semester wise marks obtained in all semesters, CGPA and % of cumulative marks obtained from all semesters.
9. There shall be Revaluation / Challenge valuations provisions as per the prevailing rules and regulations.
10. Marks obtained from the OEC shall not be considered for award of CASH PRIZE / RANK / GOLD MEDAL.

IX. MAXIMUM DURATION FOR COMPLETION OF THE PROGRAMME

A candidate admitted to any P.G. Programme shall complete it within a period, which is double the duration of the programme from the date of admission.

X. ANY OTHER TERMS AND CONDITIONS

Apart from the above, the prevailing rules and regulation are valid for any other matters which are not addressed in this regard.

11. AWARD OF GOLD MEDALS

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

- The Vamanrao Kore 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's Sridevi Gold Medal
- Dr. Mumtaz Ahmed Khan Gold Medal
- Late (Smt) Padmabai Balajirao Koimattur Gold Medal
- Prof. M. Madaiah Memorial Gold medal

XII. 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.

XIII. 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.

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, Bioremediation, Nanotechnology, Neuroscience, Protein Biochemistry, 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 (Subject Code: 72)

1. PROGRAMME OUTCOMES:

- The Master of Science programme at Karnatak University helps to develop a scientific temper and creative abilities useful for societal wellbeing and development with advancement in the field of science and technology.
- The programme ignites independent thinking responsible for self-learning as well as development of transferable quantitative skills.
- It helps to demonstrate leadership and collaborative research.
- Apart from scientific knowledge, the students will be imbibed with realization of human values, a sense of social responsibility to become responsible and dutiful citizens.

2. PROGRAMME SPECIFIC OUTCOMES:

- 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.

I-SEMESTER

Sem	Type of course	Theory/ Practical	Course Code	Course Title	Instruction / week	Total hours / Sem	Duration of exam	Formative	Summative	Total marks	Credits
I	DSC-1	Theory	A1BIC001T	Bioorganic and Cell Biology	4	60	3	20	80	100	4
	DSC-2	Practical	A1BIC005P	Bioorganic and Cell Biology Practicals	4	56	4	10	40	50	2
	DSC-3	Theory	A1BIC002T	Analytical Biochemistry	4	60	3	20	80	100	4
	DSC-4	Practical	A1BIC006P	Analytical Biochemistry Practicals	4	56	4	10	40	50	2
	DSC-5	Theory	A1BIC003T	Biochemistry of Macromolecules	4	60	3	20	80	100	4
	DSC-6	Practical	A1BIC007P	Biochemistry of Macromolecules Practicals	4	56	4	10	40	50	2
	DSC-7	Theory	A1BIC004T	Physiology & Nutrition	4	60	3	20	80	100	4
	DSC-8	Practical	A1BIC008P	Physiology and Nutrition Practicals	4	56	4	10	40	50	2
								120	**480**	**600**	**24**

II-SEMESTER

Sem	Type of course	Theory/ Practical	Course Code	Course Title	Instruction / week	Total hours / Sem	Duration of exam	Formative	Summative	Total marks	Credits
II	DSC-9	Theory	A2BIC001T	Enzymology	4	60	3	20	80	100	4
	DSC-10	Practical	A2BIC004P	Enzymology Practicals	4	56	4	10	40	50	2
	DSC-11	Theory	A2BIC002T	Metabolism of Fuel Molecules and Bioenergetics	4	60	3	20	80	100	4
	DSC-12	Practical	A2BIC005P	Metabolism of Fuel Molecules and Bioenergetics Practicals	4	56	4	10	40	50	2
	DSC-13	Theory	A2BIC003T	Plant and Microbial Biochemistry	4	60	3	20	80	100	4
	DSC-14	Practical	A2BIC006P	Plant and Microbial Biochemistry Practicals	4	56	4	10	40	50	2
	OEC-1	Theory	A2BIC204	Analytical Techniques	4	60	3	20	80	100	4
								110	**440**	**550**	**22**

III-SEMESTER

Sem	Type of course	Theory/ Practical	Course Code	Course Title	Instruction / week	Total hours / Sem	Duration of exam	Formative	Summative	Total marks	Credits
III	DSC-15	Theory	A3BIC001T	Nitrogen Metabolism and Nanoscience	4	60	3	20	80	100	4
	DSC-16	Practical	A3BIC004P	Nitrogen Metabolism and Nanoscience Practicals	4	56	4	10	40	50	2
	DSC-17	Theory	A3BIC002T	Immunology and Clinical Biochemistry	4	60	3	20	80	100	4
	DSC-18	Practical	A3BIC005P	Immunology and Clinical Biochemistry Practicals	4	56	4	10	40	50	2
	DSC-19	Theory	A3BIC003T	Cell Signaling	4	60	3	20	80	100	4
	DSC-20	Practical	A3BIC006P	Cell Signaling Practicals	4	56	4	10	40	50	2
	OEC-2	Theory	A3BIC204T	Medical Biochemistry	4	60	3	20	80	100	4
								110	**440**	**550**	**22**

IV-SEMESTER

Sem	Type of course	Theory/ Practical	Course Code	Course Title	Instruction / week	Total hours / Sem	Duration of exam	Formative	Summative	Total marks	Credits
IV	DSC-21	Theory	A4BIC001T	Molecular Genetics and Genetic Engineering	4	60	3	20	80	100	4
	DSC-22	Practical	A4BIC004P	Molecular Genetics and Genetic Engineering Practicals	4	56	4	10	40	50	2
	DSC-23	Theory	A4BIC002T	Molecular Biology	4	60	3	20	80	100	4
	DSC-24	Practical	A4BIC005P	Molecular Biology Practicals	4	56	4	10	40	50	2
	DSC-25	Theory	A4BIC003T	Applied Biochemistry	4	60	3	20	80	100	4
	DSC-26	Practical	A4BIC006P	Applied Biochemistry Practicals	4	56	4	10	40	50	2
	DSC-27	Project / Dissertation	A4BIC007P		4			30	120	150	6
								120	**480**	**600**	**24**

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.

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

- The Vamanrao Kore 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's Sridevi 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.

Semester-I

Course Code: A1BIC001T
Name of the course: Bioorganic and Cell Biology

Type of Course	Theory/ Practical	Credits	Instructions in hours/week	Total No. of Lect/ Sem	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC-1	**Theory**	**04**	**04**	**60 hours**	**3 hours**	**20**	**80**	**100**

Course Learning Objectives:

- To acquire knowledge on fundamental of bioorganic chemistry and biomolecules.
- To understand types of bonds and functional groups of biomolecules and reaction mechanism.
- To learn about importance water, buffers.
- To study classification of heterocyclic compounds and its derivatives.

Course Outcomes: On successful completion of the course, the students will be able to

- Explain about structure, functions and importance of reactions.
- Illustrate fundamentals aspects such as chemistry and reaction mechanisms.
- Describe importance of water, buffers, structural and functional significance.
- Explain about cell, composition and biomembrane functions.

Unit-1	**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. **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). **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.	**15 Hr**
Unit-2	**Stereochemistry-** Optical isomerism, optical activity, specific rotation, chiatlity, enantiomers, diatereomers, DL, RS, threo and erythro notations, Conforamtion and configuration. Stereoismerism and geometrical isomerism, cis-trans and EZ notations. Stereochemistry of glucose-anomers, epimers, stereiosmers. Mutrarotation and racemization. Heterocyclic compounds: Occurrence in biological systems, structure and properties of furan, pyrrole. Indole, thiazole, imidazole, pyridine, pyrimidines, purine, quinine, pteridine and isoalloxazine.	**15 Hr**
Unit-3	**Cell Structure:** Structural organizations of eukaryotic cells, structure and functions of sub-cellular organelles. Molecular components of cells, Stem cells-different types. **Cellular interaction:** Introduction to cell-cell and cell-matrix interaction, Cell adhesion molecules, extracellular matrix, proteoglycan and collagen, cell-cell adhesion, Catherins, Junction between the cells desmosomes, hemi-desmosomes and tight junctions, communication via gap junctions, plasmadesmata. **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.	**15 Hr**
Unit-4	**Cell cycle:** Mitosis and meiosis, cell cycle and its regulation (outline), cyclin and cyclin dependent kinases (CDKs). **Biomembranes:** Structure and composition of biomembranes, Supra molecular organization. Models of membranes: Gorter and Grendel's experiment, bilayer structure, Danielle and Daveson model of membrane, Singer and Nicholson's model, fluid-mosaic model of membrane, techniques to study membrane organization (EM**,** NMR, Fluorescence), Membrane domains-caveolae, rafts, Membrane potential.	**15 Hr**

	Membrane proteins: peripheral and integral proteins. Membrane asymmetry, protein-lipid interactions, factors affecting membrane fluidity. Membrane protein dynamics and Unit membrane hypothesis. **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.	

References books:

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 Lubert strayer, (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 3rd Edn. (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
14. Essentials of Glycobiology, 2nd edition, Ajit Varki, Richard D Cummings, ISBN-13: 9780879697709

List of Practicals
Paper A1BIC005P: Bioorganic and Cell Biology Practicals (4 Hr/Week).

Type of Course	Theory/ Practical	Credits	Instructions in hours/week	Total No. of Lect/ Sem	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC-2	**Practical**	**02**	**04**	**56 hours**	**4 hours**	**10**	**40**	**50**

1. Preparation of different buffer solutions.
2. Preparation of buffers.
3. Measurement of pH by pH meter
4. Titration curve of weak acids.
5. Determination of pKa value.
6. Acid hydrolysis of sucrose and starch.
7. Acid hydrolysis of proteins.
8. Isolation of subcellular Organelles
9. Fractionation of subcellular Organelles
10. Estimation of protein by Biuret Method.
11. Preparation of liposomes.
12. Identification of mitotic stages in onion root tips.
13. Identification of meiosis stages from biological samples.
14. Test for mutagenesis Ames test.

Course Code: A1BIC002T
Name of the course: Analytical Biochemistry

Type of Course	Theory/ Practical	Credits	Instructions in hours/week	Total No. of Lect/ Sem	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC-3	Theory	04	04	60 hours	3 hours	20	80	100

Course Learning Objectives:

- To study the analytical techniques required to perform cutting edge research in the field of biochemistry.
- To understand the principle and procedure of various techniques.
- To study the principle and procedure of various spectrophotometers.
- To learn the separation of amino acids, sugars, lipids etc.

Course Outcomes: On successful completion of the course, the students will be able to

- Explain the various analytical techniques such as chromatographic.
- Describe the electrophoretic, spectrophotometric and other techniques.
- Describe principle and procedures and their trouble shooting of various techniques in the separation of components.
- Explain the principle and procedure of various spectrophotometers.

Unit-1	**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. **Dialysis:** Principles, and applications of equilibrium dialysis and ultrafiltration. Artificial membranes, semi-permeable membranes, Donnan membrane equilibrium, and biological significance of osmosis and micelles.	**15Hrs**
Unit-2	**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. **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.	**15 Hrs**
Unit-3	**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.	**15 Hrs**

Unit-4	**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 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.	**15 Hrs**

References books

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 Zbigniew Darzynkiewicz, 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

List of Practicals

Paper A1BIC006P: Analytical Biochemsitry Practicals (4Hr/Week)

Type of Course	Theory/ Practical	Credits	Instructions in hours/week	Total No. of Lect/ Sem	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC-4	**Practical**	**02**	**04**	**56 hours**	**4 hours**	**10**	**40**	**50**

1. Determination of R_f value and identification of unknown monosaccharide by performing ascending paper chromatography.
2. Determination of R_f value and identification of unknown monosaccharide by performing descending paper chromatography.
3. Determination of R_f value and identification of unknown amino acid/s by performing ascending paper chromatography.
4. Determination of R_f value and identification of unknown amino acid/s by performing descending paper chromatography of amino acids.
5. Determination of R_f value and identification of unknown amino acid/s by performing circular paper chromatography.
6. Identification of carbohydrates in the given fruit juice sample by performing thin layer chromatography (TLC).
7. Identification of amino acids in given fruit juice sample by performing TLC.
8. Separation of lipids in the given oil/fat sample by performing TLC.
9. Separation of chlorophyll pigments from Spinach leaves by performing column chromatography.
10. Goat liver tissue homogenization and preparation of cell free extract by centrifugation.
11. Desalting of protein from ammonium sulphate precipitated protein sample by dialysis.
12. Separation of nucleic acid (DNA) by performing agarose gel electrophoresis.
13. Demonstration of SDS-PAGE for the separation of protein from the liver homogenate sample.
14. Determination of molecular weight of a protein from the pre-run SDS-PAGE.

Course Code: A1BIC003T
Name of the course: Biochemistry of Macromolecules

Type of Course	Theory/ Practical	Credits	Instructions in hours/week	Total No. of Lect/ Sem	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC-5	Theory	04	04	60 hours	3 hours	20	80	100

Course Learning Objectives:

- To study the proteins and nucleic acids in details.
- To understand functional aspects of proteins and nucleic acids.
- To study the different types of structure of proteins.
- To study structure, classification and functional importance of amino acids and proteins.

Course Outcomes: On successful completion of the course, the students will be able to

- Explain the detailed structure and functions of proteins and nucleic acids
- Illustrate fundamentals aspects such as chemistry and reaction mechanisms of biomolecules.
- Explain the structural and functional classification and importance of amino acids and proteins.
- Describe the physico-chemical properties, structures and functions of nucleic acids and proteins.

Unit-1	**Introduction**: classification based on source, composition, solubility and functions. Physicochemical properties of 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. **Methods of isolation and purification** of proteins, criteria of protein purity. **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.	**15 Hrs**
Unit-2	**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. **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. **Structure and function relation of proteins:** 3-D conformation of myoglobin, cytochrome c, insulin, evolutionary significance of proteins. **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. **General screening procedures for inborn errors of metabolism:** of proteins	**15 Hrs**
Unit-3	**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. **Chemical and physical properties of nucleic acids:** UV absorbance of nucleic acids, hypochromism and Hyperchromism. **Isolation and purification of nucleic acids** – DNA and RNA, estimation of nucleic acids. **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.	**15 Hrs**

Unit-4	**DNA sequencing:** Chemical method of Maxam-Gilbert, Sanger's Dideoxy method and other recent methods, automated DNA sequencing. **Tertiary or higher-order structure of DNA:** DNA supercoiling, superhelix topology linking number, biological importance of DNA supercoiling, role of topoisomerases. **Ribonucleic acids (RNA):** Structure of m-RNA, r-RNA and t-RNA, Clover leaf model and L-shaped model of t-RNA. **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. **General screening procedures for inborn errors of metabolism:** of purines and pyrimidines and subsequent therapeutic measures.	**15 Hrs**

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
15. DNA structure and function by R.R. Sinden (1984) Academic Press

List of Practicals

Paper A1BIC007P: Biochemistry of Macromolecules Practicals (4Hr/Week)

Type of Course	Theory/ Practical	Credits	Instructions in hours/week	Total No. of Lect/ Sem	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC-6	**Practical**	**02**	**04**	**56 hours**	**4 hours**	**10**	**40**	**50**

1. Preparation of solution/reagents.
2. Estimation of amino acids by ninhydrin method
3. Estimation of protein by FCR method
4. UV absorption spectra of amino acids.
5. UV absorption of nucleic acids/ nucleotides.
6. Determination of pka value of an amino acid.
7. Isolation of nucleic acid from plant sources.
8. Estimation of nucleic acid from plant sources
9. Isolation of nucleic acid from animal sources
10. Estimation of nucleic acid from animal sources
11. Isolation of casein protein from milk.
12. The identification of C terminal amino acids of protein.
13. The determination of the free amino end group of the same protein.
14. The determination of changes in the conformation of BSA by Viscosity measurement.

Course Code: A1BIC004T

Name of the course: Human Physiology and Nutrition

Type of Course	Theory/ Practical	Credits	Instructions in hours/week	Total No. of Lect/ Sem	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC-7	**Theory**	**04**	**04**	**60 hours**	**3 hours**	**20**	**80**	**100**

Course Learning Objectives:

- To learn and understand the fundamentals of physiology and nutrition.
- Knowledge of functioning of cardiovascular systems.
- To study the basics of bloods.
- Understand the nutritional requirement for the daily life

Course Outcomes: On successful completion of the course, the students will be able to

- Explain the basics of structure, functions and nutritional systems.
- Understand the basics of physiological process of digestion, cardiovascular & respiratory system and nervous systems.
- Describe the fundamentals of nutrition of carbohydrates and proteins, vitamins macro, micro elements etc.,
- The student with understand the special nutritional aspects during the pregnancy and lactation.

Unit-1	**Muscle contraction:** Structural organization of muscles, muscle proteins, mechanism of muscle contraction and its regulation. Sliding filament theory. **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. **Cardiovascular:** Circulatory system, cardiac cycle, blood pressure and its regulation, Mechanism of transport of O_2 and CO_2 in blood.	**15 Hrs**
Unit-2	**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. **Excretory system:** Nephron, and mechanism of urine formation. Anatomy of kidney and nephron, urine formation, urine concentration, waste elimination and micturition. Role of kidney in the regulation of water balance electrolyte balance and acid-base maintaenance. **Respiratory System:** Arterial and venous circulation, Bohr effect, O_2 and CO_2 binding haemoglobin. Regulation of respiratory system and waste elimination.	**15 Hrs**
Unit-3	**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, experimentally and by calculation average BMR for Indians. SDA of food. **Carbohydrates**- Sources and functions carbohydrates. Role of dietary fiber. Fats-Sources and functions, essential fatty acids, saturated and polysaturated fatty acids (PUFA). **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. **Special aspects of nutrition** during infancy, childhood, pregnancy, lactation and old age. Factors affecting the nutritional.	**15 Hrs**
Unit-4	**Diet for nutrition therapy:** Balance diet-dietary constitution and importance. Recommended daily allowances (RDA), Nutrition for diabetes and cardiovascular disease patients. Welleness diets, fitness diets, obesity. BMI (Body mass index) and its significance. Nutraceutical, types and health importance. Food as drug for health and disease. Special dietary restrictions and brief idea of deficiencies caused by trace elements in metabolism.	**15 Hrs**

	Vitamins: Sources, structure functions and deficiency symptoms of fat (A, D, E, K)and water-soluble (B-complex and C) vitamins. **Macro & Micro Nutrient:** Sources, functions and deficiency symptoms Ca, P, Na, K, Fe, I, Cu, Zn and other trace elements. **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.	

Reference Books:

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. Pralhad Rao 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 PublishingVitamins and Hormones by G. Litwack (Ed) Vol 50, 1995, Academic Press
14. Principles of Nutrition and Dietetics by M Swaminathan Bapp 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.

List of Practicals
Paper A1BIC008P: Human Physiology and Nutrition Practicals (4 Hr/Week)

Type of Course	Theory/ Practical	Credits	Instructions in hours/week	Total No. of Lect/ Sem	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC-8	**Practical**	**02**	**04**	**56 hours**	**4 hours**	**10**	**40**	**50**

1. Determination of blood group analysis.
2. Measurement of blood pressure.
3. Determination of WBC and RBC count.
4. Estimation of dietary proteins.
5. Estimation of dietary fats.
6. Estimation of vitamin C by 2,6-Dichlorophenol indophenol method
7. Estimation of calcium content in foods.
8. Estimation of calcium content in milk.
9. Determination of inorganic phosphate by Fiske-Subbarao method
10. Determination of Moisture, fibber and ash contents of biological samples
11. Estimation of iron in foods.
12. Estimation of Hb content in blood sample.
13. Determination of cell number using hemocytometer.
14. Determination of erythrocyte sedimentation rate (ESR).

Semester-II

Course Code: A2BIC001T
Name of the course: Enzymology

Type of Course	Theory/ Practical	Credits	Instructions in hours/week	Total No. of Lect/ Sem	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC-9	**Theory**	**04**	**04**	**60 hours**	**3 hours**	**20**	**80**	**100**

Course Learning Objectives:

- To study the biocatalysts in the form of enzymes and their functions
- To learn themechanism of action of enzymes.
- To learn different mechanisms and their applications.
- To learn about classification, structure, kinetics, inhibition of enzymes.
- To study the mechanism of action of enzymes and co-enzymes.

Course Outcomes: On successful completion of the course, the students will be able to

- Explain the functional aspects of different enzymes and inhibition/ mechanism.
- Describe the molecular mechanisms of enzyme actions.
- Explain the allosteric regulations and its clinical and industrial applications.
- Illustrate on classification, specificity, kinetics and active site structure of enzyme.

Unit-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). **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. **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 andkinetics, Methods of kinetic analysis-Lineweaver Burk, Eadie Hofstee, Hanes and Dixon plots. **Enzyme inhibition:** Reversible and irreversible inhibition, Types of reversible inhibitors – competitive, noncompetitive, uncompetitive and mixed inhibitors. substrate inhibition.	**15 Hrs**
Unit-2	**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. **Molecular basis of enzymes catalysis**: General theories and hypotheses proposed to explain enzyme specificity, lock andkey, induced fit theory, contribution of structural flexibility to the specificity of enzymes. **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. **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.	**15 Hrs**
Unit-3	**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	**15 Hrs**

	physicochemical and 3-D structural data-Lysozymes, RNase and chymotrypsin, Including zymogen activation. eg. Chymotrypsinogen. **Different forms of enzymes:** Isozymes, multienzyme complexes, multifunctional enzymes, ribozymes, coenzymes and metalloenzymes, abzymes. **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.	
Unit-4	**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. **Applications of enzymes**: Immobilized enzymes- Clinical and Biotechnological applications of enzymes, temperature resistant enzymes. **Biosensors :** Classification, characteristics, bioactive components, Sensing Device. Optical Piezoelectric, thermal detection Ion sensitive Electrochemical, (Condctometric Amperometric Potentiometric) Biochip, immunobiosensors, working principle of biosensors. Immunosensors, calorimetric. Biosensors for health care. **Oxygen utilizing enzymes:** Monooxygenases, dioxygenases, and mixed function oxidizes oxygen toxicity– active oxygen species, role of superoxide dismutase, catalase and peroxidases.	**15 Hrs**

References books:

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) Lubert strayer, 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.

List of Practicals
Paper A2BIC004P: Enzymology Practicals (4Hr/Week)

Type of Course	Theory/ Practical	Credits	Instructions in hours/week	Total No. of Lect/ Sem	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC-10	**Practical**	**02**	**04**	**56 hours**	**4 hours**	**10**	**40**	**50**

1. Preparation of solutions, buffer and enzyme.
2. Construction of maltose calibration curve.
3. Determination of alpha amylase activity.
4. Determination of the activity of salivary amylase
5. Determination of the specific activity of β-amylase in sweet potato and salivary amylase.
6. Effect of pH on the activity of amylases
7. Effect of temperature on the activity of amylases.

8. Effect of salt concentration on the activity of amylases
9. Determination of K_m and V_{max} of amylases
10. Isolation and purification of β-amylase from sweet potato
11. Determination of lipase activity in caster seed extract
12. Isolation and activity of lysozyme from egg white
13. Determination of the activity of urease in jack bean meal/ esterase in peas.
14. LDH activity of rate liver homogenate.

Course Code: A2BIC002T
Name of the course: Metabolism of Fuel Molecules and Bioenergetics

Type of Course	Theory/ Practical	Credits	Instructions in hours/week	Total No. of Lect/ Sem	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC-11	**Theory**	**04**	**04**	**60 hours**	**3 hours**	**20**	**80**	**100**

Course Learning Objectives:

- To study the metabolic pathways taking place in the human body/plants/microbes pertaining to carbohydrates, lipids and its energetic.
- To acquire basic concepts of thermodynamics, metabolism oxidative phosphorylation and ETC.
- To study metabolic transformation of glucose, other carbohydrates and regulation.
- To learn about bioenergetics, metabolic transformation of biomolecules and regulation.

Course Outcomes: On successful completion of the course, the students will be able to

- Illustrate the various metabolic pathway that occur in the human body and also energy production.
- Explain the bioenergetics, metabolic transformation of biomolecules and regulation.
- Illuminate basic concepts of thermodynamics, metabolism oxidative phosphorylation and ETC.
- Describe metabolic transformation of glucose, other carbohydrates, energetic and regulation.

Unit-1	**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 and O linked glycans, carbohydrate binding proteins and their biological significance. Blood group antigens and heteropolysaccharides, glycosaminoglycans, proteoglycans, lipopolysaccharides and peptidoglycan. **Metabolism of carbohydrates**: Basic concepts in metabolism; Catabolism, anabolism, catabolic, anabolic and amphibolic pathways. Glycolysis, its energetics, Glycerol-3-phosphate and Malate Asparate shuttle. Regulation of glycolysis, role of PFK, Pasteur effect. 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.	**15 Hrs**
Unit-2	**Glycolysis:** 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. Futile 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 disaccharides and polysaccharides:** Maltose, Sucrose and Lactose. Regulation of lactose biosynthesis, biosynthesis of starch, cellulose and peptidogiycan. Effect of antibiotics on peptidoglycan biosynthesis. Therapeutic measures of	**15 Hrs**

	carbohydrates and its related diseases.	
Unit-3	**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. **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). Peroxisomal oxidation of fatty acids (Phytanic acid), Refsum's disease. 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 biosynthesis. 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. Therapeutic measures of lipids and its related diseases.	**15 Hrs**
Unit-4	**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. **Electron transport in mitochondria**: Electron carriers in mitochondria, sequence of electron carriers and their mechanism of electron transfer reactions, specific inhibitors of ETC. **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.	**15 Hrs**

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) Lubert strayer, 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.

List of Practicals
Paper A2BIC005P: Metabolism of Fuel Molecules and Bioenergetics Practicals (4Hr/Week)

Type of Course	Theory/ Practical	Credits	Instructions in hours/week	Total No. of Lect/ Sem	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC-12	**Practical**	**02**	**04**	**56 hours**	**4 hours**	**10**	**40**	**50**

1. Preparation of solutions/reagents.
2. Preparation of serum from blood.
3. Determination of blood glucose by Sasaki method
4. Isolation of cholesterol from egg yolk.
5. Estimation of cholesterol by Zak's method.
6. Determination of iodine number of oils and fats
7. Determination of saponification value of oils.
8. Isolation of starch from potato
9. Quantitative estimation of sugars by phenol-sulphuric acid method.
10. Estimation of reducing sugar by DNS method.
11. Estimation of glycogen and its purity by titrimetric method.
12. Isolation of glycogen from the goat liver.
13. Lipase activity of goat liver homogenate.
14. Detection of cytochromes.

Course Code: A2BIC003T
Name of the course: Plant and Microbial Biochemistry

Type of Course	Theory/ Practical	Credits	Instructions in hours/week	Total No. of Lect/ Sem	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC-13	**Theory**	**04**	**04**	**60 hours**	**3 hours**	**20**	**80**	**100**

Course Learning Objectives:

- To study the microorganisms and their properties, industrial and medical applications of microorganisms.
- To study plant-cell, growth regulators, metabolism, biotic and abioticstress responses.
- To acquire knowledge on plant cell, plant cell membranes and transport.
- To learn about plant growth regulators, totipotency, *invitro* plant regeneration and callogenesis.
- To study plant metabolism, secondary metabolites and their overproduction strategies.
- To learn plant responses during biotic and abiotic stresses.

Course Outcomes: On successful completion of the course, the students will be able to

- Describe the properties and special aspects of microorganisms.
- Explain the applications in the field of medicine, microbial disease and industrial importance of microorganisms.
- Illustrate plant-cell, growth regulators, metabolism, biotic and abiotic stress responses.
- Describe plant cell and photorespiration.
- Illustrate plant growth regulators, totipotency, *invitro* plant regeneration and callogenesis.
- Explain plant metabolism, secondary metabolites and strategies for over production.

Unit-1	**Introduction**: Historical development and scope of microbiology and microbial Biotechnology. **Classification of microorganisms**: Nomenclature, study of different types of microorganisms, characteristics of the main groups of microorganisms. **Cultivation of bacteria:** Nutritional requirements for the bacteria, growth curve of bacteria 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.	**15 Hrs**

	Identification of bacteria: Staining methods- Gram staining and Acid fast staining, structure and differences between Gram-negative and Gram-positive bacteria. **Bacteriology of milk** and Flora of the normal human body. **Bacterial toxins**: Classification: exotoxins and endotoxins, chemical nature and associated diseases. **Food microbiology:** Production of cheese, single cell protein, pasteurization of milk, contamination of milk and its prevention, food spoilage, food preservation .	
Unit-2	**Environmental microbiology and energy:** Biomass production, biogas, environmental pollution, Biodegradation, Use of microbes in pollution control, metal leaching and extraction, nonconventional energy sources **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.	**15 Hrs**
Unit-3	**Photosynthesis**: Introduction, photosynthetic organisms, pigments and accessory components,light and dark phases, photosynthetic apparatus, Hill reaction, role of 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. **Plant responses to biotic and abiotic stresses:** Introduction; plant pathogens and diseases; plant defense system-hypersensitive response; systemic acquires resistance; induced systemic resistance; Plant abiotic stress responses-salt stress, drought and heavy metal stress responses; osmotic adjustment and significance of osmotic agent such as proline, sugar, alcohaols and quaternary ammonium compounds; An overview of oxidative stress and oxidative damage. Anti-oxidant enzymes and stress tolerance. Plant biotic stress reponse-pathogen and insects.	**15 Hrs**
Unit-4	**Plant growth regulators and tissue culture:** Biosyntesis, and functional significance of auxins, cytokinins, gibberellins, abscisic acid, ethylene, brassinosteroids, polymines, jasmonic acid, salicylic acid. **Plant tissue culture:** Totipotency of plant cell; preparation and surface sterilization of explants; composition and constituents of regular media, conditions for culture maintenance. Influence of plant growth regulators on *in vitro* plant regeneration, callogensis. **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. **Plant secondary metabolites:** Introduction; Structural, functional classification and biosynthesis. An overview of primary metabolism contribution to secondary metabolite biosynthesis; important routes (pathways) of secondary metabolite biosynthesis-phenylpropanoid pathway; Acetate-mevalonate pathway; Acetate-malonate pathway. Strategies and approaches for the over production of plant secondary metabolites–plant cell suspension cultures, metabolic engineering, heterologous gene expression and combinatorial biochemistry.	**15 Hrs**

References books:

1. Microbial world (5th edn. 1987) R.Y. Stanier, Hampshire-Macmillan Press.
2. Medical Microbiology (12th edn. 1973) Cruckishank R and others, ELBS Press, London
3. Microbiology (1967) B D Davis, R Deilbecco, H M Eisent H S Ginaberg, Med Divn NY
4. Microbiology (5th edn. 2000) Michael J Pelczar (Jr) ESC Chan, N R Kreig, Tata McGraw Hill.
5. Modern Food Microbiology: James M. Jay (1996) Ed. CBS Publishers
6. A Modern introduction to food microbiology: Board, R.B. [Ed] (1983) Blackwell Scientific publications.
7. Biology of microorganisms, Brock (1996) Prentice Hall.
8. Industrial Microbiology: Miller and Litsky [Edn] (1976) McGraw Hill publishers
9. Microbiology, Prescot, Hartely and Klein (1993) WCB Publications
10. Microbiology: Essential s and applications, Larry Mckane and J. Kandel (19) McGraw Hill Publishers.
11. Fundamentals virology (1995) B.N. Fields, D M Nkie, P M Howley, R M Chanock, J L Meenick, T P Monath, S E Strans, LippinCott Raven.
12. Biology of Microorganisms by M.T. Modigam, J.M. Matinko& J. Oanker, 8th Edn. (1999) Prentice Hall.
13. Microbial Biotechnology; Fundamentals of applied microbiology (2nd edn.) A.N. Glazer and H.Nikaido, W.H. Freeman & Co. N.Y.
14. Manual of Industrial Microbiology and Biotechnology by A.L. Demain& J.E.
15. Davie second edn. (1999), ASM press, Washington DC
16. BiochemistryandMolecularBiologyofPlants -Buchanan,GreussemandJones. American Society of Plant Physiologists.
17. Reviewarticlespublishedin,ThePlantCell,PlantMolecularBiology.
18. ArticlespublishedinAnnualReviewofPlantBiology,AnnualReviewofPlant Physiology and Molecular Biology.
19. ArticlespublishedinTrendsinPlantSciences.
20. PlantCellTissueandOrganCulture:FundamentalMethods-O.L.Gamborg&G.C. Phillips Narosa Publishers, New Delhi (1995).

List of Practicals
Paper A2BIC006P: Plant and Microbial Biochemistry Practicals (4Hr/Week)

Type of Course	Theory/ Practical	Credits	Instructions in hours/week	Total No. of Lect/ Sem	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC-14	**Practical**	**02**	**04**	**56 hours**	**4 hours**	**10**	**40**	**50**

1. Methods of sterilization by dry heat and moist heat – autoclaving.
2. Preparation of culture media for microbes and tissue culture.
3. Isolation and preparation of pure cultures of bacteria (pour, spread and streak)
4. Isolation and preparation of pure cultures of fungi (pour, spread and streak)
5. Gram staining and other staining procedures
6. Identification of bacteria by morphological and biochemical tests.
7. Antibiotic sensitivity test for microbial cultures
8. Bacterial growth curve–effect of pH, temperature, salt concentrated on growth of bacteria.
9. Wine preparation by fermentation from graphs
10. Isolation of chloroplast and chlorophyll from spinach leaves and its spectral measurement.
11. Extraction and estimation of flavones.
12. Extraction and estimation of tannins and quinolones.
13. Estimation of indole-3-acetic acid and gibberlines from plants.
14. Determination of starch in plant tissues.

Course Code: OEC-I: A2BIC204T
Name of the course: Analytical Techniques

Type of Course	Theory	Credits	Instructions in hours/week	Total No. of Lect/ Sem	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
OEC-1	**Theory**	**04**	**04**	**60 hours**	**3 hours**	**20**	**80**	**100**

Course Learning Objectives:

- To study the analytical techniques required to perform cutting edge research in the field of biochemistry.
- To understand the principle and procedure of various techniques.
- To study the principle and procedure of various spectrophotometers.

Course Outcomes: On successful completion of the course, the students will be able to

- Explain the various analytical techniques such as chromatographic, electrophoretic, spectrophotometric and other techniques.
- Describe principle and procedures and their trouble shooting of various techniques in the separation of components.
- Explain the principle and procedure of various spectrophotometers.

Unit-1	**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. **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.	**15 Hrs**
Unit-2	**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.	**15 Hrs**
Unit-3	**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 chr omatography -** 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.	**15 Hrs**
Unit-4	**Spectrophotometry:**. UV and Visible spectroscopy - Principle, Instrumentation and applications**,** Principle and applications of Fluorescence spectroscopy, NMR andInfrared spectroscopy.	**15 Hrs**

References books

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 Zbigniew Darzynkiewicz, 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

Semester-III

Course Code: A3BIC001T
Name of the course: Nitrogen Metabolism and Nanoscience

Type of Course	Theory/ Practical	Credits	Instructions in hours/week	Total No. of Lect/ Sem	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC-15	Theory	04	04	60 hours	3 hours	20	80	100

Course Learning Objectives:

- To study the metabolic reactions of amino acids..
- To learn the metabolic pathways relevant to catabolism and anabolism of nitrogen compounds and its associated disease.
- To study metabolic transformation of amino acids, nitrogen bases and regulation.
- To understand the nanobiotechnology, preparation of nanoparticals, synthesis and characterization.
- To understand the discovery and design of drugs and its mechanisms.

Course Outcomes: On successful completion of the course, the students will be able to

- Understand the general metabolic reaction and mechanisms of amino acids.
- Describe the metabolic pathways relevant to catabolism and anabolism of nitrogen compounds and its associated disease in related enzymes or amino acids or nucleic acids.
- Explain metabolic transformation of amino acids, nitrogen bases and regulation.
- Explain the Nanoscience, nanomedicins, nanofertilizers and its applications.
- Describe the design of drugs, targets, validation and its mechanisms with kinetics.

Unit-1	**Introduction:** Importance of nitrogen in biological systems and metabolism of nitrogen compounds. **Metabolism of amino acids:** General reactions of amino acid metabolism – transmination, deamination, decarboxylation and racemization. Role of pyridoxal phosphate in amino acid metabolism. **Catabolism of amino acids:** Metabolic fate of amino nitrogen, transdeamination, Kreb's urea cycle, ketogenic and glycogenic amino acids, degradation of individual amino acids, transmethylation, genetic disorders – phenylketonuria, alcaptonuria, albinism, maple syrup urine disease. **Biosynthesis of amino acids**: Essential and non-essential amino acids, regulation of glutamine synthetase and aspertate family of amino acids.	**15 Hrs**
Unit-2	**Biosynthesis of** Epinephrine, Norepinephrine, dopamine, histamine, serotonin, GABA creatine and polyamines. **Non-ribosomal peptide synthesis**: Glutathione and Gramicidin **Metabolism of nucleotides:** Biosynthesis of purine and pyrimidine nucleotides by De novo and Salvage pathways, Regulation of nucleotide biosynthesis, Interconversion of nucleotidemono-, di- and triphosphates. Biosynthesis of deoxyribonucleotides and deoxythymidyrate, Inhibitors of nucleotide biosynthesis – mechanism of action of azaserine, acivicin, 5-fluorouracil and methotrexate as anticancer drugs. **Degradation of purine and pyrimidine mucleotides:** Genetic disorders – Gout, Lesch-Nyhan syndrome, immunodeficiency disease. **Biosynthesis of nucleotide coenzymes:** NAD^+, $NADP^+$, FAD and coenzyme A. **Metabolism of Heme**: Biosynthesis and degradation of heme porphyrin, regulation and porphyrias, formation of bile pigments. **Biological nitrogen fixation:** Nitrogen cycle, utilization of nitrate, nitrogen-fixing organisms, mechanism of nitrogen fixation-nitrogenase and its regulation symbiotic nitrogen.	**15 Hrs**
Unit-3	**Nanobiotechnology:** History, definition and scope, unique properties and applications of nanoparticles, nanobiotechnology to nanomedicine, various types of nanoparticles in biology. Principles of drug delivery, targeted, non-targeted delivery; controlled drug	**15 Hrs**

	release; exploting novel delivery routes using nanoparticles. **Synthesis and properties of nanomaterials:** Brief introduction to synthesis of nanoparticles-physical, chemical and biological methods, synthesis and applications of gold and silver nanoparticles, micelles, quantum dots, liposomes, dendrimer, nanopores, carbon nanotubes and othr polymeric nanoparticles. Biological synthesis of nanaoparticles-natural and artificial synthesis of nanaoparticles by microorganisms and plants magnetic nanoparticles.	
Unit-4	**Drug discovery:** Design of experiments, factorial experiments, randomization, interaction among factors. Types of studies: Cohort studies, double blind, placebo control, cross over and double dummy. Overview of some studies (UKPDS, CUPS, and Framingham). Clinical studies, toxicity studies, good laboratory practices, safe disposal of used and rejected samples and materials. Proof of concept, target identification and validation, identifying the lead compound, optimization of lead compound, mechanism of action, drug target, validation of target, safety pharmacology, pharmaco-kinetics and pharmaco-dynamics, acute and chronic toxicity, CNS toxicity, hERG assay, *invitro* and *invivo* mechanism of action, DNA microarray and mechanism of action.	**15 Hrs**

Reference Books:

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) Lubert strayer, 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 6thEdn. 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

List of Practicals
Paper A3BIC004P: Metabolism of Nitrogen Compounds practical (4Hr/Week)

Type of Course	Theory/ Practical	Credits	Instructions in hours/week	Total No. of Lect/ Sem	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC-16	**Practical**	**02**	**04**	**56 hours**	**4 hours**	**10**	**40**	**50**

1. Preparation of solutions/reagents.
2. Determination of ATP in biological systems
3. Preparation of nanoparticles by chemical method
4. Preparation of nanoparticles by biological method
5. Determination of glutathione in animal tissues.
6. Determination of glutathione in blood serum.
7. Estimation of urea
8. Determination of uric acid
9. Determination of bile pigments
10. Determination of activities of aminotransferases
11. Characterization of NPs by UV-visible and FTIR spectroscopy.
12. Determination of nucleotide coenzymes (NAD^+/FAD)
13. Determination of IC_{50} value of drugs
14. Determination of IC_{50} value of nanoparticles

Course Code: A3BIC002T
Name of the course: Immunology and Clinical Biochemistry

Type of Course	Theory/ Practical	Credits	Instructions in hours/week	Total No. of Lect/ Sem	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC-17	**Theory**	**04**	**04**	**60 hours**	**3 hours**	**20**	**80**	**100**

Course Learning Objectives:

- To understand the defensive mechanism of human body.
- To study about cells, organs and molecules of immune system, immune responses and vaccines.
- To learn about antigens, immunoglobulins and their diversity, immunochemical techniques.
- To study antigen presentation, activation of T cells, B cells, and cytokines, effectors responses.
- To acquire knowledge on monoclonal antibodies, hypersensitivity, autoimmunity and vaccines.

Course Outcomes: On successful completion of the course, the students will be able to

- Explain human body fights with invading microorganism and pathogens.
- Illustrate history of immunology, immunity, cells and organs of immune system.
- Describe antigens, immune globulins and their diversity, immunochemical techniques.
- Explain antigen presentation, activation of T cells, B cells and cytokines effector responses.
- Describe monoclonal antibodies, hypersensitivity, autoimmune responses and vaccines.

Unit-1	**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, **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, **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. **Antigens and antibodies:** Chemical complexity and molecular property of Antigens, Haptens, Epitopes, Paratope. Epitope analysis, Basis of antigen specificity. Immunoglobulin fine structure and classes, Antigenic determinants on immunoglobulins, Immunoglobulin superfamily, monoclonal and polyclonal antibodies and their production by hybridoma technology.	**15 Hrs**
Unit-2	**Antigen-antibody:** Interactions, Principles, affinity and avidity and cross reacivity.TechniquesPrecipitation, Agglutination, Radioimmunoassay,Enzyme-Linked Immunosorbent Assay, Western Blotting, , Immunofluorescence, , Immunoelectron Microscopy **Adaptive immune response:** Primary and secondary immune response. Nature of T and B cell surface receptors, Major Histocompatibility Complex- Molecular organization ofMHC molecules (H-2, HLA),Structure of MHC molecules. Class I MHC-peptide and Class II MHC-Peptide interactions. Antigen presenting cells (APCs), Antigen processing andpresentation by endo and exogenous pathways. **Immune effector mechanisms**: Immunological tolerance, Hypersensitivity: Immediate (type I, type II, type III) and delayed hypersensitivity reactions. **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	**15 Hrs**

	control, immunosuppressive agents. Cancer-immunology – Tumor associated antigens, Immunological surveillance of cancer. **Cytokines:** Properties and functions of lymphokines, monokines, interleukins and chemokines; Transplantation Immunology: Mechanism of graft rejection and Immunosuppressive therapy. GVHD.	
Unit-3	**Hematology and hematology disorders**: Blood composition: Blood cells, serum and plasma content. Different types of anemias-nutritional and sickle cell anemia. Complete blood count (CBC). Total and differential and platelet counts and their clinical significance. Blood groups, blood group substances, Rhessus factor, nature of blood group antigens and rare blood groups. Hospital-laboratory method of blood grouping and Rh typing. Erythrocyte sedimentation rate (ESR) determination and its importance in the diagnosis of certain diseases. **Enzymes of clinical and diagnostic importance**: Enzymes as markers in the diagnosis of diseases. Clinical significance of cholinesterass, alkaline and acid phosphatases, LDH, CPK, SGOT and SGPT. **Cerebrospinal fluid (CSF):** Collection of CSF, function and their composition in health and diseases. **Serology:** WIDAL, VDRL, malaria and filarial parasitic antigens.	**15 Hrs**
Unit-4	**Biochemical investigations in kidney diseases**: Kidney profile in health and disease. Urine analysis for normal and abnormal constituents, urine microscopy culture and antibiotic sensitivity test. Clearance test and its importance in the assessment of kidney function. Kidney diseases like urinary tract infection (UTI) and nephritis. Kidney transplantation and dialysis. **Biochemical investigations in liver diseases:** Liver profile in health and disease. Hepatocellular functions, with special emphasis on its participation in the various detoxification mechanism. Liver function tests (LFT), and their clinical significance in the diagnosis of liver diseases like cirrohosis and jaundice. Gall-bladder-stone analysis and its clinical significance. Hepatitis infections. **Cardio-vascular diseases**: Brief mention of heart diseases. Atherosclerosis and its complications. **Diabetes mellitus**: Regulation of blood sugar, classification, stages and diagnosis (urine analysis, GTC/GTT, Glycosylated Hb. Role of anti-diabetic oral drugs and different types of insulins. **Gastric profile in health and diseases:** Gastric function tests (gastric analysis). Hypo and hyper acidity and Gastric ulcers. Malabsorption syndrome.	**15 Hrs**

References books:

1. Biochemistry (V Ed 2002) Lubert strayer, 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 2nd edn Freeman and Co. (1998)
6. Molecular conning: A Laboratory manual, 3rd edn. (2001) by J. Sambrock and Russel, Spring Horbour Laboratory press.
7. Principles of Gene Manipultion 6th Edn. (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 (4th edn.) 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.

List of Practicals
Paper A3BIC005P: Immunology and Clinical Biochemistry Practicals (4Hr/Week)

Type of Course	Theory/ Practical	Credits	Instructions in hours/week	Total No. of Lect/ Sem	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC-18	**Practical**	**02**	**04**	**56 hours**	**4 hours**	**10**	**40**	**50**

1. Preparation of solutions/reagents and buffers.
2. Precipitation of antibodies with $(NH_4)_2 SO_4$
3. Separation of immunoglobulins by SDS-PAGE.
4. Double immunodiffusion for determining the antigen antibody specificity
5. Determination of antibody concentration by ELISA.
6. Isolation of human peripheral blood mononuclear cells (PBMCs)
7. Determination of hemagglutination activity of lectins
8. Establishing the sugar specificity of lectin by hapten inhibition assay.
9. To determine temperature optima for alkaline phosphatise.
10. Urine analysis, qualitative analysis of normal,
11. Urine analysis, qualitative analysis of abnormal, constituents.
12. Estimation of blood analysis glucose by enhson and Hegedoran method.
13. Qualitative analysis of urine by tritratable acidity,
14. Estimation of creatine and creatinine.

Course Code: A3BIC003T
Name of the course: Cell Signalling

Type of Course	Theory/ Practical	Credits	Instructions in hours/week	Total No. of Lect/ Sem	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC-19	**Theory**	**04**	**04**	**60 hours**	**3 hours**	**20**	**80**	**100**

Course Learning Objectives:

- To study pathophysiological processes responsible for common biochemical reaction in the endocrinology.
- To study the biochemical overview of molecular basis of diseases.
- To learn about endocrineg lands, functions of hormones, neurotransmitters and growth factors.
- To learn about laboratory techniques of endocrinology and regulation of hormone synthesis.
- To acquire knowledge on genomic and non-genomic mechanisms of hormone action.
- To study mechanism of action and receptors of neurotransmitters and chalones.

Course Outcomes: On successful completion of the course, the students will be able to

- Explain the molecular basis of endocrinology: hormones and hormones its action.
- Illuminate endocrine glands, functions of hormones, neurotransmitters and growth factors.
- Explain human endocrine glands, structural and functional classification of hormones.
- Describe laboratory techniques of endocrinology and regulation of hormone synthesis.
- Illustrate genomic and non-genomic mechanisms of hormone action.
- Explain mechanism of action and receptors of neurotransmitters and chalones.

Unit-1	**Apoptosis and necrosis:** Apoptosis; intrinsic and extrinsic pathway. Factors resulting to cell death. Necrosis-types and physiological signal and cellular changes underlying necrosis. Apoptosis–Programmed cell death. Cellular changes underlying apoptosis. Inflammosomes -	**15 Hrs**

	role in death of infected cells autophagy and significance. **Carcinogenesis:** Mechanism of carcinogenesis. Characteristics of cancer cells, Types of cancer, benign and malignant tumors. Cancer metastasis, garcinogens (chemical, physical and biological), Ames test for carcinogenicity. **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 and cell differentiation.	
Unit-2	**Salient features of hormones** and their general classification. **Endocrine system:** A brief outline of various endocrine glands, pituitary, pancreas, adrenals, thyroid, parathyroid, adrenal cortex and their physiological roles. Brief account on structure, storage and secretion of hormones; and feedback 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. Structure biosynthesis function and mechanism of action of steroid hormones. **Hormonal signaling:** 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.	**15 Hrs**
Unit-3	**Components of bio-signaling:** definition of cell signaling, general principles of cell signaling and communication; various forms of communication between cells; signaling process and its stage-signal recognling, transduction and cellular effect; Types of cell signaling-autocrine signaling, direct contact signaling, paracrine signaling, synaptic signaling, endocrine (distance) signaling. First messenger, glands and types of secretions, ligands, agonists, antagonists, receptors for first messengers, second messengers, soluble second messengers, membrane bound second messengers. Receptor, down regulation, Receptor up regulation. **Vision:** Photoreceptor cells- rods and cones, photoreceptor pigments, cascade of biochemical reactions involved in the visual cycle, color vision.	**15 Hrs**
Unit-4	**Neuronal signaling**: 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. **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 and adrenergic receptors.	**15Hrs**

References books:

1. Molecular Biology of the Cell, 3rd edition. Bruce Alberts, Dennis Bray, Julian Lewis, Martin Raff, Keith Roberts, and James D Watson. Publisher New York: Garland Science.
2. The Cell: A Molecular Approach, Fifth Edition, by Geoffrey M. Cooper andRobert E. Hausman, published by ASM Press.
3. Lehninger- Principles of Biochemistry, David L. Nelson, Michael M. Cox Publisher: W. H. Freeman.
4. Molecular Cell Biology; Lodish et al., 7thEdn. W.H. Freeman and Co. (2012).
5. Biochemistry 5thEdn. Jeremy M. Berg, John L. Tymoczko, LubertStryer.
6. Harper's Illustrated Biochemistry; 27thEdn. Robert K. Murray, Daryl K. Granner, Victor W.Rodwell,The McGraw-Hill (2006).
7. Lipid Biochemistry; 5thEdn. Michael I. Gurr, John L. Harwood and Keith N. Frayn,

8. Blackwell Science (2002).
9. Principles of Human Physiology; 4th Edn. Cindy L. Stanfield Pearson, (2010).
10. BiochemistryofSignalTransductionandRegulation,GerhardKrauss(2014).Wiley- VCH Verlag GmbH & Co.
11. TheBiochemistryof Cellsignaling;Ernst J.M.Helmreich(2001), OxfordUniversity Press.
12. Signal transduction and human disease; Toren Finkel, and J. Silvio Gutkind (2003), John Wiley & Sons, Inc.
13. Textbookofcellsignalingandcancer;JacquesRobert(2019)SpringerPublishers.
14. Cell Signaling-Principle and Mechanism; Wendell Lim, Bruce Mayer, TonyPawson (2014); Garland Science press.

List of Practicals
Paper A3BIC006P: Cell Signalling (4Hr/Week)

Type of Course	Theory/ Practical	Credits	Instructions in hours/week	Total No. of Lect/ Sem	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC-20	Practical	02	04	56 hours	4 hours	10	40	50

1. Preparation of solutions/reagents and buffers.
2. Determination of acetyl choline esterase activity from rat serum.
3. Determination of acetyl choline esterase activity from serum goat (signal transduction).
4. Estimation of 17-ketosteriod by Zimmerman's method from urine sample.
5. Estimation of serum calcium by Clarck and Collips method.
6. Estimation of calcium in cell extracts (As it is a secondary messengers)
7. Western blot or PAGE demonstrate signalling proteins separations
8. Determination of molecular weight of some signalling molecules
9. Estimation of phosphorylated enzymes, tyrosine (from standard curve of tyrosine).
10. Estimation of phosphorylated enzymes ATP tyrosine kinase from crude extract.
11. Determination of bleeding time by Duke's method.
12. Study of yeast cell cycle.
13. Estimation of cellular nitric oxide synthase.
14. Estimation of phospholipase C.

Course Code: OEC-II: A3BIC204T
Name of the course: Medical Biochemistry

Type of Course	Theory	Credits	Instructions in hours/week	Total No. of Lect/ Sem	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
OEC-2	Theory	04	04	60 hours	3 hours	20	80	100

Course Learning Objectives:

- To learn and understand the fundamentals of physiology and nutrition.
- Knowledge of functioning of blood and excretory system**.**
- To study the basic of clinically important enzymes.
- To understand the defensive mechanism of human body.
- To study the respiratory, cardiovascular systems.

Course Outcomes: On successful completion of the course, the students will be able to

- Explain the basics of physiological process of digestion, cardiovascular & respiratory system and nervous systems.
- Explain human body fights with invading microorganism and pathogens.
- Explain the defensive mechanism of blood in the human body.
- Describe the respiratory, cardiovascular systems.
- Explain the Muscle contraction and blood coagulation systems

Unit-1	**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. **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. Anatomy of kidney and nephron, urine formation, urine concentration, waste elimination and micturition. Role of kidney in the regulation of water balance electrolyte balance and acid-base maintaenance.	**15 Hrs**
Unit-2	**Muscle contraction:** Structural organization of muscles, muscle proteins, mechanism of muscle contraction and its regulation. Sliding filament theory. **Respiratory System:** Arterial and venous circulation, Bohr effect, O_2 and CO_2 binding haemoglobin. Regulation of respiratory system and waste elimination. **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.	**15 Hrs**
Unit-3	**Hematology and Hematology disorders**: Blood composition: Blood cells, serum and plasma content. Different types of anemias-nutritional and sickle cell anemia. Complete blood count (CBC). Total and differential and platelet counts and their clinical significance. Blood groups, blood group substances, Rhessus factor, nature of blood group antigens and rare blood groups. Hospital-laboratory method of blood grouping and Rh typing. Erythrocyte sedimentation rate (ESR) determination and its importance in the diagnosis of certain diseases. **Enzymes of clinical and diagnostic importance**: Enzymes as markers in the diagnosis of diseases. Clinical significance of cholinesterass, alkaline and acid phosphatases, LDH, CPK, SGOT and SGPT. **Cerebrospinal fluid (CSF):** Collection of CSF, function and their composition in health and diseases. **Serology:** WIDAL, VDRL, malaria and filarial parasitic antigens.	**15 Hrs**
Unit-4	**Biochemical investigations in kidney diseases**: Kidney profile in health and disease. Urine analysis for normal and abnormal constituents, urine microscopy culture and antibiotic sensitivity test. Clearance test and its importance in the assessment of kidney function. Kidney diseases like urinary tract infection (UTI) and nephritis. Kidney transplantation and dialysis. **Biochemical investigations in Liver diseases:** Liver profile in health and disease. Hepatocellular functions, with special emphasis on its participation in the various detoxification mechanism. Liver function tests (LFT), and their clinical significance in the diagnosis of liver diseases like cirrohosis and jaundice. Gall-bladder-stone analysis and its clinical significance. Hepatitis infections. **Cardio-vascular diseases**: Brief mention of heart diseases. Atherosclerosis and its complications. **Diabetes mellitus**: Regulation of blood sugar, classification, stages and diagnosis (urine analysis, GTC/GTT, Glycosylated Hb. Role of anti-diabetic oral drugs and different types of insulins. **Gastric profile in health and diseases:** Gastric function tests (gastric analysis). Hypo and hyper acidity and Gastric ulcers. Malabsorption syndrome.	**15 Hrs**

References books:

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

2.Robbins, Pathologic basis of disease 2/5th edn. (Robbis, Cotran, Jumar (W.B.Sauders Co) (1995)

3.Davidson's Principles and Practice of Medicine (17th edn) (1995) C.Haslett, E.R. Chilvers (Churchill-Livingstone)

4.Clinical laboratory diagnosis by S.A Levinson and R.P MACFATE 7th Edn(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)

Semester-IV

Course Code: A4BIC001T
Name of the course: Molecular Genetics and Genetic Engineering

Type of Course	Theory/ Practical	Credits	Instructions in hours/week	Total No. of Lect/ Sem	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC-21	Theory	04	04	60 hours	3 hours	20	80	100

Course Learning Objectives:

- To study the molecular aspects of human genetics.
- To learn basic principles of in heritance and sex-linked inheritance.
- To study sex determination, eukaryotic chromosomes gene mapping and recombination.
- To learn extrachromosomal inheritance, human genetics and quantitative genetics, mutations, chromosomal alterations.

Course Outcomes: On successful completion of the course, the students will be able to

- Understand the human genetics and related components.
- Explain basic principles of inheritance and sex-linked genes and pattern of inheritance.
- Describe sex determination, eukaryotic chromosomes gene mapping and recombination.
- Explain extrachromosomal inheritance, human genetics and quantitative genetics, mutations, chromosomal alterations.

Unit-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. **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. **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. **DNA** repair: Photoreaactivation, Excision, Post-replication and Recombinational DNA repair mechanisms.	**15 Hrs**
Unit-2	**Viral genetics:** 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.	**15 Hrs**
Unit-3	**Genetic engineering:** Extraction and purification of nucleic acids (DNA and RNA) from biological sources. Definition, aims and objectives of recombinant DNA technology, restriction-modification systems, restriction enzymes; type I, II and III, specificity, sticky ends and blunt ends, isoschizomers. Characteristics and applications of restriction endonucleases and modifying enzymes. **Gene cloning:** Basic principles and tools and techniques of gene cloning: Methods of isolation of gene/ DNA fragment for cloning. Methods for gene cloning: *in vivo*- cloning in *E. coli. In vitro* polymerase chain reaction. Characteristics and applications of plasmid, cosmid, phagemid, M13phage vector, λvector, BAC, PAC, and YAC. Selection of suitable vectors for cloning, expression and sequencing of DNA fragments. **Ligation:** Blunt end and sticky end ligation, use of linkers and adopters, homo polymer tailing, colony hybridization, plaque hybridization.	**15 Hrs**
Unit-4	**Transformation:** Micro injection, electroporation, lipofection, calcium phosphate	**15 Hrs**

	method, protoplast fusion/somatic cell hybridization and biolistic methods. Transgenic plants and animals, gene knock out. **Identifying the right clones:** Direct screening; insertional inactivation of marker gene, visual screening, and plaque phenotype. Indirect screening; immunological techniques, hybrid arrest translation, hybrid select translation. Screening using probes; construction of gene probes, hybridization and labelling. **Recombinant vaccines:** Types, development of vaccines-conventional vaccines-attenuated, killed organisms and subunit vaccines; modern vaccines-recombinant vaccines and DNA vaccines. Vaccines against AIDS and tropical infections diseases-leprosy, malaria and TB. Vaccines for control of fertility, Anti-HCG vaccines and anti-sperm antigen vaccine. **Public health:** Production of vaccines, interferon's growth hormones human plasminogen activators. **Applications**: Gene therapy, applications in agriculture medicine, industry. GM foods, terminator gene, negative impact of genetic engineering.	

References books:

1. Biochemistry (V Ed 2002) LubertStryer, W.H. Freeman and Co.,
2. Biochemistry (III Ed 1999) Voet, D. and Voet J.G. John Wiley and Sons.
3. Biochemistry (III Ed 1999) Mary. K CambellHarcocrt Brace college Publishers.
4. 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)
5. Principles of information technology second edn. P.F. Stanbay, and S.J. Hall, ButterwortHiremann 1995
6. Bioinformatics-sequence, Structure and detabanks Edited by thgginstaylor. W (2001) (Oxford
7. 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
10. Russel, Spring Harbor Laboratory press.
11. Principles of Gene Manipultion 6thEdn. (2001) by S.B. Primose, R.M. Tqyman, R.W. Old,
12. Blankwell Scientific
13. DNA Cloning: A Practical approach by D.M. Gover (1985) Vol. 1. and 2, IRL Press.
14. Plant cell culture by W. Horn's and K.J. Opara (1994) IRL press, Oxford University
15. Applied and Fundamental Aspects of plant cell, Tissue and organ culture by J.R. Reinert and Y.P.S. Bajaj (1997) Narosa Publications.
16. PCR Technology: and Application for DNA Amplification by H.AErlich (Ed) (1989) Stocketon press.
17. Recombinant DNA: A short course by J.D. Watson, J. Toose and D.T. Kurtz (1983) Scientific American Books/Freeman**.**
18. Genes VII Benjamin Lewin (Ed 2000) University Oxford Press
19. Microbial Biotechnology by Alexander, Glaser &ItiroslniNikaido 2ndedn Freeman and Co. (1998)
20. Molecular conning: A Laboratory manual, 3rdedn. (2001) by J. Sambrock and Russel, Spring Horbou Laboratory press.
21. Molecular Biology of the cell by Alberts et al., (1989) Garland publications
22. DNA Clonning: A Practical approach by D.M. Gover (1985) Vol. 1. and 2, IRL press.

List of Practicals
Paper A4BIC004P : Molecular Genetics and Genetic Engineering Practicals (4Hr/Week)

Type of Course	Theory/ Practical	Credits	Instructions in hours/week	Total No. of Lect/ Sem	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC-22	**Practical**	**02**	**04**	**56 hours**	**4 hours**	**10**	**40**	**50**

1. Preparation of solutions/reagents/media.
2. Preparation of bacterial culture for isolation of plasmid DNA isolation.
3. Isolation of plasmid DNA from bacterial cells.
4. Qualitative study of isolated DNA using UV spectrophotometer.
5. Quantitative estimation of isolated DNA by DPA method.
6. Restriction digestion of isolated plasmid DNA.
7. Ligation of DNA fragments by DNA ligase.
8. Separation of the DNA using agarose gel electrophoresis.
9. Preparation of competent cells.
10. Transformation of the competent bacterial cell.
11. Selection of bacterial recombinant cells-X-Gal marker by antibiotic resistant markers.
12. Staining of chromosomes basic dyes
13. Extraction of total nucleic acids from plant tissues embryos from germinating seeds.
14. Karyotyping which chromosome is affected (Down, Klinfelter, tri and tetrasomy)

Course Code: A4BIC002T
Name of the course: Molecular Biology

Type of Course	Theory/ Practical	Credits	Instructions in hours/week	Total No. of Lect/ Sem	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC-23	**Theory**	**04**	**04**	**60 hours**	**3 hours**	**20**	**80**	**100**

Course Learning Objectives:

- To understand biological phenomena in molecular forms.
- To study of gene structure and function at the molecular level.
- To study DNA as genetic material, DNA replication in prokaryotes and eukaryotes.
- To learn translation in prokaryotes and eukaryotes, post-translational modifications of proteins.
- To study regulation of gene expression, DNA damage and repair in prokaryotes and eukaryotes.

Course Outcomes: On successful completion of the course, the students will be able to

- Explain genes and their activities in molecular terms.
- Describe the structure &activity of genes and the experimental evidence underlying those concepts.
- Describe the structure & functions of DNA and entrains basic converge of DNA replicationand gene expression.
- Explain DNA as genetic material, DNA replication in prokaryotes and eukaryotes.
- Explain genetic code, protein synthesis, post-translational modifications and targeting.
- Illustrate regulation of gene expression, DNA damage and repair in prokaryotes and eukaryotes.

Unit-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.	**15 Hrs**
Unit-2	**Transcription**: Biosynthesis of RNA, role of RNA polymers, structure, properties and	**15 Hrs**

	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. **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.	
Unit-3	**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 and prokaryotic system, protein targeting, synthesis of secretary and membrane proteins., signal sequence hypothesis. Mechanism of translational control.	**15 Hrs**
Unit-4	**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**.**	**15 Hrs**

References books:

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 Alberts etal, (1989) Garland publications.

Paper A4BIC005P : Molecular Biology Practicals (4Hr/Week)

Type of Course	Theory/ Practical	Credits	Instructions in hours/week	Total No. of Lect/ Sem	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC-24	**Practical**	**02**	**04**	**56 hours**	**4 hours**	**10**	**40**	**50**

1 Preparation of solutions/reagents/media.
2 Isolation of genomic DNA from bacteria.
3 Quantitative analysis of genomic DNA.
4 Total RNA isolation from bacterial cells.
5 Isolation of RNA from microbial source
6 Estimation of RNA by Orcinol method
7 Characterization of RNA by spectroophotmetry
8 Isolation and UV-visible spectrum of DNA from Plant (Cauliflower).
9 The viscosity of DNA solution
10 Induction of β-galactodidase by lactose in *E coli*.
11 Isolation and UV-visible spectrum of genomic DNA from Goat/Sheep liver.
12 The isolation of RNA from yeast.
13 The viscosity of DNA solution.
14 The viscosity of RNA solution.

Course Code: A4BIC003T
Name of the course: Applied Biochemistry

Type of Course	Theory/ Practical	Credits	Instructions in hours/week	Total No. of Lect/ Sem	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC-25	**Theory**	**04**	**04**	**60 hours**	**3 hours**	**20**	**80**	**100**

Course Learning Objectives:

- To study the basic tools of recombinant DNA Technology, restriction endonuclease,
- Basic understanding of bioinformatics and biostatics.
- To study the genomics of human, microorganisms and animal.
- To study the proteomics of human, microorganisms and animal.
- To study the various types of PCR and research methodology.

Course Outcomes: On successful completion of the course, the students will be able to

- Explain the various tools used in rDNA, viz., plasmid, restriction enzymes.
- Explain the genomics of human, microorganisms and animal.
- Describe the proteomics of human, microorganisms and animal.
- Learn the various types of PCR.
- Understand the application of research.
- Apply the bioinformatics tools and understand the various biostatics for analytical applications

Unit-1	**Bioinformatics:** Introduction, scope and basic principles of bioinformatics. Bioinformatics programmes and languages, scripts and scripting languages. Running programmes over internet. **Biological databases:** Contents, structure, annotation, file formats, annotated databases, genomes and organism specific databases. **Techniques**: DNA sequencing, shot gun and orderly sequencing, chromosome walking, PCR; analysis of products, nested PCR, applications of PCR in cloning, agriculture and medicine. RT-PCR technique and applications. Real time PCR for quantification, DNA finger print assay and microarray studies. **Research methodology:** Meaning of research; Objectives of research; Motivation in research; Types of research; Research approaches; Significance of research; An overview of research process. Definition of Research problem and selecting the research problem; Techniques involved in defining a research problem. Collection and review of research literature, source of literature and their evaluation. Designing research methodologies. General strategies for preparation of research proposal. Data representation in technical reports, posters, presentation in scientific conferences and workshops. Preparation of manuscripts for publication in national and international journals. Yardsticks employed in evaluation of manuscripts for publications.	**15 Hrs**
Unit-2	**Proteomics:** Introduction to proteomics, protein separations, protein, quantitative proteomics, protein interactions. Edman sequencing to mass spectrophotometry, digestion, tandem mass spectrometry. The importance of isotopes for finding the charge state of a peptide, sample preparation and handling (digestion methods). Post–translational modification of proteins, protein phosphorylation and identification of phasphopeptides, Mass spectrometry of glycosylation sites and structure of sugars. Identification of disulfide linkages by mass spectrometry. Analysing protein complexes. Analsis of complex protein mixtures by mass spectrometry, Qualitative analsis of complex protein mixtures by mass spectrometry, iTRAQ of TMT. Selected–ion monitoring (SIM) and multiple-reaction monitoring (MRM). **Biotechnology** and international market, brief aspects about patent laws, culture collection, data bank, ethical values, pros and con of biotechnology.	**15 Hrs**
Unit-3	**Genomics:** Introduction to genomics, classical tools, identifying the gene mutated in a human disease. Techniques in genomics sequencing, human genome project, vectors for	**15 Hrs**

	large scale genome projects, clone -by –clone strategy, Shotgun sequencing. Studying and comparing genomic sequences, human genome, personal genomics, vertebrate genomes, minimal genome, barcode of life, functional genomics: Gene expression on a genomic scale, transcriptomics, genomic functional profiling, single nucleotide polymorphisms and pharmacogenomics.	
Unit-4	**Introduction to biostatistics:** Population, sample, sampling techniques, random sample, mean, median, mode, range, variance, coefficient of variation, frequency, standard deviation, standard error. Representation of statistical data line graph, histogram, bar diagram, pie chart, scatter diagram. **Collection of data**: Relevance of sample size. Sources, methods-questionairs, records, archives, scaling-Likert and Gutman. Validation and standardization of the methods, modification and experimental design. **Probability:** Rules of probability, binomial distribution, normal distribution, area under the curve, Z value, choosing sample size, hypothesis testing, Student's t test. One way ANOVA, correlation and regression.	**15 Hrs**

References books:

1. Choosing and Using Statistics; A Biologist Guide, ClavinDythan, Blackwell Scientific (1999).
2. Basic Mathematics for Biochemists; Cornish Bowden, Oxford University Press (1998).
3. Statistics, Basic Concepts and Methodology for the Health Sciences Daniel WW, Pub Wiley India.
4. Biostatistics –Arora &Malhan, Himalaya Publishing House.
5. Introduction to Bioinformatics- Attwood T K and parry –smith, D.J. Pearson Education.
6. Bioinformatics (Sequence and Genome Analysis) Mount David W, Press CSH.
7. Discovering Genomics, Proteomics and Bioinformatics – Campell&Heyer, Benjamin / Cummings pub.

List of Practicals:
Paper A4BIC006P: Applied Biochemistry Practicals (4Hr/Week)

Type of Course	Theory/ Practical	Credits	Instructions in hours/week	Total No. of Lect/ Sem	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC-26	**Practical**	**02**	**04**	**56 hours**	**4 hours**	**10**	**40**	**50**

1. Estimation of DNA by diphenylamine method.
2. Designing of PCR primers and Amplification of DNA by PCR technique
3. Determination of purity of DNA from previously isolated DNA by using UV-spectroscopy.
4. Cell culture laboratory and equipments' overview along with requirements.
5. Cell counting using the Trypan blue exclusion method and determining the cell viability.
6. Conducting the review of literature using online biological database.
7. Searching and retrieval of sequence data by using primary biological databases.
8. Searching and retrieval of sequence data by using secondary biological databases.
9. Identifying the given nucleotide or protein sequence using FASTA format with description.
10. Conducting the comparative sequence analysis of given nucleotide or protein sequence by using suitable BLAST programming.
11. Application of MS-Excel for the calculation of mean, mode, standard deviation and error using plotting graph for a given data set.
12. Introduction to Prism graph pad by downloading free trial and conducting few operations of statistical analysis.
13. Demonstration of RasMol software for the analysis of protein structure and learning few command lines.

14 Visit to agriculture/forest/research institute/food processing/dairy industry and submission of report during practical examination

Course Code: A4BIC007P
Name of the course: Project

Type of Course	Project	Credits	Instructions in hours/week	Total No. of Lect/ Sem	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC-27	**Project**	**06**	**04**	**90 hours**	**4 hours**	**30**	**120**	**150**

Course Learning Objectives:

- To gain research interest and attain hands on research experience.
- To able to face biotech companies.
- To able to face the interviews in biochemical/chemical industries.
- To learn the research techniques, presentation of results and data.

Course Outcomes: On successful completion of the course, the students will be able to

- 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 chemistry.
- Literature survey on the topic.
- Basics of research methodology and design of experiments.
- Execution of research work by various techniques.
- Preparation of manuscript for publication.
- Presentation of research data in the conferences/seminars.

GENERAL PATTERN OF THEORY QUESTION PAPER FOR DSC/ EC

Biochemistry

DSC-

Time: 3 Hours **Max. Marks: 80**

Note: Answer all questions

Part-A

Answer the following questions, **TWO** marks each: 2X10=10

1.
2.
3.
4.
5.
6.
7.

Part-B

Answer any **SIX** of the following questions, **FIVE** marks each: 5X6=30

08.
09.
10.
11.
12.
13.
14.
15.

Part-C

Answer any **FOUR** of the following questions, **TEN** marks each: 10X4=40

16.
17.
18.
19.
20. Write short notes on any TWO of the following:

(Minimum 1 question from each unit and 10 marks question may have sub questions for 7+3 or 6+4 or 5+5 if necessary)

Note: Proportionate weight age shall be given to each unit based on number of hours

Prescribed

Formative Assessment for Theory	
Assessment Occasion/type	**Marks**
Internal Assessment Test 1	10
Internal Assessment Test 2	10
Total	**20**
Formative Assessment as per guidelines.	

GENERAL PRACTICAL QUESTION PAPER MODEL

Biochemistry

DSC-

Time: 4 Hours **Max. Marks: 40**

1. Answer the following question (Principle/Procedure writing) 05 Marks
2. Experiment 20 Marks
3. Viva-voce 10 Marks
4. Record 05 Marks

Project/Internship assessment

1. **Formative Assessment :** Project/Internship assessment carrying 30 marks out of 150 marks Interaction with the project supervisor and submission of progress reports=30 marks
2. **Summative Assessment :** Project/Internship assessment carrying 120 marks out of 150 marks

(e) Internal Assessment: 30 marks

(f) Project report submission: 50 marks

(g) Presentation: 40 marks

(h) Viva-voce: 30 marks

Total 150 marks

****