REVA UNIVERSITY
Bengaluru, India

(School of Applied Sciences)
M.Sc. Biochemistry
HANDBOOK
2017

Rukmini Knowledge Park
Kattigenahalli, Yelahanka, Bengaluru – 560064
Phone No: +91-080-46966966, Fax: 080-28478539
www.reva.edu.in

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Rukmini Educational Charitable Trust

A Unit of DivyaSree

MESSAGE FROM THE HON'BLE CHANCELLOR

Dr. P. Shyama Raju
Chancellor
REVA University

Education during recent years has witnessed a great transformation. Today's society, termed as "Knowledge Society" has brought about unprecedented economic and social growth. This has propelled universities across the world to devise new ways of tapping human potential for different competencies and building a vibrant society with a win-win situation for all.

REVA University has seen the light of the day to imbibe this character of paradigmshift in academic pursuits to contribute to the knowledge society. REVA works hard to bring in you an exciting and rewarding educational experience, to discover new interests that will develop your career prospects. You will benefit from a unique approach to student-entered learning through group work and individual study tackling real world challenges alongside experienced practitioners and researchers.

REVA has excellent learning facilities including custom built teaching facilities designed specifically to emulate working conditions, air-conditioned library opened for your studies from early morning till midnight and facilities for variety of sports and cultural activities.

Our faculties have introduced socially relevant and market driven commerce courses after studying the market situation in detail and consulting entrepreneurs, experts in different areas of commerce and industry and other stake-holders. I am glad that the Choice Based Credit System (CBCS) and Continuous Assessment Grading Pattern (CAGP) being adopted will facilitate learning environment under continuous guidance and monitoring by the faculty and equip you with competent skills apt for different job prospects across the globe.

I hope that the present scheme of instructions, continuous periodic progress assessments, course curriculum of MSc Biochemistry program and other information provided in this hand book will guide you to choose appropriate courses of study and move ahead in the right direction in your chosen area of study. I hope you will enjoy and experience the curriculum, the student-centred teaching and learning ambience in developing your personality to become successful professionals, entrepreneurs and proud citizens of the country. I wish you every success in your career.

MESSAGE FROM THE VICE-CHANCELLOR

Higher education across the globe is opening doors of its academic disciplines to the realworld experiences. The disciplinary legitimacy is under critical review. Trans-border mobility and practice learning are being fore-grounded as guiding principles. Interactive learning, bridging disciplines and facilitating learners to gain different competencies through judicious management of time is viewed as one of the greatestand fascinating priorities and challenges today.

All the programs in REVA University are designed with a great care keeping in view of present requirements and job opportunities. Experts in respective areas of study from primary institutions, industries, research organizations, business sectors and such others have been involved in designing the curriculum of each program.

The L: T: P structure of teaching and learning under Choice Based Credit System (CBCS) and Continuous Assessment Grading Pattern (CAGP) would certainly help our students learn and build competencies needed in this knowledge based society.It provides students an opportunity to choose subject(s) of interest in other areas of study and learn courses with students of different subjects and also facilitates cross cultural learning. It further facilitates students to move in fast track and earn additional certificates and diploma.

The well qualified, experienced, committed teachers in REVA University will involve students in integrative learning and application environment within and outside the University. They will certainly mould them with knowledge, skill and ethical values and empower them to face the competitive world with courage and confidence.

This handy document containing brief information about MSc Biochemistry, scheme of instructions, course content, CBCS-CAGP regulations, its advantages and calendar of events for the year will serve as a guiding path to students to move forward in a right direction. It is for the students to be disciplined, committed, to work hard, make use of enormous resources and take guidance from expert facultiesto accomplish all round development of their personalities and succeed with flying colours not only in earning degree but also in their future career as leaders and proud citizens of Mother India.

Dr. S Y Kulkarni
Vice-Chancellor

MESSAGE FROM THE DIRECTOR - FACULTY OF SCIENCE

The curriculum of an Institution of higher learning is a living entity. It evolves with time, reflects the ever hanging needs of the society and keeps pace with the growingtalent of the students and the faculty. The curriculum of the M.Sc. Biochemistry program of REVA University is no exception.

An experience of a decade in preparing graduates and postgraduates in engineering, architecture, law, commerce and science for a wide variety of industries & research organizations has led to creation of the new curriculum. I sincerely believe that it will meet the aspirations of all stake holders – students, faculty and the employers of REVA University

The curriculum has been designed in such a way that the teacher enjoys freedom to expand it in any direction he feels appropriate and incorporates the latest knowledgeand stimulates the creative minds of the students. There is also provision for new experiments with new contents and new techniques. This is going to lead to new teaching – learning paradigm with experiential, experimental & industry relevant approaches. The present curriculum is contemporary because it is culmination of efforts of large number of faculty members, experts from industries and research level organizations. An effort of benchmarking this curriculum with curriculum of other institutions of repute like NITs and IITs has been done.

I am very sure that all students of REVA University enjoy this curriculum and take fullest advantage to expose themselves to fundamentals and applications. Also, imbibe all attributes that are required to term them as Global Engineers. The innovativeness and creativity being introduced should be explored fully by our students.

The flexibility in the curriculum permits staff and students to incorporate changes in terms of addition of new courses and deletion of irrelevant courses keeping the rapid advances in the technology into consideration.

The curriculum caters to and has relevance to local, regional, national, global developmental needs. Maximum number of courses are integrated with cross cutting issues with relevant to professional ethics, gender, human values, environment and sustainability.

I also record my personal gratitude to Chancellor, Vice-Chancellor and members of Academic Council who have lent every bit of their wisdom to make this curriculum truly superior.

Dr. N. Ramesh,
Director, Faculty of Science

PREFACE

M.Sc Biochemistry conceived by REVA University is an intensive intellectually challenging programme expect to acquire many transposable skills, allows studentsto gain research and industrial experience in contemporary Biochemistry. The curriculum covers Core courses with good number of electives in the final year. The electives include the area of General/Applied Biochemistry, Food Technology and Computational Biology. Short term training, Internships, Student Projects in Biochemistry, Clinical Research, SAS, Clinical Diagnostics provide opportunity for the students to choose their area of interest and eligibility criteria.

The students may also choose fast track learning and acquire additional Proficiency Certificate or Diploma in addition to the curriculum. Interactions with Industries, Diagnostic Laboratories, and Research Institutes are made through Industrial visits, Internships, Training programs and MOUs.

Collaborations with Research Institutes / Industries

- FRLHT-The Trans disciplinary University
- CIMAP- CSIR Laboratory
- CIFT & other Central Institutes
- Himalaya Drug Company
- Clinical Research Institutes

Such collaborations will help a student to compete in employment and research to recognize them as Research Scholars, Scientists in reputed Chemical, Biological, Healthcare, Pharmaceutical, Agriculture, Petrochemicals, Cosmetics, Food Industries, Clinical data management and Diagnostic Laboratories.

Prof.Jayashree S

Head, School of Biochemistry

CONTENTS

RUKMINI EDUCATIONAL CHARITABLE TRUST

It was the dream of late Smt. Rukmini Shyama Raju to impart quality education to millions of underprivileged children as she knew the importance of education in the contemporary society. The dream of Smt. Rukmini Shyama Raju came true with the establishment of Rukmini Educational Charitable Trust (RECT), in the year 2002. The Rukmini Educational Charitable Trust (RECT) is a Public Charitable Trust, set up in 2002 with the objective of promoting, establishing and conducting academic activities in the fields of Arts, Architecture, Commerce, Education, Engineering, Law, Management and Science & Technology, among others. In furtherance of these objectives, the Trust has set up the REVA Group of Educational Institutions comprising of REVA Institute of Technology & Management (RITM), REVA Institute of Science and Management (RISM), REVA Institute of Management Studies, (RIMS) REVA Institute of Education,(RIE) REVA First Grade College,(RFGC) REVA Degree College (Evening), REVA Independent PU College at Kattigenahalli, Ganganagar and Sanjaynagar and REVA University. Through these institutions, the Trust seeks to fulfill its vision of providing world class education and create abundant opportunities for the youth of thisnation to excel in the areas of Engineering, Commerce, Management, Architecture, Law,Education, Arts and Science & Technology.

Every great human enterprise is powered by the vision of one or more extraordinary individuals and is sustained by the people who derive their motivation from the founders. The Chairman of the Trust is Dr. P. Shyama Raju, a developer and builder of repute, a captain of the industry in his own right and the Chairman and Managing Director of the DivyaSree Group of companies. The idea of creating these top notched educational institutions was born of the philanthropic instincts of Dr. P. Shyama Raju to do public good, quite in keeping with his support to other socially relevant charities such as maintaining the Richmond road park, building and donating a police station, gifting assets to organizations providing accident and trauma care, to name a few.

The Rukmini Educational Charitable Trust drives with the main aim to help students who are in pursuit of quality education for life. REVA is today a family of ten institutions providing education from PU to Post Graduation and Research leading to M. Phil and Ph.D degrees. REVA has well qualified experienced teaching faculty of whom majority are doctorates. The faculty is supported by committed administrative and technical staff. Over 10,000 students study various courses across REVA's three campuses equipped with exemplary state-of-the-art infrastructure and conducive environment for the knowledge driven community.

ABOUT REVA UNIVERSITY

REVA University established under the Government of Karnataka Act 80 of the year 2012 and notified in the Karnataka Gazette dated 7th Feb, 2013, is located 14 kms away from the Bangalore International Airport on the way to Bangalore city. The university has a sprawling lush green campus spread over 41 acres of land equipped with state-of-the-art infrastructure and conducive environment for higher learning.

The REVA campus has well equipped laboratories, custom-built teaching facilities designed specifically to emulate working conditions, fully air-conditioned library and central computer centre kept open from morning 8.00 AM till mid-night for the students and the faculty. The well planned sports facility for variety of sports activities, facilities for cultural programs and friendly campus lifestyle add to the overall personality development of students. The campus also has residential facility for students, faculty and staff.

Currently, REVA University offers 23 Post Graduate programs and 17 Graduate programs in Engineering and Technology, Science, Commerce & Management and Humanities in addition to research degrees leading to Ph.D in different disciplines. The University aims to offer many more PG and UG programs in Science, Arts, Commerce, Engineering & Technology, Management Studies, Education and Humanities in the years to come.

The programs being offered by REVA University are well planned and designed after detailed study in emphasis with knowledge assimilation, applications, global job market and their social relevance. Highly qualified, experienced faculty and scholars from reputed universities / institutions, experts from industries and business sectors have contributed in preparing the scheme of instruction and detailed curricula for this program. Greater emphasis on practice in respective areas and skill development to suit respective job environment has been given while designing the curricula. The Choice Based Credit System and Continuous Assessment Grading Pattern (CBCS – CAGP) of education has been introduced in all programs to facilitate students to opt for subjects of their choice in addition to the core subjects of the study and prepare them with needed skills. The system also allows students to move forward under fast track for those who have the capabilities to surpass others.

These programs are taught by well experienced qualified faculty supported by the experts from industries, business sectors and such other organizations. REVAUniversity has also initiated many supportive measures such as bridge courses, specialcoaching, remedial classes, etc., for slow learners so as to give them the needed input and build in them confidence and courage to move forward and accomplish success in their career. The University has also entered into MOUs with many industries, businessfirms and other institutions seeking their help in imparting quality education through practice, internship and also assisting students' placements.

SCHOOL OF BIOCHEMISTRY

- The School of Biochemistry offers graduate, post graduate and PhD programs.
- The course trains students to acquire knowledge and skills in the field of General, Industrial and Clinical Biochemistry applicable to Industry, Research and Development laboratories

Vision

To impart contemporary knowledge in various socially relevant disciplines to students and transforming them to become global citizens by nurturing intellect, creativity, character and professionalism.

Mission

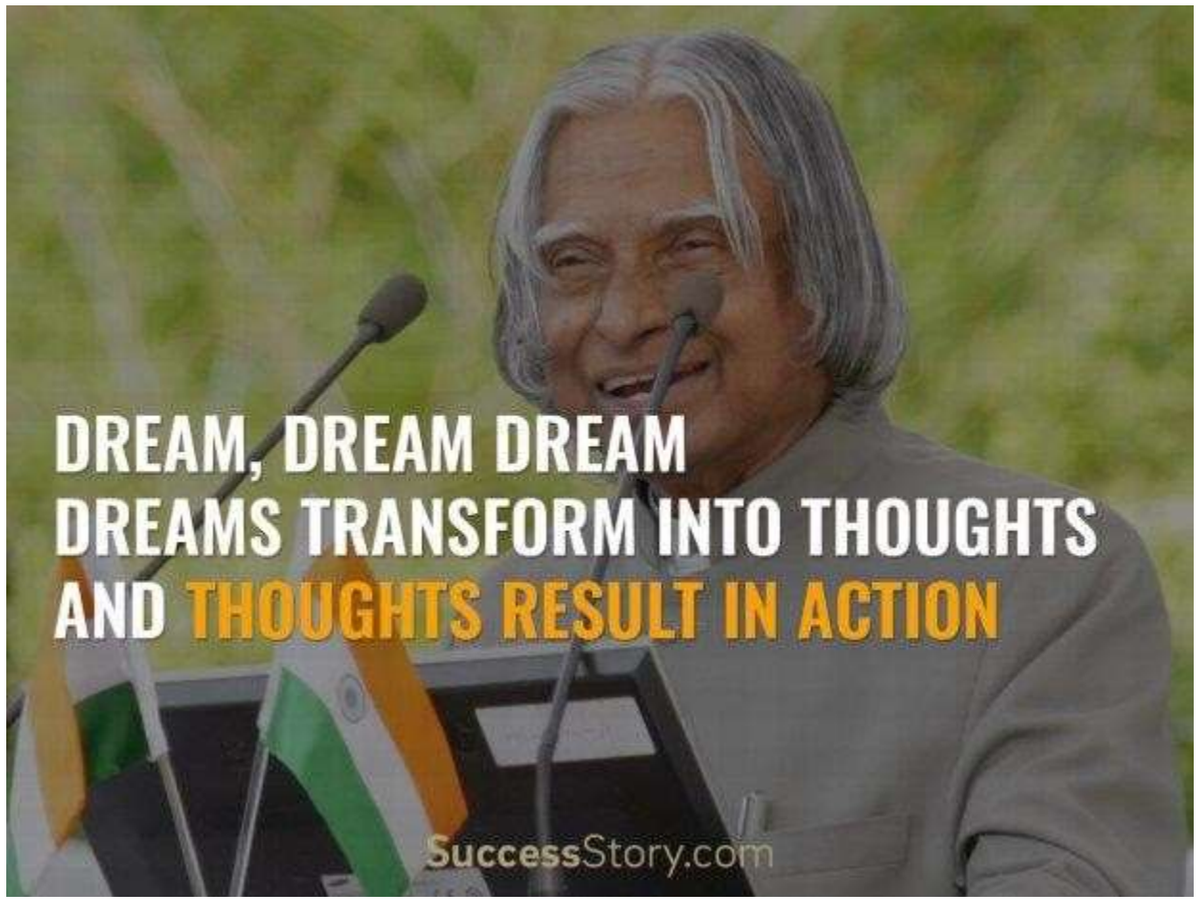
To achieve excellence through pedagogy, support interface between industry and academy through research in order to help students achieve creative and professional outlook to make them global citizens.

Objectives:

- Impart need based, practical education and global competence in contemporary biological sciences in accordance with the vision of REVA University.
- Provide an advanced understanding of the core principles of Biochemistry and their experimental basis.
- Enable students to acquire specialised knowledge and understanding of selected aspects by means of series of lectures.
- Foster growth, innovation, research and to promote entrepreneurship.
- Publish research papers in peer reviewed journals.

VALUE SYSTEM

- Excellence in all our academic and research endeavours
- Dedication and service to our stakeholders
- Leadership through innovation
- Accountability and transparency
- Creating conducive academic environment with service motto
- Integrity and intellectual honesty
- Ethical and moral behaviour
- Freedom of thought and expression
- Adaptability to the change
- Team-work



External Advisory Board

Sl. No.	Members
1	Dr. U.V Babu, Head- Phytochemistry, Research and Development, Himalaya Drug Company, Yeshwantpur, Bangalore.
2	Dr. Subramanya, Department of Life Sciences, Foundations for Revitalisation of Local Health Traditions (FRLHT), Yelahanka, Bangalore
3	Dr.Sudha Devaraj Director, Aristogene Biosciences PVT. Ltd. Rajaji Nagar Industrial Estate,Bangalore.
4	Dr. V.R. Devaraj, Professor, Department of Biochemistry,Bangalore University
5	Dr. Renuka Srihari, Professor, Department of Biochemistry, MLACW, Bangalore

CBCS (CHOICE BASED CREDIT SYSTEM) AND CAGP (CONTINUOUS ASSESSMENT AND GRADING PATTERN) OF EDUCATION AND ITS ADVANTAGES

CBCS is a proven, advanced mode of learning in higher education. It facilitates students to have freedom in making their own choices for acquiring a Masters Degree program. It is more focused towards the student's choice in providing a wide range of modules available in a single campus across various disciplines offered by experts in the subjects. It leads to quality education with active teacher-student participation.

Studying under CBCS has following advantages:

- Students may undergo training in cross-disciplinary and multi-disciplinary subjects and acquire more focused and preferred knowledge.
- Students are allowed to practice various methods of learning a subject.
- Students may get more skills from other subject(s) which are required for the career path in addition to their regular subject knowledge.
- Students may get ample opportunities to use the laboratories and gain practical exposure to the much needed modules available in other departments/schools for want of scientific inputs.
- Courses are conducted by subject experts identified on the basis of their experiences. Courses taught by such experts may provide in-depth information and clear understanding of the modules.
- Students may get an opportunity to study courses with other students of different programs and exchange their views and knowledge in a common class room.
- CBCS provides a cross-cultural learning environment.
- Students may benefit much from selecting the right options to successfully placed in the industries having production / Research and Development divisions. Also to compete in public service examinations like CSIR-UGC JRF/NET, GATE, UPSC and other Central Institute recruitment services wherein the knowledge of additional subjects become mandatory for general or optional papers.

Summary of REVA University Regulations for Choice Based Credit System (CBCS) and Continuous Assessment Grading Pattern (CAGP) for Two Years Post Graduate Program

1.0 Teaching and Learning Process

The teaching and learning process under CBCS-CAGP of education in each course of study will have three components, namely-

(i) L= Lecture (ii) T= Tutorial (iii) P= Practical where:

L stands for **Lecture** session consisting of classroom instruction.

T stands for **Tutorial** session consisting participatory discussion / self-study/ desk work/ brief seminar presentations by students and such other novel methods that make a student to absorb and assimilate more effectively the contents delivered in the Lecture classes.

P stands for **Practice** session and it consists of Hands on Experience / Laboratory Experiments / Field Studies / Case Studies that equip students to acquire the much required skill component.

2.0 Course of Study and Credits:

The Program is grouped under various courses. Each of these courses carries credits which are based on the number of hours of teaching and learning. In terms of credits every one-hour session of L amounts to 1 credit per Semester and a minimum of 2 hour session of T or P amounts to 1 credit per semester or a three hour session of T/P amounts to 2 credits over a period of one semester of 16 weeks for teaching-learning process.

The total duration of a semester is 20 weeks inclusive of end-semester examination.

A course shall have only lecture, lecture and tutorial or practical component or combination of any two or all the three components.

The total credit earned by a student at the end of the semester upon successfully completing the course are L + T + P. **The credit pattern of the course is indicated as L:T:P.**

2.1. Various course of study are labelled and defined as: (i) Core Course (CC) (ii) Hard Core Course(HC)(iii)Soft Core Course(SC) (iv) Open Elective Course (OE).

(i) **Core Course (CC):** A course which should compulsorily be studied by a candidate as a core-requirement is termed as a Core course.

(ii) **Hard Core Course (HC):** The **Hard Core Course** is a Core Course in the main branch of study and related branch (es) of study, if any that the candidates have to complete compulsorily.

(iii) **Soft Core Course (SC):** A Core course may be a **Soft Core** if there is a choice or an option for the candidate to choose a course from a pool of courses from the main branch of study or from a sister/related branch of study which supports the main branch of study.

(iv) O**pen Elective Course (OE):**

An elective course chosen generally from other discipline / subject, with an intention to seek exposure is called an O**pen Elective Course.**

2.2. Project Work: Project work is a special course involving application of knowledge in solving / analyzing /exploring a real-life situation / difficult problem.

School of biochemistry, REVA University is associated with several central govt research organizations namely CIMAP, FRLHT, CIFT, CFTRI, and other research organizations like

Himalaya Drugs, Clinical research institutes [Clini India], SKANDA Labs, Clinical Diagnostics Labs, [ELIBT Laboratories, CHANRe Diagnostics] for students projects.

2.3. Minor Project:

A minor project work along with practical sessions as a hard core.

2.4. Major Project / Dissertation:

The Major Project / Dissertation shall be Hard Core.

The Project work and presentation commence soon after the completion of the second semester end examination. This project work is preliminary and will continue during fourth semester. A project work of Four and Fourteen credits together with eighteen is called Major Project work.

3.0. Total Credits to be earned:

3.1. A candidate has totally 96 credits for entire MSc Biochemistry program with a distribution of credits are tabulated in the next section for different courses as prescribed by the university as illustrated in scheme of instruction.

3.2. The credit system vary for different courses and a candidate can enrol for a maximum ranges of 22 to 25 per Semester.

3.3. Only such full time candidates who register for a minimum prescribed number of credits in each semester from I to IV semester and complete successfully 96 credits in 4 successive semesters shall be considered for declaration of Ranks, Medals, Prizes and are eligible to apply for Student Fellowship, Scholarship, Free-ship, and such otherrewards / advantages which could be applicable for all full time students and for hostel facilities.

4.0. Add on Proficiency Diploma and Add on Proficiency Certification:

4.1. Add on Proficiency Diploma: In excess to the minimum of 96 credits prescribed a candidate can opt to complete a minimum of 18 extra credits to acquire add on proficiency diploma in a particular discipline / subject in his / her subject of study or in other subjects / discipline along with the masters' degree.

4.2. Add on Proficiency Certification: To acquire add on proficiency certification a candidate can opt to earn a minimum of 4 extra credits either in the field of Biochemistry or in different discipline(s) / subject(s) in addition to a minimum of 96 prescribed credits for the Masters degree program.

5. Scheme of Assessment & Evaluation for P G Degree Programs of two years duration

5.1. The Scheme of Assessment and Evaluation will have two components, namely;

i. Internal Assessment (IA); and ii. Semester End Examination (SEE)

5.2. Assessment and Evaluation of each Course shall be for 100 marks. The Internal Assessment (IA) and Semester End Examination (SEE) of PG programs shall carry 50 marks each (i.e., 50 marks internal assessment; 50 marks semester end examination).

5.3. The 50 marks of Internal Assessment (IA) shall comprise of:

Internal Test (2) = 30 marks

Assignments (2) = 10 marks

Seminars (2) = 10 marks

5.4. There shall be three internal tests conducted as per the schedule given below. The students have to attend all the three tests compulsorily.

- 1st test for 15 marks at the end of 5th week of the beginning of the Semester;
- 2nd test for 15 marks at the end of the 10th week of the beginning of the Semester; and
- 3rd test for 15 marks at the end of the 15th week of the beginning of the Semester

5.5. The coverage of syllabus for the said three tests shall be as under:

- For the 1st test syllabus shall be 1st unit and 1st half of Second Unit of the Course;
- For the 2nd test it shall be 2nd half of Second Unit and Third Unit of the Course;
- For the 3rd test the syllabus will be 4th Unit of the Course.

5.6. Out of 3 tests, the highest marks scored in two tests / average are automatically considered while assessing the performance of the students along with the attendance for the complete semester.

5.7. There shall be two Assignments and two Seminars each carrying 5 marks each. Hence two assignments carry 10 marks (5+5 marks) and two seminars carry 10 marks (5+5 marks) as stated above.

5.8. The duration of the internal test shall be 75 minutes and for semester end examination the duration shall be 3 hours.

5.9. The Semester End Examination (SEE) for 50 marks shall be held during 19th and 20th week of the beginning of the semester and the syllabus for the semester end examination shall be entire 4 units.

5.10. There shall be double evaluation, viz, first valuation by the internal teachers who have taught the subject and second evaluation shall be the external examiner.

5.11. The average of the two evaluations (internal examiner & external examiner) shall be the marks to be considered for declaration of results. However the difference between the marks awarded by the external and internal examiners shall not be more than 20%.

In such cases where there is a difference of more than 20%, there shall be third valuation by the external examiner who has not valued the script, in which case the average of the marks awarded by the third valuer and nearest marks of the marks awarded by the first two examiners (internal and external) shall be considered for declaration of results.

5.12. Summary of Internal Assessment and Evaluation Schedule is provided in the table given below:

Summary of Continuous Assessment and Evaluation Schedule

Type of Assessment	**Period**	**Syllabus**	**Marks**	**Activity**
Allocation of Topics for Assignments / Seminars / Model making	Beginning of 5th Week	First Unit and Second Unit		Instructional process and Continuous Assessment
First Internal Test	Second Part of 6th Week	First Unit and 1st half of Second Unit	15	Consolidation of First Unit and 1st half of Second Unit
Submission of Assignments	8th Week	First Unit and Second Unit	5	Instructional process and Continuous Assessment
Seminars	9th Week	First Unit and Second Unit	5	Instructional process and Continuous Assessment
Second Internal Test	2nd Part of 13th Week	2nd half of Second Unit and Third Unit	15	Consolidation of 2nd half of Second Unit and Third Unit
Allocation of Topic for 2nd Assignment / Seminars	11th Week	Third Unit and Fourth Unit		Instructional process and Continuous Assessment
Submission of Assignments	13th Week	Third Unit and Fourth Unit	5	Instructional process and Continuous Assessment
Seminars	14th Week	Third Unit and Fourth Unit	5	Instructional process and Continuous Assessment
Third Internal Test	2nd Part of 16th Week	Fourth Unit	15	Consolidation of Entire Fourth Unit

Semester End Practical Examination	17th & 18th Week	Entire Syllabus	50	Conduct of Semester- end Practical Exams
Preparation	17th & 18th	Entire		Revision and
for Semester– End Exam	Week	Syllabus		preparation for semester–end exam
Semester End Theory Examination	19th and 20th Week	Entire Syllabus	50	Evaluation and Tabulation
	End of 21st Week			Notification of Final Grades

Note:

1. *As per the model making is concerned, the School shall decide about the Marks and the Number of Model Designs and as well the schedule of allocation and presentation of model design(s). If the model design carries 5 marks, there shall be two model designs; and in case of 10 marks, there shall be one model design. However, the decision of the School should be announced in the beginning of the Semester for students to avoid ambiguity and confusion.

2. Examination and Evaluation shall take place concurrently and Final Grades shall be announced latest by 5 day after completion of the examination.

3. Practical examination wherever applicable shall be conducted after 3rd test and before semester end examination. The calendar of practical examination shall be decided by the respective School Boards and communicated well in advance to the Registrar (Evaluation) who will notify the same immediately.

6. Assessment of Performance in Practical's

6.1. The performance in the practice tasks / experiments shall be assessed on the basis of: a) Knowledge of relevant processes b) Skills and operations involved c) Results / products including calculation and reporting with error calculation.

6.2. The 50 marks meant for continuous assessment of the performance in carrying out practical shall further be allocated as under:

I	Conduction of regular practical / experiments throughout the semester	20 marks
II	Maintenance of lab records	10 marks
III	Performance of mid-term test (to be conducted while conducting second test for theory courses); the performance assessments of the mid-term test includes performance in the conduction of experiment and write up about the experiment	20 marks
	Total	**50 marks**

6.3. The 50 marks meant for Semester End Practical Examination, shall be allocated as under:

I	Conduction of semester end practical examination	30 marks
II	Write up about the experiment / practical conducted	10 marks
III	Viva Voce	10 marks
	Total	**50 marks**

6.4. The duration for semester-end practical examination shall be decided by the concerned School Board.

7. Evaluation of Minor Project / Major Project / Dissertation: Right from the initial stage of defining the problem, the candidate has to submit the progress reports periodically and also present his/her progress in the form of seminars in addition to the regular discussion with the supervisor. At the end of the semester, the candidate has to submit final report of the project / dissertation, as the case may be, for final evaluation.

The components of evaluation are as follows:

I	Periodic Progress and Progress Reports (25%)
II	Results of Work and Draft Report (25%)
III	Final Evaluation and Viva-Voce (50%). Evaluation of the report is for 30% and the Viva-Voce examination is for 20%.

8. Provision for Appeal

If a candidate is not satisfied with the evaluation of Internal Assessment components, he/she can approach the grievance cell with the written submission together with all facts, the assignments, test papers etc, which were evaluated. He/she can do so before

the commencement of semester-end examination. The grievance cell is empowered to revise the marks if the case is genuine and is also empowered to levy penalty as prescribed by the university on the candidate if his/her submission is found to be baseless and unduly motivated. This cell may recommend taking disciplinary/corrective action on an evaluator if he/she is found guilty. The decision taken by the grievance cellis final.

Grievance Cell:

For every program there will be one grievance cell. The composition of the grievance cell is as follows. The Registrar (Evaluation) - Ex-officio Chairman / Convener | One Senior Faculty Member (other than those concerned with the evaluation of the course concerned) drawn from the school / department/discipline and/or from the sister schools / departments/sister disciplines – Member. One | Senior Faculty Members / Subject Experts drawn from outside the University school / department – Member.

9. Eligibility to Appear for Semester End Examination (SEE)

Only those students who fulfil a minimum of 75% attendance in aggregate of all the courses including practical courses / field visits etc, as part of the program, as provided in the succeeding sections, shall be eligible to appear for Semester End examination.

10. Requirements to Pass the Semester and to Carry Forward the Failed Subjects / Courses:

10.1. Requirements to Pass a Course

A candidate's performance from IA and SEE will be in terms of scores, and the sum of IA and SEE scores will be for a maximum of 100 marks (IA = 50 + SEE = 50) and have to secure a minimum of 40% to declare pass in the course. However, a candidate has to secure a minimum of 30% (15 marks) in Semester End Examination (SEE) which is compulsory.

10.2. Provision to carry forward the failed subjects / courses:

The student who has failed in 4 courses in odd and even semesters together shall move to next semester of immediate succeeding year of study. And he / she shall appear for SEE of failed courses of previous semesters concurrently with even end SEE of current year of study. However, he / she shall have to clear all courses of both odd and even semesters of preceding year to register for next succeeding semester. Students of final semester program can appear for make up examinations.

11.0. Re-Registration and Re-Admission:

11.1. In case a candidate fails in more than 4 courses in odd and even semesters together in a given academic year has to seek re-admission to those semesters during subsequent year within a stipulated period.

11.2. In case a candidate's class attendance in aggregate of all courses in a semester is less than 75% or as stipulated by the University, such a candidate is not allowed to appear for end semester examination (SEE) and he / she shall have to seek re-admissionto that semester during subsequent year within a stipulated period.

11.3. In such case a candidate drops all the courses in semester due to personal reasons he / she readmission to such dropped semester.

12.0. Attendance Requirement: a) All students must attend every lecture, tutorial and practical classes. b) In case a student is on approved leave of absence (e g:- representing the university in sports, games or athletics, placement activities, NCC, NSS activities and such others) and / or any other such contingencies like medical emergencies, the attendance requirement shall be minimum of 75% of the classes attended. c) Any student with less than 75% of attendance in a course in aggregate during a semester shall not be permitted to appear to the SEE. d) Teachers offering the courses will place the above details in the School / Department meeting during the last week of the semester, before the commencement of SEE, and subsequently a notification pertaining to the above will be brought out by the Head of the School before the commencement of SEE. A copy of this notification shall also be sent to the office of the Registrar & Registrar (Evaluation).

12.1. Absence during Internal test: In case a student has been absent from a internal tests due to the illness or other contingencies he / she may give a request along with necessary supporting documents and certification from the concerned class teacher / authorized personnel to the concerned Head of the School, for conducting a separate internal test. The Head of the School may consider such request depending on the merit of the case and after consultation with course instructor and class teacher, and arrange to conduct a special internal test for such candidate(s) well in advance before the Semester end examination of that respective semester. Under no circumstances internaltests shall be held / assignments are accepted after Semester end examination.

12.2. Absence during end semester examination:

In case a student is absent for end semester examination on medical grounds or such other exigencies, the student can submit request for make-up examination, with necessary supporting documents and certification from the concerned class teacher / authorized personnel to the concerned Director of the School. The Director of the School may consider such request depending on the merit of the case and after consultation

with class teacher, course instructor and permit such student to appear for make-up mid semester examination

13.0. Provisional Grade Card: The tentative / provisional grade card shall be issued by the Registrar (Evaluation) at the end of every semester indicating the courses completed successfully. The provisional grade card provides Semester Grade Point Average (SGPA). The SGPA is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student,
i. e SGPA (Si) = $\sum$(Ci x Gi) / $\sum$Ci Where Ci is the number of credits of the ith course and Gi is the grade point scored by the student in the ith course.

13.1. Final Grade Card: Upon successful completion of MSc in Biotechnology Degree a Final Grade card consisting of Grades of all courses successfully completed by the candidate will be issued by the Registrar (Evaluation).

13.2. The Grade and the Grade Point: The Grade and the Grade Point earned by the candidate in the subject will be as given below.

Marks P	**Grade G**	**Grade Point (GP=V x G)**	**Letter Grade**
90-100	10	v*10	O
80-89	9	v*9	A
70-79	8	v*8	B
60-69	7	v*7	C
50-59	6	v*6	D
40-49	5	V*5	E
0-39	0	v*0	F

O - Outstanding; A-Excellent; B-Very Good; C-Average ; C+-Average; C-Satisfactory; F – Unsatisfactory.

Here, P is the percentage of marks (P=[(IA)+SEE] secured by a candidate in a course which is rounded to nearest integer. V is the credit value of course. G is the grade and GP is the grade point.

13.3. Cumulative Grade Point Average (CGPA):

Overall Cumulative Grade Point Average (CGPA) of a candidate after successful completion of the required number of credits (96) for MSc BT degree is calculated taking into account all the courses undergone by a student over all semesters of a program, i.e: CGPA = $\sum$(Ci x Si) / $\sum$Ci

Where Si is the SGPA of the ith semester and Ci is the total number of credits in that semester.

The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

13.4. Computation of SGPA and CGPA

The Following procedure to compute the Semester Grade Point Average (SGPA)

The SGPA is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e 24

SGPA (Si) = ∑(Ci x Gi) / ∑Ci

Where Ci is the number of credits of the ith course and Gi is the grade point scored by the student in the ith course.

Illustration for Computation of SGPA and CGPA

Illustration No. 1

Course	Credit	Grade letter	Grade Point	Credit Point (Credit x Grade)
Course 1	4	A	9	4X9=36
Course 2	4	B	8	4X8=32
Course 3	3	C	7	3X7=21
Course 4	3	O	10	3X10=30
Course 5	3	E	5	3X5=15
Course 6	3	D	6	3X6=18
Course 7	2	O	10	2X10=20
Course 8	2	B	8	2X8=16
	24			188

Thus, SGPA = 188 ÷ 24 = 7.83

Illustration No. 2

Course	Credit	Grade letter	Grade Point	Credit Point (Credit x Grade point)
Course 1	4	B	8	4X8=32

Course 2	4	C	7	4X7=28
Course 3	3	A	9	3X9=27
Course 4	3	C	7	3X7=21
Course 5	3	D	6	3X6=18
Course 6	3	E	5	3X5=15
Course 7	2	C	7	2X7=21
Course 8	2	O	10	2X10=20
	24			175

Thus, SGPA = 175 ÷ 24 = 7.29

Illustration No.3

Course	Credit	Grade Letter	Grade Point	Credit Point (Credit x Grade point)
Course 1	4	D	10	4 x 10 = 40
Course 2	4	A	9	4 x 9 = 36
Course 3	3	C	7	3 x 7 = 21
Course 4	3	D	6	3 x 6 = 18
Course 5	3	A	9	3 x 9 = 27
Course 6	3	C	7	3 x 7 = 21
Course 7	2	A	9	2 x 9 = 18
Course 8	2	A	9	2 x 9 = 18
	25			199

Thus**, SGPA = 199 ÷ 25 = 8.29**

9.5. Cumulative Grade Point Average (CGPA):

Overall Cumulative Grade Point Average (CGPA) of a candidate after successful completion of the required number of credits (144) for MSc Biochemistry program is calculated taking into account all the courses undergone by a student over all the semesters of a program, i. e

CGPA = ∑(Ci x Si) / ∑Ci

Where Si is the SGPA of the ith semester and Ci is the total number of credits in that semester.The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

Illustration:

CGPA after Final Semester

Semester (ith)	No. of Credits (Ci)	SGPA (Si)	Credits x SGPA (Ci X Si)
1	24	6.83	24 x 6.83 = 163.92
2	24	7.29	24 x 7.29 = 174.96

3	24	8.29	24 x 8.29 = 198.96
4	24	8.55	24 x 8.55 = 205.20
Cumulative	96		743.04

Thus, CGPA = $\frac{24x6.83+24x7.29+24x8.29+24x8.55}{96}$ = 7.74

CONVERSION OF GRADES INTO PERCENTAGE: Conversion formula for the conversion of CGPA into Percentage is: Percentage of marks scored = CGPA Earned x 10
Illustration: CGPA Earned 7.67 x 10 = 76.7

14. Classification of Results

The final grade point (FGP) to be awarded to the student is based on CGPA secured by the candidate and is given as follows.

CGPA	**Numerical Index**	**FGP**
		Qualitative Index
> 4 CGPA < 5	**5**	SECOND CLASS
5 > = CGPA < 6	6	
6 >= CGPA < 7	7	FIRST CLASS
7 >= CGPA < 8	8	
8 >= CGPA < 9	9	DISTINCTION
9 >= CGPA 10	10	

Overall percentage=10*CGPA

15. Challenge Valuation

A student who desires to apply for challenge valuation shall obtain a photo copy of the answer script by paying the prescribed fee within 10 days after the announcement of the results. He / She can challenge the grade awarded to him/her by surrendering the grade card and by submitting an application along with the prescribed fee to the Registrar (Evaluation) within 07days after the announcement of the results. This challenge valuation is only for SEE.

The answer scripts for which challenge valuation sought for shall be evaluated by the external examiner who has not involved in the first evaluation. The higher of two marks from first valuation and challenge valuation shall be the final.

16. With regard to any specific case of ambiguity and unsolved problem, the decision of the Vice Chancellor shall be final.

M Sc in BIOCHEMISTRY (2017-18 batch)

Eligibility: Bachelors Degree of three years with Biochemistry,Chemistry or any Life Science subject as one of the cognate / major / optional subjects with 45% (40% in

case of candidates belonging to SC/ST) of marks in aggregate from any recognized

University / Institution or any other qualification recognized as equivalent thereto.

Table

Course Structure and Credit Distribution across Semesters

* Hard-Core Course- includes practical lessons

**Soft-Core Course- does not include practical lessons

+Open Elective

M Sc (Biochemistry) Program Overview

Biochemistry explores the chemical processes within and related to living organisms. The subject focuses on processes happening at a molecular level. It focuses on what's happening inside our cells by studying components like proteins, lipids and organelles. It also looks at how cells communicate with each other, for example during growth or fighting illness. Biochemists need to understand how the structure of a molecule relates to its function, allowing them to predict how molecules will interact.

By using chemical knowledge and techniques, biochemists can understand and solve biological problems

Biochemistry covers a range of scientific disciplines, including genetics, microbiology, forensics, plant science and medicine. Because of its breadth, biochemistry is very important and advances in this field of science over the past 100 years have been staggering. It's a very exciting time to be part of this fascinating area of study.

Biochemists find opportunities in Hospitals, Universities, Agriculture, Food institutes/organisations, Cosmetics, Forensic crime research, Drug discovery and development, and many other sectors.

In India, the hospital, pharmaceutical, food processing and agricultural sectors are all growing at a significant rate and development of biotech industries is being given prime importance by the Government of India to make it $100 billion industry by 2025, creating greater opportunities for Biochemists.

In this context, University Programme in Biochemistry at postgraduate level in India remains relevant for the creation of trained human resources.

M. Sc. (Biochemistry) at REVA UNIVERSITY has been designed to meet the human resources needs of existing and futuristic biotech industries and biotech research organizations involved in pharmaceuticals, food processing, agriculture, biomedical devices development; academic institutions and hospitals. The programme is designed to produce graduates with higher order critical, analytical, problem solving and research skills; ability to think rigorously and independently to meet higher level expectations of biotech industries, research organizations, hospitals and academic institutions. The programme in addition to core courses covers a number of specialized electives in the areas of Bioinformatics, Food Technology, Pharmacovigilance and SAS, Clinical Biochemistry and Diagnostics, and Plant & Industrial Biochemistry. The short term training in industries / R & D institutions, Internships, Student Projects in Biochemistry, Clinical Research, SAS and Clinical Diagnostics provide opportunity for the students to choose and acquire in-depth knowledge and skills in their area of interest.

Programme Educational Objectives (PEOs)

PEO-1	Become a professional biochemist with strong ethics and communication skill
PEO-2	Pursue carrier in reputed industry and diagnostic laboratories
PEO-3	Explore idea in research and consultancy services to develop new process and product

Programme Outcomes (POs)

PO-1: Science knowledge: Apply the knowledge of different fundamentals of life sciences including healthcare considering public health and safety, and the cultural, societal, and environmental concerns.

PO-2: Problem analysis: Identify, design and analyse problems related to the various domains of Biochemistry such as Clinical Biochemistry, Agricultural Biochemistry, Genetic Engineering, Molecular Biology, Food biochemistry and enzymatic diagnosis.

PO-3: Conduct investigations of complex problems: Use research-based knowledge including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO-4: Modern tool usage: Identify, select the methodology, and apply appropriate techniques, resources, and modern technology for product/process development which in turn benefit the society.

PO-5 Environment and sustainability: Understand and implement environmental-friendly approaches in Biochemistry to support sustainable development.

PO-6: **Ethics:** Apply ethical principles and commit to professional ethics, responsibilities and norms in life sciences.

PO-7: **Individual and team work**: Function effectively as an individual, and as a member or leader in teams, and in multidisciplinary settings.

PO-8: Communication: Communicate effectively with the science community and with society at large. Be able to comprehend and write effective reports documentation. Make effective presentations, and give and receive clear instructions.

PO-9: Project management and finance: Prove knowledge and understanding of Biochemistry and management principles and apply these to research work, as a member and leader in a team. Manage projects in interdisciplinary field.

PO-10: Life-long learning: Recognize the need for, and have the preparation as well as abilityto engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSO)

After successful completion of the programme, the graduates shall be able to

PSO-1: Work as scientist or biochemist experts in industries and research organizations in ateam with further training.

PSO-2: Develop strong ethics and communication as consultant with lifelong learningattitude.

PSO-3: Use higher order critical, analytical skill to solve a new problem.

REVA UNIVERSITY
M.Sc. BIOCHEMISTRY

Scheme of Teaching, Examination and Credits

FIRST SEMESTER MSc Biochemistry

Scheme & Syllabus-2017

Course code **I Semester**	**Title of the paper**	**Type of paper**	**Periods / Weeks**	**Duration of Exam Hours**	**IA**	**EA**	**Maximum Marks**	**Credit**
MSBC16F1100	Fundamentals of chemistry and Toxicology	H Core	4	3	50	50	100	4
MSBC16F1200	General Physiology	H Core	4	3	50	50	100	4
MSBC16F13 00	Bioenergetics and Intermediary Metabolism	H Core	4	3	50	50	100	4
MSBC16F1400	Analytical Techniques	H Core	4	3	50	50	100	4
MSBC16F1500	Biomolecules	S Core	2	1 1/2	25	25	50	2
MSBC16F1600	Laboratory Course I and Short term Training	Practical	12	6	20(practical) 30(project)	50	100	6
	Total Marks and Credits						500	20

Second Semester

Sl. No	**Code**	**Title**	**HC/ SC/ FC**	**Credit Pattern**			**Credits**
				L	**T**	**P**	

1	MS17BC301	Molecular Biology	HC	3	1	0	4
2	MS17BC302	Nutritional Biochemistry	HC	3	1	0	4
3	MS17BC303	Research Methodology & Statistics	HC	3	1	0	4
4	MS17BC304	Biochemistry in daily life *	OE	2	1	0	4
5	MS17BC305	Laboratory cum Training - V (Advanced Molecular Techniques)	HC	2	0	4	4
6	MS17BC306	Project work and presentation **	HC		0	4	4
Total Credits				**13**	**4**	8	**24**

Third Semester

Sl. No	**Code**	**Title**	**HC/ SC/ FC**	**Credit Pattern**			**Credits**
				L	**T**	**P**	
1	MS17BC201	Enzymology	HC	3	1	0	4
2	MS17BC202	Biotechnology	HC	3	1	0	4
3	MS17BC203	Immunology	HC	3	1	0	4
4	MS17BC204	Biochemical genetics	HC	2	1	0	3
5	MS17BC215	Bioinformatics	SC	2	0	0	2
6	MS17BC225	Food Technology	SC				
7	MS17BC206	Laboratory cum Training – III (Protein chemistry and Immunology)	HC	0	0	4	4
	MS17BC207	Laboratory cum Training - IV(Molecular Biology and Bioinformatics)	HC	0	0	4	4
Total Credits				**13**	**4**	8	**25**

*OE = Open Elective course “Biochemistry in daily life” is offered for students belonging to other schools. The students of M Sc Biochemistry have to choose Open Elective offered by other schools.

** The Project work and presentation commence soon after the completion of the second semester end examination. This project work is preliminary and will continue during fourth semester.

Fourth Semester

Sl. No	**Code**	**Title**	**HC/ SC/ FC**	**Credit Pattern**			**Credits**
				L	**T**	**P**	
1	MS17BC411	Pharmacovigilance and SAS	SC	3	1	0	4

2	MS17BC421	Clinical Biochemistry and Diagnostics	SC				
3	MS17BC431	Plant and Industrial Biochemistry	SC				
4	MS17BC402	Laboratory cum Training - VI (Genetic Engineering)	HC	0	0	4	4
5	MS17BC403	Project work-dissertation (continued from III Semester)	Project report	-	-	14	14
Total Credits							**22**
Total Credits of all Semesters							**96**

Project Guidelines

1. Students should develop a project individually.

2. They should implement their project in the university/Government or Private laboratory after approval of the Head of School.

3. The project should be subject based. The students have to collect data outside practical hours.

4. Internal marks can be awarded by the guide by evaluating the performance of The students during the course of project work.

6.In viva-voce the questions must be directed only on the project work to access The involvement and understanding of the problem by the students.

7. The project carries 200 marks is distributed as follows:

Demonstration and Presentation	130 Marks
Viva-voce	50 Marks
Project Report	20 Marks

Training and Placement

A degree with real life skills will open doors to the world of opportunities. But Employers are looking for much more than just a degree.

Popular skills employers look for include:

1. Willingness to learn
2. Self motivation
3. Team work
4. Communication skills and application of these skills to real scenarios
5. Requirement of gathering, design and analysis, development and testing skills
6. Analytical and Technical skills
7. Computer skills

8. Internet searching skills

9. Information consolidation and presentation skills

10. Role play

11. Group discussion, and so on

The REVA University therefore, has given utmost importance to develop these skills through variety of training programs and such other activities that induce the said skills among all students. A full-fledged Career Counselling, Training and Placement (CCTP) Centre headed by well experienced dynamic Trainer, Counsellor and Placement Officer supported by an efficient team does handle all aspects of Internships and Placement for the students of REVA University. The prime objective of the CCTP Centre is to liaison between REVA graduating students and industries by providing a common platform where the prospective employer companies can identify suitable candidates for placement in their respective organization. The CCTP Centre organizes pre-placement training by professionals and also arranges expert talks to our students. It facilitates students to career guidance and improve their employability. In addition, CCTP Centre forms teams to perform mock interviews. It makes you to enjoy working with such teams and learn many things apart from working together in a team. It also makes you to participate in various student clubs which helps in developing team culture, variety of job skills and overall personality. The University has signed MOU's with Multi-National Companies,

research institutions and universities abroad to facilitate greater opportunities of employability and as well students' exchange programs for higher learning.

The need of the hour is efficient leaders of repute, who can deal the real time problems with a pinch of innovation. This kept in focus, the training and Placement cell has designed the training process, which will commence from second semester along with the curriculum. Special coaching in personality development, career building, English proficiency, reasoning, puzzles, leadership, strategic management and communication skills to every student of REVA University are given with utmost care. The process involves continuous training and monitoring the students to develop their interpersonal skills that will fetch them a job of repute and to choose a proper career path.

FACULTY PROFILE - SCHOOL OF BIOCHEMISTRY

MRS. JAYASHREE.S

Professor and Head School of Biochemistry, REVA University

Specialization: General Biochemistry

Dr.V.VEERA RAGHAVAN

Professor, School of Biochemistry, REVA University

Specialization: Clinical Biochemistry

MR.CHARAN RAJ T P

Assistant Professor, School of Biochemistry, REVA University

Specialization: Organic Chemistry

MRS.JAYASRI.P

Assistant Professor, School of Biochemistry, REVA University

Specialization: Analytical techniques

MRS.DEEPA.H N

Assistant Professor, School of Biochemistry, REVA University

Specialization: Enzymology

MS.MEGHANA. M.V

Assistant Professor, School of Biochemistry, REVA University

Specialization: General Physiology

MS.SMITHA.A R

Lab Instructor, School of Biochemistry, REVA University

FIRST SEMESTER CALENDAR 2017-18 (REVA)

Time Table for First Semester **W.E.F**

	8.30-9.30	9.30-10.30	TEA BREAK	10.45-11.45	11.45-12.45	LUNCH BREAK	1.30-2.30	2.30-.30	3.30-4.30
Mon									
Tue									
Wed									
Thu									
Fri									
Sat									

DO'S AND DON'TS

DO'S

1. Maintain discipline and respect the rules and regulations of the university.
2. Be regular and punctual to classes.
3. Study regularly and submit assignments on time.
4. Be respectful to you Teachers/friends and hostel staff / management.
5. Read the notice board (both at your college and the hostel) regularly.
6. Utilize your Personal Computer for educational purpose only.
7. Follow the code of conduct.
8. Visit Health Centre on the campus whenever you are unwell.
9. Be security conscious and take care of your valuables especially Cash, Mobile Phones, Laptop and other valuables.
10. Carry your valuables along with you whenever you proceed on leave/vacation.
11. Use electric appliances, lights and water optimally.
12. Keep the campus clean and hygienic.
13. Use decent dressing.

DONT'S

1. Ragging inside/outside the campus.
2. Use of Alcohols, Toxic drugs, sheesha, gutka and hashish/heroin etc.
3. Use of Crackers, explosives and ammunition etc.
4. Smoking and keeping any kind of such items.
5. Misusing college & hostel premises/facilities for activities other than studies.
6. Playing loud music in the room which may disturb studies of colleagues/neighbours.
7. Making noise and raising slogans.
8. Keeping electrical appliances, other than authorised ones.
9. Involvement in politics, ethnic, sectarian and other undesirable activities.
10. Use of mobiles in academic areas.

I SEMESTERPAPER-I

MS17BC101: Organic, Biophysical, Biochemical and Environmental Toxicology

52hrs

Unit-1

ORGANIC CHEMISTRY

Electronic theory of valency. Electronic displacements in a molecule: Inductive effect, Electronic effect, resonance. The hydrogen bond, hydrophobic interactions. Atomic and molecular orbitals. Shapes of biomolecules, hybridization and tetracovalency of carbon.

Types of organic reactions: Substitution, addition, elimination, rearrangement, condensation and polymerization.

Free radicals in biological system: Oxygen as free radical in the auto oxidation of fats. Antioxidants (free radicals inhibitors in the cell such as vitamin A, vitamin E,vitamin C,Se etc)

Mechanism of substitution in benzene ring: ortho, para and Meta directing groups. The concept of resonance with reference to benzene derivatives. Direct influence of substituents- Electronic interpretation. **13hrs**

Unit-2

Stereochemistry: Structural isomerism, stereoisomerism, geometrical isomerism. Opticalisomerism,opticalactivity,mesocompounds,specificrotation,chirality,chiralcentre enantiomers,diastereoisomeres,confirmation and configuration, boat and chair forms, axialandequatorialbonds,anomersandmutarotation,glycoside,epimers,glucopyranose, fructopyranose, periodic acid oxidation of sugars.

Heterocyclic systems occurring in living systems: Numbering of the ring and properties of pyran, furan, thiazole, indole, pyridine, pyrimidine quinine,purine and pteridine. **13hrs**

Unit-3

Biophysical chemistry

T**hermodynamics studies in chemistry and biochemistry:** Definition and application of the first and second law of thermodynamics in understanding energies in living cells, chemical potential, equilibrium constant. Phosphate group transfer potentials.

Biological solvents: Water properties, dipole moments, ionic product of water

Acids, Bases and Buffers: pH scale, acids-bases, Henderson-Hasselbalch equation, buffers, ionization behavior of amino acids and proteins, titration curve, buffer solutions and action.

Microbiology: Physical,environmental and nutritional requirements for growth(growth curve).continuos culture of bacteria and synchronous growth of bacteria.Preparationof culture media, staining techniques and isolation of pure cultures. starter cultures for dairy industry. Fermented products. (food and dairy)
11hrs

Unit-4

BIOCHEMICAL AND ENVIRONMENTAL TOXICOLOGY **15hrs**

Definition and scope of toxicology: Eco-toxicology and its environmental significance. Toxic effects: Basic for general classification & nature. Dose - Response relationship: Synergism and Antagonism, Determination of ED50 & LD50. Acute and Chronic exposures. Factors influencing Toxicity. Pharmacodynamics & Chemodynamics.OECD guidelines.

Principles & procedures of testing for acute toxic effects: Regulatory guidelines, Mammalian systems affected & the clinical signs of Systemic Toxicity. Factors affecting acute Toxicity studies.

Xenobiotic metabolism: Absorption & distribution. Phase I reactions. Oxidation, Reduction, Hydrolysis and Hydration. Phase II reactions/Conjugation: Methylation, Glutathione and amino acid conjugations.

Biochemical basis of toxicity: Mechanisms of Toxcity: Disturbance of Excitable membrane functions. Altered calcium Homeostasis. Covalent binding to cellular macromolecules & Genotoxicity. Tissue specificity of Toxicity.

Pesticidetoxicity: Insecticides: Organochlorines, Anticholinesterases. Organophosphates and Carbamates. Fungicides.Herbicides. Environmental consequences of pesticide toxicity. Biopesticides.

Food toxicity: Common food adultrants, detection of adultrants, sources and effects of food toxicants. Toxicology of food additives i.e preservatives, colourants taste enhancers

Metal toxicity: Toxicology of Arsenic, mercury, lead and cadmium, sources and permissible limits of metals in organs, antidotes.

PAPER-II

MS17BC102: GENERAL PHYSIOLOGY

52hrs

Unit-1:

Muscular System: Ultra structure of smooth, skeletal and cardiac muscle fibers. Contractile and other proteins of muscle. Energy metabolism in muscle; Phosphagens, neuro-muscular junctions, excitation of striated muscles. Organization of

sarcolemma, transverse-tubular system and sarcoplasmic reticulum, mechanism of muscle contraction. Regulation of contraction in striated and smooth muscle. Calmodulin and its regulatory role, muscular dystrophies.

Resting potentials and action potentials of excitable cells, contraction of skeletal,cardiac and smooth muscles

Cardiovascular system: Anatomy and physiology of blood vessels, structure of heart, cardiac cycle, heart sounds, ECG, blood pressure and haemorrhage. **13hrs**

Unit-2

Nervous system: Types and structure of neuron. Neurotransmitters and receptors, mechanism of synaptic transmission. Briefly about membrane potential, resting potential and action potential. Briefly about EEG and epilepsy. Outline and function of CNS and PNS.Neuromuscular junctions. **7hrs**

Biochemistry of cancer – carcinogenesis, characteristics of cancer cell, agentspromoting carcinogenesis. **2hrs**

Respiratory system: Anatomy of lungs, mechanism and regulation of respiration, transport of gases O_2 and CO_2 respiratory, mechanism of acid and base balance with briefly the disorders of respiratory system. **4hrs**

Unit-3:

Blood and Body fluids: Composition and functions of blood. Erythrocytes including Hb, leukocytes and thromobocytes plasma proteins in health and diseases. Blood coagulation – mechanism and regulation. Fibrinolysis,anticoagulants,transfers of blood gases – oxygen and carbon dioxide. Hydrogen ion homeostasis- Factors regulating blood pH – buffers. Composition and functions of lymph and CSFAcid-base balance, metabolic and respiratory acidosis and alkalosis. **7hrs**

Digestive system:– Secretions, functions and regulation of saliva, gastric, pancreatic, intestinal and bile juice.

Digestion and absorption of carbohydrates, lipids, proteins, nucleic acids, minerals and vitamins. **6hrs**

Unit-4

Renal physiology and Excretion: Structure and functional unit of kidney, mechanism of urine formation (Glomerular filtration, Tubular reabsorption and Tubular secretion), concentration of urine, tubular function test, kidney hormones, regulation of acid-base balance, electrolyte and water balance. Renal failure, nephrosisand nephrites **7hrs**

Endocrine system: Chemistry of hormones and hormonal activity**.** Site of synthesis , secretion,functions and Circulation in blood of hypothalamus, pituitary, thyroid, adrenal cortex, parathyroid and pancreas, local hormones and their biological significance.Degradation and peripheral transformation.Receptors and the mechanismof hormone action.Disorders of endocrine system. **6hrs**

PAPER-III

MS17BC103: BIOENERGETICS AND INTERMEDIARY METABOLISM

52hrs

Unit-1

Bioenergetics: Energy transformation, Laws of thermodynamics, Biological oxidations, oxygenases, hydroxylases, dehydrogenases and energy transducing membranes. Gibbs energy, free energy changes and redox potentials, phosphate potential,chemo-osmotic theory.Proton circuit and electrochemical gradient, ionophores. Uniport, antiport and symport mechanisms, shuttle systems.

The mitochondrial respiratory chain, order and organization of carriers, proton gradient, iron sulphur proteins, cytochromes and their characterization. The Q cycle; P/O ratio. Reversed electron transfer, respiratory controls and oxidative phosporylation, uncouplers and inhibitors of energy transfer. Fractionation and reconstitution of respiratory chain complexes.
ATP – synthetase complex., partial reduction of oxygen, superoxides.
12hrs
Unit-2
Intermediary metabolism: Approaches for studying metabolism. Introduction to metabolism.

Carbohydrates: Glycolysis, citric acid cycles, its function in energy generation and biosynthesis of energy rich bonds, pentose phosphate pathway and its regulation. Alternate pathways (glyoxalic and uronic acid pathways)of carbohydrate metabolism. 38

Gluconeogensis. Interconversions of sugars. Biosynthesis of glycogen, starch and oligosaccharides.
Regulation of blood glucose homeostasis. Hormonal regulation of carbohydrate metabolism.

12hrs

Unit-3: Lipids

Fatty acid biosynthesis: Acetyl CoA carboxylase, Fatty acid synthase, desaturase and elongase. Fatty acid oxidation: α, β, ω oxidation and lipoxidation. Lipid Biosynthesis: Biosynthesis of triacyglycerols, phosphoglycerides and sphingolipids, Biosynthetic pathways for terpenes, steroids and prostaglandins. Ketone bodies: Formation and utilization. Metabolism of circulating lipids: chylomicrons, LDL, HDL and VLDL. Free fatty acids. Lipid levels in pathological conditions.

Amino Acid Metabolism : Overall nitrogen metabolism,digestion of dietary proteins,transaminationreaction(ALT,AST),mechanism of action of aminotransferases.Urea cycle and its regulation.Metabolism of ammonia and its disorders.Biosynthesis and degradation of essential and non essential amino acids and their regulation.Synthesis and degradation of catecholamines.In-born errors of amino acid metabolism.

17hrs

Unit-4
Nucleic Acid Metabolism: Biosynthesis of purines and pyrimidines. Degradation of purines and pyrimidines. Regulation of purine and pyrimidines biosynthesis. Structure and regulation of ribonucleotide reductase.Biosynthesis of ribonucleotides, deoxy ribonucleotides and polynucleotides. Inhibitors of nucleic acid biosynthesis.Salvage pathways.Disorders of nucleic acid metabolism.

11hrs

PAPER-IV

MS17BC104: ANALYTICAL TECHNIQUES

52 hrs

Unit-1

Centrifugation: Basic principles of centrifugation.Factors affecting sedimentation, Sedimentation Coefficient, Instrumentation and applications of Desktop, High speed and Ultra centrifuges; Preparative and Analytical centrifugation; Density gradiant and differential centrifugation and Isopycnic Centrifugation,

Extraction methods for preparation of samples: Preparation of extracts for biochemical investigations, physicochemical properties of metabolites and drugs

extracts from biological materials. Physico-chemical properties of solvents, solubility and missibility, ionic bonds, and salting out. Partition, ionization, buffering and their effect on extraction. Choice of solvent for solvent extraction, mixed solvents, solid phase extraction.

13hrs

Unit-2

Chromatography: Introduction, partition coefficient, phase systems- liquid and solid phases. Principle, instrumentation and applications of paper and thin layer chromatography.column chromatography-Ion exchange, Affinity and gel permeation Chromatography, HPLC.

Gas chromatography: Principle and design of instrument. Factors affecting GC, .Types of detectors (flame ionization , thermionic , electron capture , mass spectrometer).G.L.C; principle and application. **13 hrs**

Unit-3

Electrophoresis: Basic principles of electrophoresis and factors effecting electrophoretic mobility, Agarose gel electrophoresis of nucleic acids, capillary and pulse field,capillary electrophoresis.SDS PAGE.

Electro blotting: Western, southern, northern equipments and application. GIMSA assay.

Microscopic techniques: Types of microscopy(light, Phase Contrast ,florescence,dark field.Electron Microscopy- Working principle and applications of TEM and SEM, advantages.Immune gold , cryo-electron and Trans focal microscopy.

13hrs

Unit-4

Spectroscopic techniques: Electromagnetic spectrum, transition in spectroscopy. Principle, design and application of UV-Visible , fluorescence,

IR ,Raman IR , Atomic Absorption Spectroscopy,Flame photometer.

Principle, instrumentation and applications of X-RAY crystallography,NMR,ESR,

Mass Spectroscopy: Principle, overview of MS experiment, ionization modes: MALDI, equipments in MS analysis (Identification of metabolites). Interfacing MS with other methods; MS/MS, LC/MS, GC/MS.

13 hrs

PAPER-V MS17BC105:BIOMOLECULES

26Hrs

Unit 1: Carbohydrates and lipids

Carbohydrates: Structure, Classification and function of carbohydrates. Structure characteristics and biological importance of aminosugars , glycosides, bacterial polysaccharides, glycoproteins, blood group antigens and Lectins

Lipids Structure, Classification ,Characteristics and biological importance of lipids. Behavior of amphipathic lipids in water, formation of micelles and lioposomes. Prostaglandins.Bio membranes, membrane composition and fluid mosaic model.

13Hrs

Unit 2: PROTEINS AND NUCLEIC ACIDS

Proteins: Structure, Classification and properties of amino acids and proteins. Structural organization of proteins- Keratin, silk fibroin, collagen , myoglobin, haemoglobin, Integral membrane proteins,,concanavalin-A and Rossmann fold, ribonuclease, glyceraldehyde-3-phosphate dehydrogenase, lysozyme, chymotrypsin ,Triose phosphate isomerase . **13hrs**

MS17BC106 : Laboratory cum Training- I (BioPhysical chemistry and Clinical Biochemistry)

1. Preparation of buffers; Acetate, phosphate and tris buffer.
2. Chromatographic techniques (Paper,TLC,Column)
3. Qualitative Tests for bio constituents in biological sample.
4. Estimation of cholesterol, urea and glucose in biological sample.
5. Estimation of Serum bilirubin by Diazo method.
6. Estimation of Hemoglobin.
7. Analysis of water: estimation of calcium and magnesium by EDTA method.

MS17BC107 : Laboratory cum Training- II (Enzymology and Microbiology)

1. Assay of salivary amylases,
2. Assay of Alkaline phosphatases
3. Assay of SGOT, SGPT and LDH.

4. Microscopic examination and chemical analyses of blood, urine and stools.
5. Isolation of air microflora Colony characteristics and Counting, pure culture techniques
6. Biochemical tests for microbial culture,testing water quality by microbial Method.
7. Bacterial growth curve.

II SEMESTERPAPER-I
MS17BC201:ENZYMOLOGY

Unit-1 52hrs

Introduction to Enzymes: Nomenclature and classification of enzymes. Mechanism of enzyme actions. Monomeric and oligomeric enzymes and multi- enzyme complexes with examples viz. Pyruvate dehydrogenase and fatty acid synthetase. Isoenzymes

The investigation of active site structure: The identification of binding sites and catalytic sites–trapping the E-S complex, use of substrate analogs, enzyme modification by treatment with proteolytic enzymes, photo – oxidation and chemical modification of amino acid side chains. The 3-D structural features of active sites.

13hrs

Unit-2

Factors affecting enzyme activity: pH, temperature, substrate concentration, enzyme concentration.

Enzyme catalysis: Chemical nature of enzyme catalysis-General acid-base catalysis, electrostatic catalysis, covalent catalysis, intramolecular catalysis and enzyme catalysis.

Mechanisms of action of the following enzymes-lysozyme, ribonuclease, serineproteases and Triose phosphate isomerases.

Co-enzymes and cofactors: Water soluble vitamins and structure and function of their coenzymes.Metallo enzymes.

13 hrs

Unit-3

Enzyme kinetics: Kinetics of single substrate enzyme catalysed reactions; Michaelis Menton equation; determination of Vmax and Km values; Line-Steady State Kinetics, Eadie-Hofste plot; Kinetics of multi substrate enzymecatalysed reaction- reorder, order and Ping-Pong mechanism. Use of initial velocity, inhibition and exchange studies to differentiate between multi substrate reaction mechanisms.

Enzyme inhibition: Types-reversible, irreversible, competitive, non-competitive, mixed inhibition, partial inhibition, substrate inhibition and allosteric inhibition; irreversible inhibition.

14 hrs

Unit-4

Enzyme regulation: General mechanisms of enzyme regulation: Feed Back Inhibition and Enzyme repression control of enzymic activity by products and substrates; Allosteric enzymes, Sigmoidal kinetics and their physiological significance.

Fundamentals of enzyme assay – enzyme units, coupled kinetic assay. Criteria of purity of enzymes.

Industrial uses of enzymes: Amylases, cellulose degrading enzymes, proteolytic enzymes in meat and leather industry, detergents and cheese production; immobilisation of enzymes and their applications; introduction to biosensors.

12hrs

PAPER-II

MS17BC202: BIOTECHNOLOGY 52hrs

Unit-1

Recombinant DNA Technology

Introduction to recombinant DNA technology, importance of recombinant DNA technology, construction and screening of genomic and cDNA libraries, chemical synthesis of oligonucleotides, cloning vectors (λ -phage, plasmid, M-13 phage, cosmid shuttle, BAC and YAC vectors), properties of restriction endonucleases and their mode of action. **10 hrs**

Unit-2 Sequenicng

Sequencing OF DNA by Sanger's method, Principle and technique of pyrosequencing, Protein sequencing by Edman degradation method, site directed mutagenesis, RFLP,RAPD, PCR, DNA finger printing, Phage display , Yeast-two-hybrid (Y2H), Three hybrid assay**.** **10 hrs**

Unit-3

Gene transfer to plants: Plant tissue cell culture, hormones in plant tissue culture media, callus culture, Acclimatization of micro propagated plant. *Agrobacterium* mediated transformation, Ti plasmid, mechanism of T-DNA transfer, Function of T-DNA genes, Ti-plasmid derivatives as plant vectors (disarmed T-DNA), cointegrate and binary vectors, selectable markersfor plants, Direct DNA transfer to plants: protoplast transformation, particle bombardment, chloroplast transformation, electroporation. **11hrs**

Animal tissue culture: Cell culture media, monolayer and suspension culture, Gene transformation: Transfection, electroporation and liposome mediated transfer. *In vitro* fertilization and embryo transfer. Introduction to Transgenic animals, ethical issues regarding genetically modified organisms. **9hrs**

Unit-4

Fermentation technology

Primary and secondary metabolites in biotechnology, continuous and batch type culture techniques, principle types of fermentors, general design of fermentor, fermentation processes-brewing, manufacture of penicillin, production of single cell proteins, production strategies for other antibiotics and other organic compounds.

12 hrs

PAPER-III MS17BC203: IMMUNOLOGY

Unit-1

Introduction to Immune System

Memory, specificity, diversity, innate and acquired immunity, self vs non-self discrimination. Structure and functions of primary and secondary Iymphoid organs.

Cells Involved in Immune Responses

Structure and functions of Lymphocytes,Granulocytes,Macrophages,Dendritic cellsand mast cells

Nature of Antigen and Antibody

Antigen vs Immunogen, Haptens ,Structure and functions of immunoglobulins ,Isotypic, allotypic and idiotypipc variations.Clonal selection theory – concept of antigen specific receptor.

13 hrs

Unit-2

Humoral and Cell Mediated Immune Responses

Complement activation and its biological consequences, Antigen processing and presentation Cytokines and costimulatory molecules: Role in immune responses.T and B cell interactions.

Major Histocompatibility Complex (MHC) Genes and Products

Polymorphism of MHC genes, Role of MHC antigens in immune responses,MHC antigens in transplantation.

13hrs

Unit-3

Immunological Techniques.

Production of polyclonal and monoclonal antibodies: Principles, techniques and applications. Agglutination and precipitation techniques, Radio immunoassay, ELISA, Immunofluorescence assays: Fluorescence activated cell sorter (FACS) technique.

Hypersensitivity

Immune – tolerance, Immunosuppression, Hypersensitivity (Type I, II, III and IV).

13hrs

Unit-4

Immune Responses in Diseases

Immune responses to infectious diseases: viral, bacterial and protozoal, Cancer and immune system, Immunodeficiency disorders, Autoimmunity.

Immunization

Active immunization (immunoprophylaxis), Passive immunization (immunotherapy), Role of vaccines in the prevention of diseases**.** **13 hrs**

PAPER-IV

MS17BC204: BIOCHEMICAL GENETICS

Unit I

Introduction: Nature of genetic material. Chromosomes and genes. Mutation: types of mutation, mutagens, mechanism of mutation **3 hrs**

Classical Genetics: Review of classical genetics; work on Pisum sativum, Drosophila Melanogaster, Neurospora Crassa etc. inheritance (sex-linked and others). Population genetics, extranuclear inheritance. Sex determination, Morgan's discovery of sex linked inheritance of sex linked genes, X;linked traits in humans. Identification of sex chromo;somes, XX,XY, mechanism of sex determination. **10 hrs**

Unit II

Quantitative Genetics: Human quantitative traits, discontinuous traits and continuous traits,Breeding analysis, genetics basis of quantitative variation, Multiple factor hypothesis and analysis of polygenes. Genotype-Environment Interaction and models for their measurement, estimation of Heritability Index.

13 hrs

Unit III

Human Genetics: Biochemical events occurring during mitosis and meiosis. Structure of chromatin; nucleosomes and higher orders of organization. Chromosome banding, Chromosome mapping based on recombination frequency data. Transposons. Overview of human genome project, mapping of human genes; techniques used, assignment of important genes. Transposition in human chromosomes. Chromosomal abnormalities. **13 hrs**

Unit IV

Bacterial Genetics: Bacterial chromosomes, plasmids; fertility, resistance, colicinogenic and others. Recombination in bacteria**.** **5 hrs**

Viral Genetics: Life cycles of bacteriophages, lytic cycle; replication of T-phages. Lysogeny and its regulation. Transduction; specialized, generalized and abortive. Fine structure analysis of T-phages; Benzers work, concept of cistrons**.** **8 hrs**

PAPER-V MS17BC215:BIOINFORMATICS

Unit-1

Computer basics, Introduction, Scope of Bioinformatics and Biological data bases

- MS windows basics, UNIX basics.
- PC X Windows (NCD PCXWARE).
- File management.
- E-Mail (PINE, EUDORA, NETSCAPE MAIL).
- File transfer (ftp, WSftp).

Operating systems: System and application software, evolution of operating systems, layered structure of operating system, CUI and GUIs, DOS internet & external commands, Batch files.

Office applications: MS-office including MS-Word, MS-Excel, and MS-Powerpoint.
Data bases: Databases structure Organization and management of data bases, Data mining. Retrieval tools of biological data. Biological information resources, Nucleic acid and protein data bases.
13 hrs

Unit 2

Sequence Alignment and prediction of structure of protein
Database similarity searches: BLAST and FASTA**,** Sequence Alignment. Methods of local and global alignment. Dynamic programming, scoring matix, PAM, BLOSUM, Pairwise and multiple sequence alignment. Phylogenetic tree construction and software, Methods of prediction

of structure of protein and structure prediction softwares, Drug designing : Chemo-informatics in Biology.

13 hrs

PAPER – VI

MS17BC225: FOOD TECHNOLOGY **26hrs**

Unit 1

Introduction and Constituents of foods.

Food: source, functions of food – food groups – basic five food groups, usage of the food guide – food in relation to health – objectives of cooking.

Water: Purification processes – Ion exchangers, reverse osmosis, activated charcoal treatment. Use of chlorination, ozone, and UV light disinfection. Specification of drinking water. Water borne diseases – microbiological examination. Sources and detection.

Milk: Composition and effectiveness as a diet. Fat content in milk, whole and skimmed. Effect of cooking and heat processing of milk – pasteurization. Preservation of milk. Deep freeze preservation, dairy products – cheese, butter, ghee and kova. Spray drying technique – milk powder, infant food preparation. Lactose intolerance. Milk substitutes – vegetable milk. Toned milk.

Effect of cooking on the nutritive value of carbohydrate, protein, fat, vitamins and minerals food products. Emulsions and emulsifiers, rancidity of fats – chemistry of fat and oil processing , Fortification with vitamins and minerals. Effect of cooking on different methods of cooking of vegetables, fruits – dehydrated fruits, canned fruit, canned fruit juices. Estimation of thiamine,riboflavin (fluorimetry) and metals in tea dust. **13hrs**

UNIT 2:

FOOD ADDITIVES,ADULTERATION AND HYGIENE

Enzymes in food processing. Enzymic browning – mode of action and prevention of enzymic and non-enzymic browning. Artificial sweetening agents. rancidity of fats ; storage of fats. Fortification with vitamins and minerals.

Food Additives: Food additives: Artificial sweeteners – saccharin, cyclomate, asparatame –food flavours – esters, aldehydes and heterocyclic compounds. Antioxidants. Food colours – changes in cooking..Restricted use. Spurious colours. Emulsifying agents, preservatives – leavening agents.Baking powder –Yeast. Taste enhancers – MSG-vinegar Modern food: Mushroom cultivation and types, . Production of bread, bun and biscuits. Raw materials, methods and machinery required.Functions and uses of food additives.

Beverages: Composition of soft drinks. Preservation of tetrapack. Nitrogen preservation and packing of fruit juices.

Food Adulterants: Common adulterants in different foods – milk and milk products, vegetable oils, fats, spices , cereals and pulses. Prevention of food adulteration

Food preservation and processing : Food deterioration, methods of preservation and processing. Quality control: Specifications and standards: PFA, FPO, FDA, drug license, WHO standards, ISI ,AGMARK. **13hrs**

PAPER – VII

MS17BC206: LABORATORY COURSE– III (PROTEIN CHEMISTRY AND IMMUNOLOGY)

1. Isolation, separation and identification of protein/enzyme using thin layer chromatography.
2. Purification of an enzyme using column chromatography(ion-exchange columns/gel filtration/ affinity chromatography).
3. Estimation of protein by Lowry's method.
4. Estimation of tyrosine by Millon's method.
5. Molecular weight determination and kinetic studies on purified enzymes.
6. Demonstration of Ag-Ab interaction: Radial immuno-diffusion and ODD.
7. Demonstration of direct agglutination reaction using human blood group antigens.
8. Bacterial agglutination (WIDAL)
9. Antibody titration – ELISA; Direct, Indirect ELISA.
10. Rocket electrophoresis.
11. Protein synthesis in a cell free protein synthesizing system from animal and plant source.(industrial visit)

PAPER – VIII

MS17BC207: LABORATORY COURSE– IV (MOLECULAR BIOLOGYAND BIOINFORMATICS)

1. Isolation of DNA from cauliflower, sheep liver and bacterial source.
2. Isolation, separation, identification and Determination of molecular weight of Proteins by SDS-PAGE.
3. Writing a BASIC computer program to plot graphs of enzyme kinetic data by a variety of linear transforms and the Michaelis- Menten hyperbolic plot.
4. Prediction of structure of a biomolecule by using various softwares.(Rasmol, PDB,Identification of ligands/substrate through docking, chemsketch etc,…)
5. Subcellular fractionation of organelles from liver cells and identification by the use of marker enzymes.(industrial visit)
6. Separation of Protein in HPLC.

III SEMESTERPAPER-I

MS17BC301: MOLECULAR BIOLOGY 52 hrs

Unit -1

INTRODUCTION: Principle of DNA sequencing**,** automated sequencing, extending the sequence, shot gun sequencing.Interpretation of DNA sequences.Role of counterions, deep and narrow grooves, single stranded DNA, A, B and Z DNA etc. Chirality of the helix, syn/antiparallel complementary stands.

Physical properties of RNA: Classes of RNA, rRNA, tRNA, mRNA, HnRNA etc.

12hrs

Unit -2

DNA Replication: Replication origin and replication fork, mapping origin ofReplication by autoradiography and electrophoresis, semi-conservative and semi-discontinuous replication; DNA Polymerases, Semi-discontinuous synthesis,Replication apparatus of phage.Properties and functions of DNA polymerase-I,Korenberg enzyme,Subunit composition of polymerase –III holoenzyme,telomerase, topoisomerase and gyrase.

Genetic code;Properties of genetic code,coding properties of mRNA,Coding properties of tRNA, triplet binding assay, Khorana and Neirenberg experiments, base pairing between codon and ani-codon, Wobble base pairing., deviation from universal genetic code.

14hrs

Unit-3

Transcription in prokaryotes: RNA synthesis and processing (transcription factors and machinery, formation of initiation complex, transcription activator and repressor, RNA polymerases, capping, elongation, and termination, RNA processing, RNA editing, splicing, and polyadenylation, structure and function of different types of RNA, RNA transport). Protein synthesis and processing (Ribosome, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, genetic code, aminoacylation of tRNA, tRNA-identity, aminoacyl tRNA synthetase, and translational proof-reading, translational inhibitors, Post- translational modification ofproteins).
15hrs

Unit -4

DNA Repair : Damaging agents and damagerecognition, direct repair, Miss-matchrepair assay for mismatch repair, Base excision repair(BER), Nucleotide excision repair(NER) systems; components and mechanism of repair, errorprone repair, SOS and Rec-A.
Satellite DNA: C-value paradox, possible functions of satellite DNA, Mechanical strength, gene library, suppressor mutation, centromeric DNA, split genes
Chromatin: Histone and non-histone proteins . Nucleosomes, role of H1.

11hrs

PAPER - II

MS17BC302: NUTRITIONAL BIOCHEMISTRY 52 hrs

Unit-1

Introduction of Nutrition: Energy concept of foods- Definition and characteristicfeature of balanced diet, proximate analysis of foods for carbohydrates, proteins, fats, fibre material.Determination of calorific value of foods, like carbohydrates, fats and proteins. Biochemical importance of R.Q. BMR, measurement of BMR, direct and indirect method, factors affecting BMR.

Biological Oxygen Demand: Definition and importance. Energy requirement for different physical activities. Standard Dynamic Action (SDA) of food. Recommended Daily Allowance (RDA) – Definition & for various food and physical activities. **15hrs**

Unit-2
Carbohydrates: carbohydrate reserves of the human body,nutritional importance of carbohydrates.

Proteins: Protein reserves of human body. Nitrogen balance studies and factors influencing nitrogen balance. Essential amino acids for man and concept of protein

quality.Protein energy malnutrition: Marasmus, Kwashiorkor, causative factors, symptoms, treatment & prevention

Lipids: Major classes of dietary lipids. Properties and composition of plasma lipo-proteins. Dietary needs of lipids. Essential fatty acids and their physiologicalfunctions.

13hrs

Unit-3

Nutritional importance of vitamins: Classification, sources, daily requirement and functions. Hypervitaminosis of fat soluble vitamins

Nutritional importance of Minerals: Definition, classification, sources, daily requirement and deficiency, symptoms. The process of digestion, absorption, functions, toxicity interaction with other nutrients. **13hrs**

Unit-4

Biochemical aspects of oxidative stress and antioxidants. Free radicals- formation and biological importance in human system. Natural antioxidants, role of free radicals and antioxidants in health & diseases.

Starvation :. Protein metabolism in prolonged fasting. Protein sparing treatmentsduring fasting. Basic concept of high protein, low caloric weight reduction diets.

Obesity : Definition and classification. Genetic and enviromental factors leading to obesity. Obesity related related diseases and management of obesity. **11 hrs**

PAPER - III

MS17BC303: RESEARCH METHODOLOGY AND STATISTICS

52hrs

Unit-1

Methodology of scientific research.The nature of scientific methods.Quantitative biochemical measurements: Analytical considerations and experimental errors, nature of experimental errors- random and systemic errors. Identification of systemic errors, SOPs. Performance of analytical methods, precision, accuracy, detection limit, analytical range, specificity, sensitivity, and robustness. **13 hrs**

Unit-2 and 3

Quantitative biochemical measurements: Analytical considerations and experimental errors,nature of experimental errors- random and systemic errors. Identification of systemic errors, SOPs. Performance of analytical methods, precision, accuracy, detection limit, analytical range,specificity, sensitivity, and robustness.

Gaussian distribution (normal) of data, quantification ofprecision by standard deviation, coefficient of variation and variance, (data to be provided forcalculation of each parameter). Assessment of accuracy; Population statistics- confidence limitsand confidence intervals, student's t-test, standard error of mean, examples for calculation. Qtests,examples and applications, Null hypothesis, use of t-test tovalidate analytical methodsunpaired,paired, one-sample, two-sample tests with examples. Calibration methods; Least meansquare method of fitting straight line to data with example. Correlation and regression analyses.ANOVA, one way and two-way ANOVA.
Principles and practice of statistical methods in biological research, Basic statistics: samples and populations ,measures of average, measures of dispersion, standarderror, confidence limits; Probability distribution: normal, binomial and Poisson distribution; correlation and regression, test of statistical significance, and analysis of variance, Distribution of student's -t, chi-square (X2), F-test, latest software, introduction of software, exercise on biochemical problems **26 hrs**

Unit-4

Collection and review of research literature, sources of literature and their evaluation. Designing research methodologies. General strategies for preparation of research proposals. 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. **13hrs**

MS17BC304: BIOCHEMISTRY IN DAILY LIFE (For Other streams)

PAPER-V

MS17BC305: LABORATORY COURSE-III

1. Preparation of plasmid DNA from bacterial source.
2. Digestion by endonucleases and separation of DNA restriction fragment on agarose gel electrophoresis.
3. Ligation of DNA.
4. Isolation, quantification and characterization of total RNA from plant and microbial source.
5. DNA and RNA techniques using nitrocellulose - Southern and Northern Blotting.
6. Electroblotting of DNA restriction fragments.
7. Sequencing of DNA and RNA on polycrylamide gels.(Industrial Visit)
8. Rapid amplification of polymorphic DNA(RAPD).

9. Amplification of desirable gene by PCR
10. Real Time– Polymerase Chain Reaction RT-PCR. (Industrial Visit)
11. Preparation of competent cells.

MS17BC306- Project work-Dissertation

SEMESTER IV

Open Elective ICombination-1

MS17BC411: Pharmacovigilance

(Four hours per week, 4 credits)

Unit-1 (13hrs)

Drug Development Process

Drug discovery,Permulation and formulation,ICH-GCP Guidelines, ICMR Guidelines,USFDA guidelines, Indian Regulatory Authority Frame Work-CDSCO Regulations, DCGI,Data to be submitted along with the application to conduct clinical trials/import/manufacture of new drugs for marketing in the country, Data requiredto be submitted by an applicant for grant of permission to import and manufacture a new drug already approved in the country. Structure,Contents and Format for clinical study reports.

Unit-2 (13hrs)

Pharmacoepidemiology

Definitions: epidemiology, Disease distribution, disease determination, disease frequency, Aims of epidemiology, Difference between epidemiology and clinical medicines, Epidemiological approach, Measurements in epidemiology, (rates, ratios, and proportions) Measurement of mortality: international death certificate, limitations and use of mortality data, mortality rates and ratios, crude death rates, specific death rates, case fatality ratio, proportional mortality ratio, survival rate, standardize rates, direct standardization, indirect standardization, Measurement of morbidity: Incidence,

Prevalence, uses of prevalence, relationship between incidence and prevalence.

Unit-3 (13hrs)

Clinical Trial Management

Definition: Clinical Research, Different phases, study designs in research, glossary, Different parties involved in Clinical research, Regulatory Authorities, IRB/IEC, Sponsor, CRO, SMO, Investigator, Patients, Clinical Research History, Food, Drug & Cosmetic Act, Nuremberg Code, Declaration of Helsinki, ICH, Thalidomide Disaster

Different Regulatory Bodies- an overview, FDA, DCGI, MHRA, MHLW, TGA, IRB/IEC, Schedule Y, IND & NDA Application, Regulatory requirements & Forms, Clinical Trials process & monitoring,Roles of different parties, Clinical Trialprocess and design, Informed Consent Process, TMF (Trial Master File), Investigator Boucher, Essential Documents

Unit-4 (13hrs)

Clinical Data Management

CDM Overview, CRF Design – Theory & Practical Design of the pCRF (Paper CRF) &eCRF (electronic CRF), Data Entry & DE Guidelines, Discrepancy Management, Data Validation, CDISC (SDTM), Query Management, QA, QC in CDM, Audits & Inspections (Indian DCGI & USFDA), SAE Reconciliation, Data Management Systems and Tools, Medical Coding and Medical Dictionaries – MedRA& WHODD, Documentation and Document Management System, Data Archival, Software's in CDM, CDM

MSBC16F4200: SAS Technique 52 hrs

Unit-1 (13hrs)

Pharmacovigilance

Introduction, Scope, definition and Aims of Pharmacovigilance.Adverse drug reactions – Classification, mechanism, predisposing factors and casualty assessment. Role ofclinical pharmacist in Reporting, evaluation, monitoring, prevention and management of ADR Adverse drug reaction.Signal detection, PSUR (Periodic safety update report),Safetyspecification,and Risk management.Eporting and monitoring Drug induced diseases.

Unit-2 (13hrs)

Introduction and use of SAS

Environment of SAS, Library structure in SAS, Data steps and Procstep,manipulating the data-Converting the numeric data to character and vice versa.Using logical operators and where conditions, Merging of the datasets, Writing the data into multiple datasets.Debugging errors in the program.Writing the procedure- Tabulate, Univariate, Means, Median, Mode, Report, Sort, Mixed, Transpose etc. Creating the html reports.Importing the data to SAS and exporting the data from SAS.Overview of SAS macros.

Unit-3 (13hrs)

Regulatory Affairs

Basic Fundamentals of Regulatory Affairs, Introduction to Regulatory Bodies, Introduction to Quality Standards for Regulatory Compliance, Common Technical Documents - CTD (API & Formulation), Introduction to eCTD, ASEAN Common Technical Dossier (ACTD), Marketing Authorization Procedures in USA, Marketing Authorization Procedures/ Channels in Europe, Marketing Authorization Procedures in India, Marketing Authorization Procedures in ROW markets, Maintenance and Annual updates for Marketing authorizations, Reference on Further reading & Dissertation

Unit-4 (13hrs)

Medical & Scientific writing

What is Medical Writing, Scope of Medical Writing, Medical Writing in Clinical trials, Medical Writing and Scientific Writing, Fundamentals of Medical Writing, Regulatory Medical Writing, The Writing Process, Good Writing Skills:Introduction to basic rules, Elements of style

Good Clinical Practice guidelines, The Clinical Study Report

Introduction to publication writing, Regulations and Industry Standards, Writing Effective Documents, Writing standard operating procedures policies, procedures, instructions and methods, Writing quality manuals and plans

Open Elective IICombination-2

MS17BC421:Clinical Diagnostics

52hrs

Unit-1
Human Physiology

Rhythmical excitation of heart, basic theory of circulatory function, blood flow and resistance, function of arterial and venous systems

Microcirculation and lymphatic system, control of blood flow, regulation of arterial pressure, cardiac output.

Spinal cord and motor functions, role of brain stems in controlling motor functions, functions of cerebellum, functions of cortical areas, the limbic system and cerebrospinal fluid system.

Medico -informatics

Introduction to Medical Network Design & Development Emergence of Medical Informatics as a Discipline; Library facilities & Logistics ; Online Resources ; Grading and Class Policies, Medical data acquisition and database systems: PC based multichannel data acquisition system; storage, analysis and retrieval techniques.

Basics of sequence analysis-

Dot matrix method, Needleman–Wunsch Algorithm and Smith-Waterman algorithm, Alignments using BLAST and FASTA, Multiple Sequence Alignment (CLUSTAL-X and CLUSTAL-W), Application of multiple sequence alignment. **13hrs**

Unit-2

Analysis tools: Analysis by TreeView, Genedoc and Lasergene. Protein Structure Prediction in Bioinformatics- Ab initio based methods, Homology based methods, prediction with neural networks, secondary structure prediction (helical membrane proteins, beta-barrel membrane proteins). Protein structure comparison of intermolecular and intramolecular methods Phylogenetics- construction by distance based methods, character based methods.

Visual programming concepts

Visual Basic environment, tools and controls; Dynamic data exchange; VB based Medical information System. Basic concepts of Multimedia; Design of Multimedia information systems; Components of virtual reality; Virtual reality applications in medicine. Medical Informatics and its levels; Design and development of educational packages on medical sciences; Integrated design concepts; Interactive multimedia,Virtual and digital libraries, Internet and its applications.

Hospital Information System its design and functional characteristics; Pattern Recognition, Neural Network and Fuzzy Logic in Medicine. Autonomous, Decision-

Support & "Expert" System: History of Artificial Intelligence in Medicine; Expert Systems in Medicine; Clinical Software Overview Risks of Decision-Support Systems,Computational Statistics in medical biology. **13hrs**

MS17BC421: CLINICAL BIOCHEMISTRY **52 hrs**

UNIT - 1

Concepts of accuracy, reproducibility, reliability and other factors in quality control: Specimen collection and processing, collection of blood- venepuncture, arterial puncture and anticoagulants. Collection and analysis of normal and abnormal urine samples, preservation, clinical significance of sugars, ketone bodies, proteins & bilirubin. Theories of CSF collection, composition and analysis.

Disorders of carbohydrate metabolism: Blood sugar levels, hyper and hypoglycemia, regulation of blood glucose level. Diabetes mellitus- types, causes and symptoms. GTT, HbAIC, GSD, HMP Shunt, fructosuria & fructose intolerance.

Disorders of lipid metabolism: Lipid levels in various conditions, lipoproteins,clinical inter-relationship of lipids.

Diagnostic tests for apolipoproteins, HDL-C, LDL-C, and triglycerides levels in healthy& diseases conditions. Hypercholestremia, fatty liver and myocardial infarction.

Disorders of protein metabolism: Non-protein nitrogenous constituents in blood- urea, uric acid & creatinine. Plasma protein abnormalities, multiple myeloma, proteinuria, haemoglobinopathies, PKU, AKU, homocystinuria, albinism & Bence Jones proteins. **13hrs**

UNIT - 2

Disorders of nucleic acid metabolism: Disorders of purine metabolism- Gout- causes & symptoms, xanthinuria, orotic acidic uria & L-N syndrome.

Disorders of mineral metabolism: Hypercalcemia, hypocalcemia, hypophosphatemia& hyperphosphatemia.

Disorders of vitamins & trace elements: Hypervitaminosm- causes & symptoms, trace elements deficiency disorders.

Evaluation of organ function test: Assessment and clinical manifestation of renal, pancreatic, gastric and intestinal functions.

Disorders of heme metabolism: Jaundice- types, causes & symptoms. Clinical importance of diagnostic enzymes- SGOT, SGPT, creatine kinase, aldolase, LDH, CPK, troponin 'C'

Renal and gastric functional test: Acute and chronic renal failure, urinary tract, observation and analysis of urinary calculi, LFT, pancreatic and gastric function test.

13hrs

Open Elective IIICombination-3

MS17BC431: PLANT BIOCHEMISTRY

52hrs

Unit-1

Structure and functions of plant cell (including cell wall, plasmodesmata, meristematic cells, vacuoles, secretary systems and root quiescent zone), Isolation of cell organelles, absorption, adsorption and transport of water and ions in plants. Evapotranspiration.

Biological nitrogen fixation and ammonia assimilation.Nitrate and sulphate reduction and their incorporation into amino acids.Translocation of inorganic and organic substances.Metabolism of sucrose and starch. Important routes (pathways) of biosynthesis- phenyl propanoid pathway; Mevalonate pathway; Acetate-mevalonate pathway

Photosynthesis – structure of organelles involved in photosynthesis in plants and bacteria. Proton gradients and electron transfer in chloroplasts of plants and in purple bacteria – differences from mitochondria. Light receptors – chlorophyll, light harvesting complexes, bacteriorhodopsin, rhodopsin as ion pump.
Photosystems I and II, their location, mechanism of quantum capture and energytransfer between photosystems – ferridoxin, plastocyanin, plastoquinone, carotenoids.The Hill reaction, photophosphorylation and reduction of CO_2.C_3, C_4 and CAMmetabolism, light and dark reaction. Light activation of enzymes, regulation ofphotosynthesis. Photorespiration.

13hrs

Unit-2

Special features of secondary plant metabolism, formation of phenolic acids, tannins, lignins, lignans, pigments, terpenes, terpenoids, plant phenolics, alkaloids and surface waxes – their biosynthesis and function, cell wall components.

Plant hormones – Growth regulating substances and their mode of action. Molecular effects of auxin in regulation of cell extension and of gibberllic, abscisic acids and cytokinins in the regulation of seed dormancy, germination, growth and development and embryogenesis. Biochemistry of seed development and fruit ripening. Defence system in plants. Tissue culture and transgenic plants.

Plant responses to biotic and abiotic stresses:Introduction; Plant pathogens and diseases; plantdefense systems-hypersensitive response; systemic acquired resistance; induced systemic resistance; Plant abiotic stress responses-Salt stress, drought and heavy metal stress responses; osmotic adjustment and significance of osmotic agents such as proline, sugar alcohols andquaternary ammonium compounds; An overview ofoxidative stress and oxidative damage. Antioxidant enzymes and stress tolerance. Plant biotic stress response – pathogen and insects.

13hrs

MS17BC431: INDUSTRIAL BIOCHEMISTRY

52hrs

Unit-1

Nanobiotechnology: Types of nanoparticles, DNA based nanostructures, nanosized carriers for drug delivery. Role of nanoparticles in drug delivery. Nanobiotechnology in gene therapy, tissue engineering andtransplantation.

Pharmaceutical biochemistry and vaccine development

Development of new drug/molecules and elucidation of their mechanisms of actions; formulations; pharmacokinetics and pharmacodynamics; factors affecting drug efficacy drug resistance; traditional medicines; biotransformation; large scale production of humanized monoclonal antibodies; vaccine development.

Food biochemistry

Introduction to different categories of food; constituents of food products and their functional properties; introduction to food processing;food spoilage; intrinsic and extrinsic factors affecting the quality and life of food material; food storage and preservation techniques; food poisoning; molasses and alcohol production.Industrial production of proteases; carbohydrases; lipases and their applications, vaccine production by rDNA technology; downstream processing.

13 hrs

Unit -2

Fermentation technology- surface, submerged and continuous culture techniques. Design and operation of fermentors, Agitation and Aeration, selection and growth of microorganisms in controlled environments, medium development. Strategies for improvement and maintenance of the industrial strains, Bioreactors.

Production of fermented milks, cheese, alcoholic beverages, breads by yeast. Fermentation production of Antibiotics- pencillin, streptomycin, Organic acid, citric acid, lactic acid, Enzymes –amylase, proteases, Amino acid-glutamic acid, lysine and Vitamins- B12 and vitamin C .

Microbial transformation

Types, techniques and commercial applications. Bioleaching and biosorption, Biodegradation and Bioremediation, Biomass and Bioenergy, Biopolymers and Biosurfactants. Enzyme electrodes and biosensors. Sewage water treatment – primary, secondary and tertiary treatments. Bio-control agents- Insecticidal toxins of Bacillus thuringenesis.

Bioethics and Biosafety, biosafety guideline and regulations, animals in research, Legal and socio-economic impacts of Biotechnology, Ethical, legal and social implications (ELSI) of HGP.Ethics in clinical trials. Intellectual property rights and protections for biological inventions. Patent and process involved in patenting.

13hrs

MS17BC402: Laboratory cum Training- VI(Genetic Engineering)

1. Digestion of endonucleases and separation of DNA restriction fragment on agarose gel electrophoresis.
2. Ligation of DNA
3. Blotting Techniques:Southern and Northern
4. DNA amplification by PCR.
5. Random Amplification of polymorphic DNA.
6. Plant tissue culture independent method of transformation.
7. Sequencing of DNA and RNA on polyacrylamide gels.

MS17BC403: Project work-dissertation (continued from III Semester)

SUGGESTED READINGS FOR M.Sc.BIOCHEMISTRY
I SEMESTER

MS17BC101: ORGANIC, BIOPHYSICAL CHEMISTRY, BIOCHEMICAL AND ENVIRONMENTAL TOXICOLOGY

1. Stereo chemistry of organic compounds (1994) by E L Eliel & SHW Awley. Inter Science Pub.30. Wiley and sons.Inc.
2. Organic Chemistry (6th ed. 2000) by R T Morrison & R N Boyd. Prentice Hall of India. New Delhi.
3. Organic Chemistry Vol.1 Fundamental Principles (6th Ed. 2003) by IL Finar, ELBS
4. Organic Chemistry, 11th edition 2014, by T W Graham Solomons, Craig B Fryhle and Scott A Synder.
5. Organic chemistry by Stanley H. Pine (4th Edition, 1987) Tata Mc-Graw hill.
6. Vol.2 Stereo Chemistry and the Chemistry of Natural Products. (5th ed. 1985) by I L Finar, ELBS.
7. Lehninger's Principles of Biochemistry (2nd Ed 2000) D L Nelson and M M Cox, Macmillan Worth pub. Inc NY.
8. Physical Biochemistry by Kansal Edward Van Holde (1971) Prentice Hall Inc. New Jersey.
9. Physical biochemistry 2nd nd (1982) by David Friedfelder, W H Freeman and Co. NY.

10. General and Applied Toxicology 1995 by Marrs and Turner. Macmillan Press Ltd.
11. Basic Envionmental Toxicology (1994) by Lorris G. Corkerhem and Barbara S S Shane CRP Press Inc.
12. Introduction to Food Technology by Talayurki Shibamato & Leonard F Bzeldanes.
13. Molecular Biotechnology 2nd ed 1994 by Barnard R Glick & J J Pasternak.

MS17BC102:GENERAL PHYSIOLOGY

1. Molecular Biology of the Cells (3rd edn 1994) by Alberts et al., Garland Publications inc NY and London.
2. Cell Biology (1993) by E S Sedava, Jones and Barlett Publishers Boston, London.
3. Cell and Molecular Biology (8th ed. 2001) by E D P de Robertis & E M F de Robertis (Jr) Lippincott Williams &Wilkins, Philadelphia.
4. Principles of Cell Biology (1988) by Klein Smith and M.Kish. Harper-Cellins Pub. Inc. New Delhi.
5. Text book of Medical Physiology (10th ed. 2001) by A C Guyton & **J** E Hall. Harcourt Asia.

MS17BC103: BIOENERGETICS AND INTERMEDIARY METABOLISM

1. Lehninger's principles of Biochemistry (2nd edn. 2000) by D L Nelson and M M Cox, Macmilian, Worth Pub Inc.
2. Biochemistry (4th edn. 1992) by Lubert Stryer WH Freeman & Co., NY.
3. Harper's Biochemistry (25th ed.) by R K Murray and others. Appleton and lange, Stanford.

MS17BC104: ANANLYTICAL TECHNIQUES

1. Instrumental methods of analysis H.H.Wilard,L.L.Merritt, J A Dean.
2. Instrumental Methods of Chemical analysis.
3. Analytical Chemistry G.D. Chritiain. Wiley
4. Introduction of instrumental analysis. R.P.Braun
5. Biophysical chemistry by Upadhyay and Upadhyay .
6. Principles and Techniques of Practical Biochemistry byKeith Wilson, John Walker, 5th Edition, 2000. Cambridge Univ.Press
7. Organic Spectroscopy by Willium Kemp,3rd edition 2008.
8. Essentials of Nuclear Chemistry- H.J.Arnikar
9. A text book of quantitative Inorganic analysis A I Vogel.
10. Pharmacopoeia of India , British Pharmacopoeia
11. Standard methods of Chemical analysis A Series of Volumes Edited F.J.Welcher R.G. Krieger publ-Company.
12. Principles of Instrumental Analysis Fifth edition Skoog, Holler, Niemay

13.Principles and techniques of practical Biochemistry. K.Wilson and J. Walker. 4thEdn. Cambridge University press (2012).

II SEMESTER

MS17BC201:ENZYMOLOGY

1. The chemical kinetics of enzyme action by K J Laidler and P S Bunting, Oxford University Press. London.
2. Enzymes by M Dixon, E C Webb, CJR Thorne and K F Tipton, Longmans, London.
3. Enzyme structure and mechanism (1977) by Alan Fersht, Reading, USA.
4. Enzymatic reaction mechanism (1979) by Cheristopher Walsh, freeman Pub., San Francisco.
5. Immobilized enzymes (1978) by Ichiro Chibata, Haisted Press Book.
6. Enzyme structure and function by S Blackburn (1976) marcel Dekker, Inc., NY.

MS17BC202: BIOTECHNOLOGY

1. Biochemistry (2nd ed 1995) by Donald Voet and Judith Voet.
2.Molecular Biology of the gene (IV ed 1987) J Watson NH Hopkin JW Roberts J P Stertz A M Weiner, FreemanPub., San Francisco.
3.Genes VII Benjamin Lewin (2000) Oxford Univ Press. London.

MS17BC203:TECHNICAL WRITING, COMPUTERS AND BIOINFORMATICS

1. Discovering Genomics, Proteomics and Bioinformatics, Campbell A M & Heyer L J, 2nd Edn. Benjamin Cummings, (2007).
2. Protein Bioinformatics; M. Michael Gromiha, Academic Press (1983).
3. Principle and Practice of Bioanalysis; Richard F. Venn (Ed.) Taylor and Francis (2000).
4. Attwood, T. and P.S. David. 2006. Introduction to Bioinformatics. Pearson Education Ltd.,New York.
5. Baxevanis, A.D., and Ouellette, B.F.F. (eds) 2006. Bioinformatics A Practical Guide to Analysis of Genes and Proteins. 3rd Edition, John Wiley and Sons, New York.
6. Attwood T.K. and Higgs, P.G. 2005. Bioinformatics and molecular evolution. Blackwell Publishers, London.
7. Lesk, A.M. 2002. Introduction to Bioinformatics. Oxford University Press

MS17BC204:IMMUNOLOGY

1. Immunology (4th edn. 1998) by Ivan Roitt, J Brostoff and David Mole (4th edn) Mosby Times Mirror Int. Pub.Ltd.
2. Essential Immunlogy (9th ed. 1997) by Ivan Roitt Blackwell Science Ltd.
3. Immunology (1992) by Janis Kuby W H Freeman and Co. Ltd. USA.

4. Immunology (2nd edn. 991) by Edwards S Golub, Sinauer Associate, Sunderland.

MS17BC225:FOOD TECHNOLOGY

5. Swaminathan M. Advanced Text Book on Food and Nutrition , volume I and II Printing and Publishing CO., Ltd., Bangalore. 1993.
6. Swaminathan M. Text Book on Food chemistry, Printing and Publishing CO., Ltd., Bangalore. 1993.
7. Norman N. Potter , Food science, CBS publishers and distributors, New Delhi. 1994.
8. Lillian Hoagoland Meyer, Food Chemistry, CBS publishers and distributors, New Delhi. 1994.
9. Owen R Fennema, Food Chemistry, Marcel Decker Inc., New York. 1996.
10. Srilakshmi B., Food Science, New age International Pvt. Ltd. Publishers, III ed. 2003.
11. Siva Sankar B., Food Processing and Preservation. Prentice – Hall of India Pvt. Ltd., New Delhi. 2002.
12. Ramakrishnan S., Prasannam K.G and Rajan R –Principles. Text book of medical biochemistry. Orient Longman Ltd. III ed. 2001.
13. Shakuntala Manay N. and ShadaksharaswamyM. FOODS: Facts and Principles. New age International Pvt. Ltd. Publishers

III SEMESTER

MS17BC301: MOLECULAR BIOLOGY

1. Molecular cloninig:a laboratory manual (Vol.1,2&3) 1989) by T.Maniatis, E.F.Fritsch, J. Sambrook. Cold SpringHarbor Laboratory Publications.
2. RNA Isolation and Analysis by P.Jones, J.Qiu, D.Rickwood (1st ed.1994) Bios Scientific Publishers.
3. Gene and Probes: A practical Approach Series (1995) by B D Hames and S J Higgins. Oxford universityPress.
4. Gel Electrophoresis of nuclei Acids: A practical Approach (1990) by D.Rickwood and B.D.Hames. OxfordUniversity Press.

MS17BC302:NUTRITION BIOCHEMISTRY

1. Nutrition: An integrated approach (3rd edn. 1984) R L Pike and M L Brown, Wiley & Sons Inc., NY.
2. Text Book of Biochemistry and Human Biology G P Talwar, Prentice Hall.
3. Mechanism and Theory is food chemistry (1996) DWS Wong, CBS, New Delhi.
4. Text Book of Human Nutrition (1996) M S Bamji N Pralhad Rao and V Reddy, Oxford & IBH Publishers.
5. Nutritional Biochemistry and Metabolism Linten.
6. Principles of Food Science-l (Food chemistry) Fennemona D R.
7. Human Nutrition and Dietetics (8th Ed. 1982) by Davidson and Passmore ELBS.

8. Modern Nutrition in Health and Diseases (7th ed. 1988) by Maurice E Skills and V R Young K M VargheseCo. Bombay.

MS17BC303:RESEARCH METHODOLOGY AND BIOSTATISTICS

1. Biostatistics : A foundation for analysis in the health. (7th ed. 1999) by W W Daniel John Wiley and Sons Inc.,New York.
2. Choosing and Using Statistics; A Biologist Guide, Clavin Dythan, Blackwell Scientific(1999).

IV SEMESTER

MS17BC411:PHARMACOVIGILANCE AND SAS TECHNIQUE

1. Basic and Clinical Pharmacology, Prentice hall, International, Katzung, B.G.
2. Clinical Pharmacology, Scientific book agency, Laurence, DR and Bennet PN.
3. Clinical pharmacokinetics, Pub. Springer Verlab, Dr. D.R Krishna, V. Klotz
4. Remington Pharmaceutical Sciences, Lippincott, Williams and Wilkins
5. Drug interaction, Kven Stockley. Hamsten
6. Drug interaction, Basic Bussiness Publ, Bombay, J.K. Mehra
7. Clinical pharmacology and drug therapy Grahame smith and Aronson,
8. Text Book of Therapeutics Drug and Disease Management Hardbound. Richard A Helms,
9. Clinical Pharmacy and therapeutics Herfindal E T and Hirschman JL, Williams and Wilkins

MS17BC421:CLINICAL DIAGNOSTICS & CLINICAL BIOCHEMISTRY

1. R. D. Lele, "Computer in Medicine", Tata McGraw-Hill, New Delhi, 1997.
2. Tay Vaughan, "Multimedia making it work', Tata McGraw-Hill, New Delhi, 1997.
3. Davis Chapman, "Teach Yourself Visual Basic 6 in 21 days", New Delhi, 1997.
4. Harold Sackman, "Biomedical Information Technology', Academic Press, New York, 1997.
5. Tietz Fundamentals of Clinical Chemistry – (5th edn.) C A Burtis, E R Ashwood (eds.) Saunders WB Co.
6. Notes on Clinical Chemistry – Whitby L G, A F Smith, G J Beckett, S M Walker, Blackewll science Inc.
7. Practical Clinical Biochemistry methods and later ,3rd edition,2003,2006 by Ranjna Chawla.

8. Practical Clinical Biochemistry,4th edition,2005,by Harold Valley.
9. Practical Biochemistry-Principles and Techniques,5th edition by Keith Wilson and John Walker(2000).
10. Introductiory Practical Biochemistry-3rd edition,2005 by S.K.Sawtrey,Randhir Singh.
11. Biochemical Methods- 3rd edition,2008,by S.Sadasivan and A.Manickam.
12. Experimental Biochemistry,3rd edition,2003, by Robert Switzer and Liam Garrity.
13. Text Book of Biochemistry and Human Biology,3rd edition,2006 by G.P.Talwar and L.M.Srinivastava.

MS17BC431: PLANT BIOCHEMISTRY& INDUSTRIAL BIOCHEMISTRY

1. Handbook of photosynthesis (ed) mohammad pe sarakle, marcel Dekkar, Inc.NY. Basel. Hong Kong 1997.
2. Introduction to plant biochemistry (1983) T W Goodwin and E I mercer.Pergaman press, Oxford, NY< Toronto,Sydney, Paris, Frankfurt.
3. Seed: physiology of development and germination (2nd ed. 1994) **J** D Bewleyand M Black Plenum Press.
4. Biochemistry of energy utilization in plants D T Dennis Blackie, Glasgow andLondon 1987.
5. Industrial Microbiology by Prescott, 4th ed. CBS Publishers.
6. Biotechnology by Crueger, PANI Publishers.
7. Principles of Fermentation Technology by Stanbury .
8. Industrial Microbiology by A.H.Pate
9. Plant Biochemistry by P M Dey and **J** B Harborne. Harcourt Asia PTE Ltd.,Singapore.

Career Development and Placement

Having a degree will open doors to the world of opportunities for you. But Employers arelooking for much more than just a degree. They want graduates who stand out from the crowd and exhibit real life skills that can be applied to their organizations. Examples of such popular skills employers look for include:

1. Willingness to learn
2. Self motivation
3. Team work
4. Communication skills and application of these skills to real scenarios
5. Requirement of gathering, design and analysis, development and testing s kills
6. Analytical and Technical skills
7. Computer skills
8. Internet searching skills
9. Information consolidation and presentation skills
10. Role play
11. Group discussion, and so on

REVA University therefore, has given utmost importance to develop these skills throughvariety of training programs and such other activities that induce the said skills among all students.

A full-fledged Career Counselling and Placement division, namely Career Development Centre (CDC) headed by well experienced senior Professor and Dean and supported by dynamic trainers, counsellors and placement officers and other efficient supportive teamdoes handle all aspects of Internships and placements for the students of REVA University. The prime objective of the CDC is to liaison between REVA graduating students and industries by providing a common platform where the prospective employer companies can identify suitable candidates for placement in their respective organization. The CDC organizes pre-placement training by professionals and also arranges expert talks to our students. It facilitates students to career guidance and improve their employability. In addition, CDC forms teams to perform mock interviews. It makes you to enjoy working with such teams and learn many things apart from working together ina team. It also makes you to participate in various student clubs which helps in developing team culture, variety of job skills and overall personality.

The need of the hour in the field of Commerce is efficient leaders of repute, who can dealthe real time problems with a flavour of innovation. This kept in focus, the CDC has designed the training process, which will commence from second semester along with thecurriculum. Special coaching in personality development, career building, English proficiency, reasoning, puzzles, leadership, and strategic management and communication skills to every student of REVA University is given with utmost care. Theprocess involves continuous training and monitoring the students to develop their soft skills including interpersonal skills that will fetch them a job of repute in the area of his / her interest and March forward to make better career. The University has recognized skill development and industry relationship as its very important activities. Therefore, the University-Industry Interaction and Skill Development Centre headed by a Senior Professor & Director has been established to facilitate skill related training to REVA students and other unemployed students around REVA campus. The centre conducts variety of skill development programs to students to suite to their career opportunities.

Through this skill development centre the students shall compulsorily complete at leasttwo skill / certification based programs before the completion of their degree. The University has collaborations with Industries, Corporate training organizations, research institutions and Government agencies like NSDC (National Skill Development Corporation) to conduct certification programs. REVA University has been recognised as a Centre of Skill Development and Training by NSDC (National Skill Development Corporation) under Pradhan Mantri Kaushal Vikas Yojana.

The University has signed MOU's with research organizations and universities abroad to facilitate greater opportunities of employability for conducting certification programs.