SHRI
DHARMASTHALA
MANJUNATHESHWARA
UNIVERSITY

# Ordinance Governing
# M.Sc. (BIOMEDICAL SCIENCE)
# (CHOICE BASED CREDIT SYSTEM)
# Curriculum 2020-21

**Amended up to December, 2021**


SHRI DHARMASTHALA MANJUNATHESHWARA UNIVERSITY
(A State Private University established under the Shri Dharmasthala Manjunatheshwara University
Act No 19 of 2018 of Government of Karnataka and Notification No. ED 261 URC 2018 dated 19th December 2018)

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|| Om Shri Manjunathaya Namaha ||

# Shree Kshethra Dharmasthala

**Edition Year : 2020-21**

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# THE LOGO

Poojya Dr D. Veerendra Heggade, Hon'ble Chancellor of the University, while searching for an appropriate Logo for the University, saw a photograph picked from Temple Architecture showing Wings of a Bird, sculpted in Indian style and wanted it to be incorporated in the logo for the University, as the Wings symbolize 'Spreading of Knowledge beyond Boundaries'. Further it was felt that the Central theme of the logo should be 'Rudra' (The Linga) with three wings on each side. In this way, the logo of the University was conceptualized.

Hence:

1. The central part represents **Rudra** who Demolishes Darkness.
2. The Three **horizontal lines on The Linga** stand for Samyak Darshan (Right Belief), Samyak Gyan (Right Knowledge) and Samyak Charitra (Right Conduct).
3. The **Wings** symbolize spreading of Knowledge across the boundaries.
4. Base line **"Truth Liberates"** highlights the Purpose of Education: to liberate oneself unconditionally. It shows that it is not discipline, nor knowledge nor the efforts to freedom that liberate but Truth is what liberates you from all your conditioning and ignorance.

The overall significance of Shri Dharmasthala Manjunatheshwara University's Logo is:

**Darkness of ignorance is destroyed by the flow of knowledge to bring Liberty to everyone, by realizing the truth. And, it should spread globally without the boundaries as hindrance**.

SHRI
DHARMASTHALA
MANJUNATHESHWARA
UNIVERSITY

TRUTH LIBERATES

## VISION

Shri Dharmasthala Manjunatheshwara University will set the highest standards of teaching and learning by awakening the intelligence of the students and nurturing the creativity hidden in them by creating an environment where the ancient wisdom blends with modern science, to transform them into whole human beings to face the challenges.

## MISSION

- To ensure that the journey of education is inspiring, pleasant and enjoyable.
- Attract the best of teachers and students.
- Achieve high principles of trust, love and spirituality in the students.
- Create a collaborative, diverse and exclusive community.
- Transform the student of today to be a leader of tomorrow and a better human being.
- Produce passionate teachers.
- Evolve innovative teaching techniques.
- Create a peaceful environment.
- Prepare the student to face the social challenges.
- Create a University of which the Nation is proud of.
- Be an effective partner in Nation Building.
- Create an Eco-friendly University.
- Create a University based on the principles of beauty, love and justice.

||Om Shanti! Om Shanti! Om Shanti||

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SDMU/F-4/Notif-124(A1)/690/2021

Date: 31.12.2021

# NOTIFICATION

## Amendment in the Ordinance Governing the Curricula of M.Sc. Biomedical Science - 2020

**Ref:**

1. Notification on Ordinance Governing the Curricula of M.Sc. Biomedical Science – 2020 (Ref. No. SDMU/Notif-124/182/2020 Dated: 19-09-2020)
2. Minutes of the 5th Meeting of Academic Council (Ref. No. SDMU/AC/M5/F-28/626/2021 Dated: 10-12-2021)
3. Minutes of the 5th Meeting of the Board of Studies - SDM Research Institute for Biomedical Science (Ref. No. SDMRIBS/BOS/2021-22/004 Dated: 06-12-2021)

In exercise of the powers conferred under Statutes 1.4 (Powers and functions - Para ix & x) & 1.8 (Powers and functions - Para i) of Shri Dharmasthala Manjunatheshwara University, Approval of the Academic Council of Shri Dharmasthala Manjunatheshwara University is hereby accorded for the Amendment of the Ordinance Governing Revised Curricula of **M.Sc. Biomedical Science – 2020** as below, with effect from the date of notification.

| | |
|---|---|
| 1. | ~~**Page No.6, Part-A:**~~<br><br>~~Part A will have 30 compulsory multiple-choice questions (MCQ) of general aptitude. Each correct answer will have a weightage of 1 mark and 0.25 negative marks for each wrong answer.~~<br><br>**Amended as below**<br><br>**Page No.6, Part-A:**<br><br>Part A will have 30 compulsory multiple-choice questions (MCQ) of general aptitude. Each correct answer will have a weightage of 1 mark. |
| 2. | ~~**Page No.6, Part-B:**~~<br><br>~~Part B will have multiple choice questions (MCQ) of bachelor degree level requiring, thinking and analysis. The questions from all branches of basic and applied life sciences as per syllabus attached. Out of 100 questions, candidates must attempt 70 questions. Each correct answer will have a weightage of 1 mark and 0.25 negative marks for each wrong answer. Sample question papers are available on SDMRIBS website.~~<br><br>**Amended as below** |

| | |
|---|---|
| | **Page No.6, Part-B:**<br><br>Part B will have 70 multiple choice questions (MCQ) of bachelor degree level requiring, thinking and analysis. The questions from all branches of basic and applied life sciences as per syllabus attached/provided. Each correct answer will have a weightage of 1 mark. Sample question papers are available on SDMRIBS website. |

Lt. Col. U. S. Dinesh (Retd.)
REGISTRAR
REGISTRAR,
Shri Dharmasthala Manjunatheshwara
University, Dharwad

Shri Dharmasthala Manjunatheshwara University ★ Dharwad ★

**To:** The Principal, SDM Research Institute for Biomedical Sciences

**Copy for kind information to:**

1. Hon'ble Chancellor, Shri Dharmasthala Manjunatheshwara University, Dharwad
2. Vice-Chancellor, Shri Dharmasthala Manjunatheshwara University, Dharwad
3. Pro Vice Chancellor (Academics), Shri Dharmasthala Manjunatheshwara University, Dharwad
4. Controller of Examination, Shri Dharmasthala Manjunatheshwara University, Dharwad
5. Chairperson, Board of Studies - SDMRIBS
6. University Office for Records File
7. Office of the Registrar

## CONTENT

**SDM RESEARCH INSTITUTE FOR BIOMEDICAL SCIENCES (SDMRIBS), DHARWAD**

# M.Sc. (BIOMEDICAL SCIENCE)
# (CHOICE BASED CREDIT SYSTEM)

## REGULATIONS AND SYLLABUS (Theory & Practicals)

**2020-21**

**SHRI DHARMASTHALA MANJUNATHESHWARA UNIVERSITY, DHARWAD**
**Syllabus: Choice Based Credit System Pattern - (CBCS)**
**M.Sc. (Biomedical Science) (Semester I- IV)**
**(w. e. f. 2020)**

## Preamble

SDM Research Institute for Biomedical Sciences (SDMRIBS) is an independent teaching and research institute started from the year 2019 under the Shri Dharmasthala Manjunatheshwara University, Dharwad. The purpose of starting a Master of Science degree program in Biomedical Science at SDMRIBS is to inculcate the culture of passion and commitments among students/staff/researchers' by igniting their minds for innovation through quality concepts, skill development and intellectual property development. The institute is aiming to offer academic programs and conduct research in the advanced and/or emerging areas of modern science with innovation and initiative for indigenous technology & product development for the betterment of humankind. Master of Science in Biomedical Science program is instituted in SDMRIBS, a constituent unit of Shri Dharmasthala Manjunatheshwara University from the academic year 2020-21. The regulation for M.Sc. (Biomedical Science) program is formulated as follows:

## 1. Introduction

This regulation shall be called Shri Dharmasthala Manjunatheshwara University regulations for M.Sc. (Biomedical Science) program and govern the policies and procedures including selection, admission, imparting of instructions, conduct of examinations, evaluations and certification of candidate's performance and all amendment thereto, leading to the award of M.Sc. (Biomedical Science) degree. The regulations shall come into effect from the academic year 2020-21 and is applicable to the batch admitted from the year 2020-21 and onwards, with modifications by the university authorities as and when required. This set of regulations shall be binding on all the candidates undergoing the said degree program. These regulations may be modified from time to time as mandated by the statutes of the university. These set of regulations may evolve and get refined or updated or amended or modified or changed through appropriate approval from the academic council or the board of management from time to time and shall be binding on all parties concerned including the candidates, faculty, staff, departments and institute authorities. All disputes arising from this set of regulations shall be addressed to the board of management. The decision of the board of management is final and binding on all parties concerned. Further, any legal disputes arising out of this set of regulations shall be limited to jurisdiction of courts of Hubli-Dharwad city only.

## 2. Definitions

Unless the context otherwise requires:

2.1 BoM means Board of Management of Shri Dharmasthala Manjunatheshwara University

2.2 BoS means Board of Studies in Biomedical Sciences.

2.3 Program Coordinator/Head of the Department/Head of the Institution/Director means a full-time faculty appointed/nominated by the University for managing the Department/Institute and authorized to and responsible for the implementation of the rules and procedures pertaining to the department/ Institute.

2.4 Department/Institute means an academic and administrative unit under the ambit of the University.

2.5 Regulations mean the set of academic regulations.

2.6 Teaching hospital means SDM College of Medical Sciences & Hospital, SDM College of Dental Sciences & Hospital and any other hospital under the management of the University.

2.7 University means Shri Dharmasthala Manjunatheshwara University.

2.8 HoI means Head of the Institution.

2.9 HoD means Head of the Department.

## 3. Introduction to Program

Biomedical Science is in an amalgamation of biological sciences and medical sciences. The focus of this program is to gain advanced knowledge and skills in the field of Biomedical Sciences, which would create a strong base for research & development for innovative ideas & translation of inventions to clinical medicine for the betterment of human health. Advanced biomedical research is a rapidly-changing, dynamic and complex science that continuously demands accuracy, efficiency and attention to minute details.

**3.1 Objectives of the Program:** The two years Master of Science in Biomedical Science program provide students with an intellectually motivating education to acquire systematic understanding of integrated specialties of biological and medical sciences. Our M.Sc. in Biomedical Science program will give students a strong foundation in a range of medically related subjects, including human anatomy, physiology, pharmacology, cell and molecular biology, microbiology, biochemistry immunology, nutritional immunology, nanotechnology, cell technologies and OMICS technologies as well as other specialized subjects like statistics, bioethics, IPR, regulations.

**3.2 Scope of the Program**

It always gives the personal satisfaction of using our scientific and detective skills to investigate disease to help scientists, physicians, and clinicians to alleviate the sufferings and/or save the life of patients. This program helps in diversifying an interesting and rewarding career with a range of opportunities for personal and career development.

3.2.1 The students will acquire hands-on experience in laboratory techniques—Skill development.

3.2.2 Develop communication skills through group discussions, journal club, and seminar presentations.

2.2.3 Education in preparation of audio-visual aids for teaching, posters/manuscripts preparation and presentation in conferences/workshops, as well as journals publications.

3.2.4 Allow them to shape their subsequent advanced studies, Ph.D. and Post-doctoral research towards the topics that interest them the most in the areas of Biological and Medical Sciences.

3.2.5 Seeking jobs in Biotechnology & Pharmaceutical Industries, Healthcare industry and Research Centers/Institutes/University.

**3.3 Structure of the Program**

3.3.1 **Duration of the program:** The duration of M.Sc. (Biomedical Science) program shall be 2 academic years with semester pattern having a total of 4 semesters.

3.3.2 **Program Syllabus:** The syllabus of M.Sc. in Biomedical Science program has been prepared as per the ***Choice Based Credit System (CBCS) pattern***. The syllabus has been prepared taking into consideration the UGC guidelines, SET, NET examination syllabus, the syllabus of other universities and the specific inputs of the Expert Committee Members.

3.3.3 **Examination Pattern:** Each semester will have theory papers of 70 marks each for University Examination and 30 marks each for internal examination and two practical courses of 70 marks each for University Examination and 30 marks each for internal practical examination.

**3.4. Medium of Instruction and Examination:** Medium of Instruction and Examination shall be in English.

**3.5. Maximum Period for Completion of Program:** The maximum duration for completion of M.Sc. (Biomedical Science) program shall not exceed 4 years (8 semesters).

**4. Eligibility for Admission:** A candidate seeking for admission to M.Sc. (Biomedical Science) program must have passed a bachelor's degree of minimum 3 years duration in biological sciences (Biomedical Science/Biotechnology/Molecular Biology/Biochemistry/Microbiology/Botany/Zoology/Genetics/Home Science/ Chemistry with Biological subjects) or passed bachelor degree in BE/B-Tech majoring in biotechnology/Medical/Dental/B. Pharm/B.Sc., Nursing (3 or 4 years) /Pharmacology/Animal Sciences and any other bachelor degree in Life Science from reputed and recognized University/Board recognized as equivalent by Shri Dharmasthala Manjunatheshwara University, with not less than 50% marks in aggregate. Candidates who are currently appearing for the qualifying exam are also eligible to apply for M.Sc. (Biomedical Science). In such a case, they have to clear it before the finalization of the admission process.

**4.1 Maximum Intake Capacity:** 20 students

**4.2 Mode of Selection of Eligible Candidates:** Selection to the M.Sc. (Biomedical Science) program shall be based on marks secured in the qualifying entrance examination and the qualifying degree, and personal interview.

4.2.2 The candidates shall be admitted to M.Sc. program on the basis of eligibility and Entrance test to be conducted by the Shri Dharmasthala Manjunatheshwara University for the same.

4.2.2 The entrance test shall be conducted by the Shri Dharmasthala Manjunatheshwara University in all cases, provided the number of eligible applicants is less than or equal to the number of seats available in the subject, the requirement of the test/personal interview may be waived by the admission committee on the recommendation of HoD/HoI/Program Coordinator and Dean Faculty.

4.2.3 A relaxation of grade will be allowed for those belonging to SC/ST/OBC (non-creamy layer)/differently abled and other categories of candidates as per the guidelines of Govt. of India from time to time.

4.2.4 The entrance examination will be conducted in a single shift for a duration of 120 minutes.

**The question paper will have two parts:**

**Part A** will have 30 compulsory multiple-choice questions (MCQ) of general aptitude. Each correct answer will have a weightage of 1 mark.

**Part B** will have 70 multiple choice questions (MCQ) of bachelor degree level requiring, thinking and analysis. The questions from all branches of basic and applied life sciences as per syllabus attached/provided. Each correct answer will have a weightage of 1 mark. Sample question papers are available on SDMRIBS website.

- There will be 100 questions in the Test Booklet with *FOUR* responses as (a), (b), (c) and (d), of them only *ONE* is correct as the most appropriate answer to the question concerned.
- Multiple answering of a question is not allowed, it will cause the answer to be rejected.
- Mobile phones or any electronic devices are not allowed in the examination hall. Only programmable calculators are allowed.
- All other conditions will be as per the Shri Dharmasthala Manjunatheshwara University Examination guidelines.

### 4.3 Exemption from Entrance Examination

The students who have qualified TIFR, JNU, CEEB, IIT, JAM, AIIMS, ICAR, AIEEA or equivalent national level examination in the relevant area are exempted from the qualifying entrance examination of Shri Dharmasthala Manjunatheshwara University and they will be directly called for personal interview. 10% of total seats are reserved for such students and are offered on merit cum means.

**4.4 Admission Procedure:** Students seeking admission must submit the application in the prescribed form, available at university website along with the application fees and required documents, as mentioned in the application form.

**4.5 Start of the Program:** The program commences on the date prescribed by Shri Dharmasthala Manjunatheshwara University.

## 5. Withdrawal-Temporary and Permanent

### 5.1 Temporary Withdrawal

5.1.1 A candidate who has been admitted to the program may be permitted to withdraw temporarily for a period of six months or more up to one year on the grounds of prolonged illness, grave calamity in the family, significant impact of natural calamity/disaster on family and society, or serving the Indian Armed Forces, etc. provided:

a. the candidate applies stating the reason of withdrawal with supporting documents and endorsement by parent/guardian.
b. the university is satisfied that without counting the period of withdrawal candidate is likely to complete his requirement of the degree within maximum time specified.
c. there are no outstanding dues or demands with the department, library, Institute or University etc.

5.1.2 The tuition fee for the subsequent year may be collected in advance based on the nature of the reason and severity of the condition/situation before giving approval for any such temporary withdrawal.

5.1.3 Scholarship holders are bound by the appropriate rules applicable, university or any other sponsoring agency.

5.1.4 The decision of the Institute/University regarding withdrawal of a candidate is final and binding.

### 5.2 Permanent Withdrawal

5.2.1 A candidate who withdraws admission before the closing date of admission/starting date of the program for the academic session is eligible for the refund of the deposit paid. The fees once paid will not be refunded on any account.

5.2.2 Once the admission for the year is closed and if a candidate wants to leave the institute, he will be permitted to do so and take the Transfer Certificate from the institute/university, if required only after remitting all the tuition fees for remaining years.

5.2.3 Those candidates who have received any scholarship/stipend/other forms of assistance from the department/institute/university shall repay all such amounts in addition to those mentioned in the clause above.

5.2.4 The decision of the institute/university regarding withdrawal of a student is final and binding.

**5.3 Migration/Transfer of Candidates**

Migration/Transfer of candidates from one recognized college to another recognized college of this University or from another University shall not be granted.

## 6. Conduct and Discipline

As per the policy of Shri Dharmasthala Manjunatheshwara University, Dharwad.

## 7. Graduation Requirements

Candidate shall be declared eligible for the award of the degree if he has:
Fulfilled degree requirements.

- No dues to the department, Institute, Library, Hostels, University etc.
- No disciplinary action pending against him.

The award of the degree must be recommended by the Board of Management.

## 8. Convocation

Degrees will be awarded in person to all the eligible students who have graduated during the preceding academic year at the annual convocation. For eligible students who are unable to attend the convocation, a degree will be sent by post. Students are required to apply for the convocation along with prescribed fee within the specified date, after having satisfactorily completed all degree requirements.

## 9. Subjects of Study and Training: Please see Annexures I to III

## 10. Teaching and Learning processes

10.1 Three components of teaching and learning process of a course

10.1.1 **Lecture (L):** lecture session

10.1.2 **Tutorial (T):** 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.

10.1.3 **Practical (P):** hands on experience/laboratory experiments/field studies/case studies that equip students to acquire the much-required skill component.

10.2 In terms of credits, every one-hour L accounts for one credit and a minimum of two-hour T or P accounts for one credit, over a period of one semester. The duration of the semester is a minimum of 90 working days/16 weeks. The total duration of a semester is about 20-22 weeks, including university examination.

10.3 Course shall have either or all the three components. That means a course may have only a lecture component, or only a practical component or combination of any two or all the three components.

10.4 The total credits earned by a student at the end of the semester by successfully completing a course are sum of L, T & P (L+T+P). The credit pattern of the course is indicated as L:T:P.

10.5 The concerned BoS will choose the appropriate credit pattern for every course based on the requirement. However, generally, a course shall be of 3 or 4 credits.

## 11. Different courses of study are labeled and defined as follows

### 11.1 Core Course

A course which should compulsorily be studied by a candidate as a core requirement is termed as a Core course.

11.1.1 Hard Core

A compulsory core course is called a Hard Core Course.

11.1.2 Soft Core

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 discipline or from a sister/related discipline/subject which supports the main discipline/subject.

### 11.2 Elective Course

Generally, a course which can be chosen from a pool of courses and which may be very specific or specialized or advanced or supportive to the discipline/subject of study or which provides an extended scope or which enables an exposure to some other discipline/subject/domain or nurtures the candidate's proficiency/skill is called an Elective Course. Elective courses may be offered by the main discipline/subject of study or by sister/related discipline/subject of study. A Soft-Core course may also be considered as an elective.

11.2.1 Open Elective

An elective course chosen generally from an unrelated discipline/subject, with an intention to seek exposure is called an **Open Elective**.

11.2.1 Self Study

An elective course designed to acquire a special/advanced knowledge, such as supplement study/support study to a project work, and a candidate studies such a course on his own with an advisory support by a teacher is called a **Self Study.**

11.2.3 Elective

A core course offered in a discipline/subject may be treated as an elective by another discipline/subject and vice versa. Project work/Dissertation work is a special course involving application of knowledge in solving/analyzing/exploring a real-life situation/ difficult problem. A project work up to 4 credits is called Minor Project work. A project work of 6 to 8 credits is called Major Project Work. Dissertation work can be a minimum of 12-20 credits. A Project/Dissertation work may be a hard core or a soft core as decided by the BoS concerned.

## 12. Scheme of Instructions

A Master's Degree program is of 4 semesters/two year's duration. A candidate can avail a maximum of 8 semesters/4 years (in one stretch) to complete Master's Degree (including blank semesters, if any). Whenever a candidate opts for blank semester(s)/DROP in a course/s or is compelled to DROP a course/s as per the provision of the regulation, he/she has to study the prevailing course/s offered by the department as per the prevailing scheme, when he/she continues his/her study.

A candidate has to earn a minimum of 76 credits, for successful completion of a Master's degree with a distribution of credits for different courses as given in the following table.

| **Course Type** | **Credits** |
|---|---|
| Hard Core | A minimum of 42, but not exceeding 52 |
| Soft Core | A minimum of 16 |
| Open Elective | A minimum of 04 |

- Every course including project work, practical work, field work, seminar, self-study should be entitled as hard core or soft core or open elective by the BoS.
- A candidate can enroll for a minimum of 24 credits per semester.
- Only such candidates who register for a minimum of 18 credits per semester in the first two semesters and complete successfully minimum 76 credits in 4 successive semesters shall be considered for declaration of ranks, medals and are eligible to apply for student fellowship, scholarship, free ships and hostel facilities.

## 13. Continuous Assessment, Earning of Credits and Award of Grades

The evaluation of the candidate shall be based on continuous assessment. The structure for evaluation is as follows:

13.1 Assessment and evaluation processes happen in a continuous mode. However, for reporting purposes, a semester is divided into 3 discrete components identified as C1, C2, and C3.

13.2 The performance of a candidate in a course will be assessed for a maximum of 100 marks as explained below.

13.3 The first component (C1), of assessment is for 15 marks. This will be based on practical exams, assignments and seminars. During the first half of the semester, the first 50% of the syllabus will be completed. This shall be consolidated during the $8^{th}$ week of the semester. Beyond $8^{th}$ week, making changes in C1 is not permitted.

13.4 The second component (C2), of assessment is for 15 marks. This will be based on practical exams, assignments and seminars. The continuous assessment and scores of the second half of the semester will be consolidated during the $16^{th}$ week of the semester. During the second half of the semester the remaining units in the course will be completed.

13.5 The outline for continuous assessment activities for Component-I (C1) and Component-II (C2) will be proposed by the teacher(s) concerned before the commencement of the semester and will be discussed and decided in the respective Departmental Council. The students should be informed about the modalities well in advance. The evaluated courses/assignments during component-I (C1) and component-II (C2) of assessment are immediately returned to the candidates after obtaining acknowledgement in the register maintained by the concerned teacher for this purpose.

13.6 During the $18^{th}$-$22^{nd}$ week of the semester, a semester-end examination of 3 hours (theory) and 4 hours (practical) duration shall be conducted for each course. This forms the third/final component of assessment (C3) and the maximum marks for the final component will be 70 each for theory and practical.

## 14. Pattern of Question Paper

a) University theory question paper of each course shall be of 70 Marks
b) The duration of University theory examination shall be of three hours.
c) The question paper shall consist of defining, short answer type and long answer type questions.
d) There shall be total three sections i.e. A, B & C, questions of equal marks out of which Section A is compulsory
e) From Section B candidate has to attempt any four questions.
f) From Section C candidate has to attempt any four questions

## 15. Instructions to the Paper Setters / Examiners

a) The question paper shall be set so as to cover the entire syllabus of the respective course (paper).
b) Scheme of marking for all questions shall be submitted along with the question paper in a separate envelope.
c) The chairperson of the respective examination shall be responsible to complete the paper setting work as per University rules/Manual of Examination.

## 16. Mode of Examination

As per the examination manual of Shri Dharmasthala Manjunatheshwara University. Preferably, the examinations are conducted using an electronic pad (E-pad) and a stylus that allows students to write exams digitally instead of using paper.

## 17. Attendance and Monitoring Progress of Students

17.1 A candidate shall study in the concerned department of the institute for the entire duration as a full-time student. No candidate is permitted to work in any laboratory/college/hospital/pharmacy etc., while studying. No candidate should join any other program of study or appear for any other degree examination conducted by this university or any other university in India or abroad during the duration of the course/period of registration.

17.2 Each semester shall be taken as a unit for the purpose of calculating attendance.

17.3 A candidate who has put in a minimum 75% of attendance in the theory and practical separately and who has fulfilled other requirements of the program shall be permitted to appear for university examination.

17.4 A candidate having shortage of attendance shall repeat the semester when it is offered next semester or academic year.

## 18. Scheme of Examinations

Candidate/Student needs to get a pass mark separately in Theory, Internal Assessment and Practical Exams in each subject. There shall be a university examination at the end of each semester. Evaluation is based on formative evaluations (internal assessment) and summative evaluation (university examination). If the student fails in any of the subject, he/she has to appear for that subject in the consecutive academic year examinations. Only on passing all the subjects in the first year will the student be eligible to continue the second year. Degree Certificate and Course Completion Certificates will be awarded only when the student passes in all the subjects. The duration of examinations for theory and Practicals shall be three and four hours respectively.

### 18.1 Internal Assessment

18.1.1 The internal assessment for theory shall be 30 marks and shall be 30 marks for Practicals. Internal assessment for theory shall be calculated as an average of two sessional examinations, seminars, assignments etc. The internal assessment for Practicals shall be calculated on the basis of the practical exam, records of the practicals maintained and assignments, seminars etc.

18.1.2 A candidate must secure at least 50% of total marks fixed for internal assessment in particular subjects in order to be eligible to appear in the university examination of that subject.

18.1.3 Marks for internal assessment for each subject will be given by the HOD/HoI twice in each semester. The average of the best two internal assessment marks will be considered.

**18.2 University Examination**

A candidate who satisfies the requirements of attendance, progress and conduct shall be eligible to appear for the university examinations. There shall be a university examination at the end of each semester.

To be eligible to appear for university examination a candidate should fulfill all the following conditions;

a. undergone satisfactorily the approved course of the study in the subject/subjects for the prescribed duration
b. 75% attendance separately in theory and practical in each subject
c. shall have the minimum attendance requirement in all subjects of that semester for the first appearance
d. secure at least 50% of total marks fixed for internal assessment in a particular subject and
e. fulfilled any other requirement that may be prescribed by the university from time to time.

**18.3 Revaluation of Answer Papers**

As per the Shri Dharmasthala Manjunatheshwara University examination manual.

**18.4 Qualifying for a Pass**

18.4.1 Minimum marks

A candidate shall be declared to have passed the examination if he/she obtains the following qualifying marks in both theory and practical of each course

| | |
|---|---|
| Theory | : 50% |
| Practical | : 50% |
| IA | : 50% |
| Overall | : 50% |

18.4.2 Passing minimum

a) There shall be 50% passing minimum for internal in both theory and practical.
b) For external examination, passing minimum shall be 50% of the maximum marks prescribed for the paper.
c) In the aggregate (External + Internal) the passing minimum shall be 50% for each Paper/Practical/Project and Viva-voce.
d) Grading shall be based on overall marks obtained (Internal + external).

## 19. Project Work/Dissertation

According to the program curriculum, each M. Sc. student will have to undertake project work in a selected area of his study under the supervision of a faculty Guide for a minimum of 6 months duration. The students will have the option of undertaking project work in the institutional/university laboratory or in other institutions/companies outside the university with due permission of supervisor/HOD/HoI/University. **If a student undertakes the project in an outside institution/company the HOD/HoI may allot one of the faculty members as the supervisor/co-supervisor of the student.**

If a student undertakes the project in an outside institution/company, the candidate shall work on their dissertation/thesis, after approval of the protocol by the supervisor/guide and Head of the institution/Program Coordinator. The HoI/HoD/Program Coordinator shall write to the colleges/institutions/company having facility for project work and get their consent in writing and then make necessary arrangements for deputing the students under intimation to the Controller of Examinations. Such project work done by a student shall be certified by the Supervisor/guide and HoI who will send it to the Controller of Examinations through proper channels. ***If a student is willing to carry out the research project outside the institution/university, the candidate should bear the project cost and other associated costs by him/her.***

The results of such a study shall be submitted to the university in the form of a dissertation as per the prescribed format and within the date stipulated by the university. Only a candidate who has put a minimum of 75% of attendance in the fourth semester shall be eligible to submit the dissertation.

The project work is aimed at training a postgraduate candidate in research methodology and techniques. It includes identification of the problem, formulation of a hypothesis, experimentation, review of literature, getting acquainted with recent advances, designing of a research study, collection of data, critical analysis, and comparisons of results and drawing conclusions.

### 19.1 Supervisor/Guide

a) A Supervisor/guide shall be a full time post graduate teacher of the institute and recognized by the university as a guide for supervision of dissertation work. However, a co-guide can be opted whenever required with prior permission of the Institute and University. The co-guide shall be a postgraduate teacher recognized by the university as guide.
b) A candidate shall submit a synopsis to the university through the supervisor/guide and HoI within the date notified by the university.

c) Once the synopsis is approved and registered by the university no change in the topic or supervisor/guide shall be made without the prior approval of the university.

d) In the event of a registered supervisor/guide leaving the institute/university or in the event of the death of the supervisor/guide, a change of supervisor/guide shall be permitted by the university, on the specific recommendation of the HoI.

### 19.2 Maintenance of Log Book

a) The students should participate in Seminars, Journal club meets, Conferences, Group Discussions, etc.

b) During the course, the candidate shall maintain a log book of activities and University Research Notebook in connection with the research works and dissertation.

c) The HoI shall scrutinize and certify the log book once in every fortnight.

d) At the end of the course, the candidate should summarize the contents and get the log look certified by the HoI.

e) The log book should be submitted at the time of practical examination for the scrutiny of the examiners.

f) At the end of the program, the candidate should submit the summary of the activities along with the log book and university research/laboratory note book to the university through HoI.

## 19.3 Schedule

The following procedures and schedule shall be strictly followed.

19.3.1 Ethical Clearance

Ethical clearance should be obtained for a study involving any procedure on a human subject. The candidate should apply for the certificate to the ethics committee of the Institution/University, through the supervisor/guide and present the study before the committee for approval. A copy of the certificate should be attached along with the synopsis forwarded at the time of approval of synopsis. All such clearance should be sought before commencement of the project/research work.

19.3.2 Submission of the Synopsis

The synopsis of the proposed study with clearances from the ethics committees (if required) should be submitted to the HoD/HoI/ Program Coordinator through the supervisor/guide. The synopsis should be submitted as per the format, before commencement of the project/research work. Once the synopsis is approved and registered by the university no change in the topic and guide shall be made without the prior approval of the university.

19.3.3 Preparation of Dissertations

The written text of dissertation shall be as per the format and shall be not less than 50 pages and shall not exceed 100 pages (cover to cover). It should neatly type with 1.5 line spacing on one side of the paper (A4 size; 8.27”x11.69”) and properly bound. Spiral binding should be avoided. E-submission of the dissertation is mandatory.

19.3.4 Final Submission of the Dissertation

The dissertation completes in all respect and duly certified by the Supervisor/Guide/Co-guide/Program Coordinator/HoD/HoI should be forwarded it to the Controller of Examinations as per the date specified by the university, generally one month before the commencement of university examinations. Four copies of dissertation shall be submitted 2 months prior to the commencement of the examination on the prescribed date to the Controller of Examination of the University.

A candidate shall present and defend his/her dissertation at the end of the second year of his/her study and shall be subjected to a Viva-Voce on his/her dissertation.

19.3.5 Scheme of Evaluation

The dissertation will be evaluated for 300 marks by a panel of internal and external examiners appointed by the university. The internal assessment is for 60 marks and is awarded on the basis of regularity in work, colloquium, seminar, publication, methodology, etc. Minimum passing marks is 100.

19.3.6 Viva-Voce Examination

The viva-voce examination shall aim at assessing the depth of knowledge, logical reasoning, confidence and oral communication skills. The viva-voce examination shall be held after the submission of dissertation. If any candidate fails to submit the dissertation on or before the date of prescribed, his viva-voce shall be conducted during the subsequent semester examination.

## 20. Criteria for Pass

A candidate is declared to have passed in a subject if he secures 50% of the marks separately in the university examination and internal assessment, fixed for the subject. A candidate who fails in any subject shall have to appear only in that subject in the subsequent examination.

### 20.1 Declaration of the Results and Classification

Class will be awarded only to those candidates who pass the entire examination in the first attempt. Class shall be declared on the basis of the aggregate of marks scored in individual semester.

**CGPA Calculation Table**

| Letter Grade | Marks Range (%) | Grade Point | Remarks | Class/ Category |
|---|---|---|---|---|
| O | 75 and above | 7.5 to 10 | Outstanding | Distinction |
| A | 60 to <75 | 6.0 to <7.5 | Excellent | First Class |
| B | 50 to <60 | 5.0 to <6.0 | Good | Pass |
| F | <50 | <5.0 | Poor | Fail |

Candidates who pass the examination in more than one attempt shall be declared as passed in Pass class irrespective of the percentage of marks secured.

### 20.2 Award of Distinction and Ranks

Distinction will be awarded to successful candidates who secure 75% marks or more as program aggregate without any failure.

The names of these candidates at the end of the program will be published in the university website and daily newspaper of Karnataka edition.

An attempt means the appearance of a candidate for one or more subjects either in part or full in a particular examination. If a candidate submits application for appearing for the examination but does not appear for any of the subjects either in full or part in the university examination, he/she can appear for supplementary examinations provided other conditions such as attendance requirement, internal assessment marks, etc. are fulfilled and his appearing in the supplementary examination shall be considered as the first attempt.

### 20.3 Award of Merit Certificates

Merit certificates in each program will be awarded on the basis of aggregate marks of I to IV semester examinations. Further, only those candidates who have completed the program and fulfilled all the requirements in the minimum number of years prescribed (i.e. two years) and who have passed each semester in the first attempt are only eligible for the award of merit certificates.

### 20.4 Award of Medals and Prizes

The university shall award at its convocation, medals and prizes to outstanding candidates (based on the overall performance) as and when instituted by the donors as per the schedule prescribed for the award by the university.

### 20.5 Authority to Issue Transcript

The university shall be the authority for issuing transcripts after remitting the prescribed fees as prescribed by the university.

## 21. Amendment of Rules

The above rules are subjected to revision from time to time by the competent authority/committee duly constituted by the university, as and when deemed necessary.

## 22. Revision of Program Structure

The program structure should regularly be updated by the BoS, or a committee appointed by the Hon'ble Vice Chancellor for this purpose.

# Annexure-I
## Subjects of Study of M.Sc. (Biomedical Science)

| Code | | Subjects | Hours of Instruction | | | Credit Hours |
|---|---|---|---|---|---|---|
| | | | Lecture | Tutorials | Practical | |
| **First Semester** | | | | | | |
| BMS | HCT 1.1 | Human Anatomy and Physiology | 04 | - | - | 04 |
| | HCT 1.2 | Biochemistry | 04 | - | - | 04 |
| | HCT 1.3 | Microbiology | 04 | - | - | 04 |
| | SCT 1.4 | Immunology | 04 | - | - | 04 |
| | PRT 1.5 | Human Anatomy and Physiology & Biochemistry | - | - | 04 | 04 |
| | PRT 1.6 | Microbiology and Immunology | - | - | 04 | 04 |
| | | Seminar/Tutorial | | 01 | - | 01 |
| **Second Semester** | | | | | | |
| BMS | HCT 2.1 | Cell Biology | 04 | - | - | 04 |
| | HCT 2.2 | Molecular Biology | 04 | - | - | 04 |
| | SCT 2.3 | Biostatistics and Bioinformatics | 04 | - | - | 04 |
| | OET 2.4 | Nutritional Immunology | 04 | - | - | 04 |
| | PRT 2.5 | Cell Biology and Molecular biology | - | - | 04 | 04 |
| | PRT 2.6 | Biostatistics and Bioinformatics & Nutritional Immunology | - | - | 04 | 04 |
| | | Seminar / Tutorial | - | 01 | - | 01 |
| **Third Semester** | | | | | | |
| BMS | HCT 3.1 | Stem Cells and Regenerative Medicine | 04 | - | - | 04 |
| | HCT 3.2 | Cancer Biology and Precision Medicine | 04 | - | - | 04 |
| | SCT 3.3 | Research Methodology and Regulatory Affairs | 04 | - | - | 04 |
| | OET 3.4 | Fundamentals of Pharmacology and Toxicology | 04 | - | - | 04 |
| | PRT 3.5 | Stem Cells and Regenerative Medicine & Cancer Biology and Precision Medicine | - | - | 04 | 04 |
| | PRT 3.6 | Research Methodology and Regulatory Affairs & Fundamentals of Pharmacology and Toxicology | - | - | 04 | 04 |
| | | Seminar / Tutorial | | 01 | | 01 |
| **Fourth Semester** | | | | | | |
| BMS | HCT 4.1 | Biomedical Applications of Nanotechnology | 04 | - | -- | 04 |
| | HCT 4.2 | Introduction to OMICS Technologies and Applications | 04 | - | -- | 04 |
| | PRT 4.3 | Biomedical Applications of Nanotechnology & Introduction to OMICS Technologies and Applications | - | - | 04 | 04 |
| | MP 4.4 | Major Project, Presentation in Conference/ Symposium Industrial Visits and Report | - | - | 20 | 20 |
| | | Seminar | - | - | 01 | 01 |
| **TOTAL CREDITS** | | | | | | **108** |

L:Lecture; T: Tutorials; P: Practical; IA: Internal Assessment; UA: University Assessment; 4 Credits of Theory:4 Hours of Teaching per Week; 2 Credits of Practical:4 Hours of Practical/Laboratory Session per Week; HCT: Hard Core Theory; SCT: Soft Core Theory; OET: Open Elective Theory; PRT: Practical; MP: Major Project

# Annexure-II
# Scheme of Examination for M.Sc. (Biomedical Science)

| Subject Code | | Subjects | Theory | | Practical | | Total |
|---|---|---|---|---|---|---|---|
| | | | UA | IA | UA | IA | |
| **First Semester** | | | | | | | |
| BMS | HCT 1.1 | Human Anatomy and Physiology | 70 | 30 | - | - | 100 |
| | HCT 1.2 | Biochemistry | 70 | 30 | - | - | 100 |
| | HCT 1.3 | Microbiology | 70 | 30 | - | - | 100 |
| | SCT 1.4 | Immunology | 70 | 30 | - | - | 100 |
| | PRT 1.5 | Human Anatomy and Physiology & Biochemistry | - | - | 70 | 30 | 100 |
| | PRT 1.6 | Microbiology and Immunology | - | - | 70 | 30 | 100 |
| | | Seminar/Tutorial | | | | | 025 |
| | | | | | **Total** | | **625** |
| **Second Semester** | | | | | | | |
| BMS | HCT 2.1 | Cell Biology | 70 | 30 | - | - | 100 |
| | HCT 2.2 | Molecular Biology | 70 | 30 | - | - | 100 |
| | SCT 2.3 | Biostatistics and Bioinformatics | 70 | 30 | - | - | 100 |
| | OET 2.4 | Nutritional Immunology | 70 | 30 | - | - | 100 |
| | PRT 2.5 | Cell Biology and Molecular biology | - | - | 70 | 30 | 100 |
| | PRT 2.6 | Biostatistics and Bioinformatics & Nutritional Immunology | - | - | 70 | 30 | 100 |
| | | Seminar / Tutorial | | | | | 025 |
| | | | | | **Total** | | **625** |
| **Third Semester** | | | | | | | |
| MS | HCT 3.1 | Stem Cells and Regenerative Medicine | 70 | 30 | - | - | 100 |
| | HCT 3.2 | Cancer Biology and Precision Medicine | 70 | 30 | - | - | 100 |
| | SCT 3.3 | Research Methodology and Regulatory Affairs | 70 | 30 | - | - | 100 |
| | OET 3.4 | Fundamentals of Pharmacology and Toxicology | 70 | 30 | - | - | 100 |
| | PRT 3.5 | Stem Cells and Regenerative Medicine & Cancer Biology and Precision Medicine | - | - | 70 | 30 | 100 |
| | PRT 3.6 | Research Methodology & Regulatory Affairs & Fundamentals of Pharmacology and Toxicology | | | 70 | 30 | 100 |
| | | Seminar / Tutorial | | | | | 025 |
| | | | **Total** | | | **625** | |
| **Fourth Semester** | | | | | | | |
| BMS | HCT 4.1 | Biomedical Applications of Nanotechnology | 70 | 30 | - | - | 100 |
| | HCT 4.2 | Introduction to OMICS Technologies and Applications | 70 | 30 | - | - | 100 |
| | PRT 4.3 | Biomedical Applications of Nanotechnology & Introduction to OMICS Technologies and Applications | | | 70 | 30 | 100 |
| | MP.4.4 | Major Project, Presentation in Conference/ Symposium Industrial Visits and Report | - | - | 210 | 90 | 300 |
| | | Seminar | | | | | 025 |
| | | | **Total** | | | **625** | |
| | | | **GRAND TOTAL** | | | ***2500*** | |

# Annexure-III
# M. Sc. (Biomedical Science) [CBCS Syllabus- Pattern]

| Sl. No. | Subjects | Credit Hours (T+P) |
|---|---|---|
| **Hard Core – Theory** | | |
| . | Human Anatomy and Physiology | 4+0 |
| 2. | Biochemistry | 4+0 |
| 3. | Microbiology | 4+0 |
| **Soft Core- Theory** | | |
| 4. | Immunology | 4+0 |
| **Core Courses – Practical** | | |
| 5. | Practical–Human Anatomy and Physiology & Biochemistry | 0+4 |
| 6. | Practical–Microbiology and Immunology | 0+4 |
| **Hard Core–Theory** | | |
| 7. | Cell Biology | 4+0 |
| 8. | Molecular Biology | 4+0 |
| **Soft Core–Theory** | | |
| 9. | Biostatistics and Bioinformatics | 4+0 |
| **Open Elective–Theory** | | |
| 10. | Nutritional Immunology | 4+0 |
| **Core Courses–Practical** | | |
| 11. | Cell Biology & Molecular Biology | 0+4 |
| 12 | Nutritional Immunology & Biostatistics and Bioinformatics | 0+4 |
| **Hard Core–Theory** | | |
| 13. | Stem Cells and Regenerative Medicine | 4+0 |
| 14. | Cancer Biology and Precision Medicine | 4+0 |
| **Soft Core–Theory** | | |
| 15. | Research Methodology and Regulatory Affairs | 4+0 |
| **Open Elective–Theory** | | |
| 16. | Fundamentals of Pharmacology and Toxicology | 4+0 |
| **Core Courses–Practical** | | |
| 17. | Stem Cells and Regenerative Medicine & Cancer Biology and Precision Medicine | 0+4 |
| 18. | Fundamentals of Pharmacology and Toxicology & Research Methods and Bioethics | 0+4 |
| **Hard Core–Theory** | | |
| 19. | Biomedical Application of Nanotechnology | 4+0 |
| 20. | Introduction to OMICS technologies and Applications | 4+0 |
| **Core Courses–Practical** | | |
| 21. | Biomedical Applications of Nanotechnology & Introduction to OMICS Technologies and Applications | 0+4 |
| **Research and Skill Empowerment** | | |
| 22. | Research Project, Conference Presentation & Industrial Visit and Report | 0+20 |
| 24. | Seminars & Assignments | 0+4 |

# SEMESTER-I

## PAPER-HCT 1.1. HUMAN ANATOMY AND PHYSIOLOGY

**TOTAL LECTURES: 52HRS** **TOTAL CREDITS: 04**

**UNIT-I: Human Body and Chemical Levels of Organization 03hrs**
Overview of anatomy and physiology, structural organization of the human body, functions of human life, requirements for human life, homeostasis, anatomical terminology, elements and atoms, chemical bonds and reactions, inorganic and organic compounds essential to human body functioning.

**UNIT-II: Cell Structure and Physiology 03hrs**
Structure of cells, function of each component of the cell, membrane potential, action potential, generation and conduction, electrical stimulation, blood—composition and function of various components of blood, normal and abnormal hematopoiesis, blood groups, destruction of red cells.

**UNIT-III: Introduction to Human Development 03hrs**
Scope of developmental biology, stages of human development, evolution of development, techniques used to study mechanisms of development, differentiation of germ cells and gametogenesis, fertilization and implantation, stages of human embryonic development, congenital malformations and teratogenesis.

**UNIT-IV: Organogenesis and Extra Embryonic Membranes 04hrs**
Formation of germ layers (gastrulation and neurulation up to formation of notochord), placenta, amnion and amniotic fluid, yolk sac and allantois, the development of the heart, vessels, bones, teeth, mammary gland, digestive tract & its derivative and nervous system, parturition and multiple pregnancies.

**UNIT-V: Musculoskeletal System 05hrs**
Introduction to musculoskeletal system, types, structure and development of bones; bones of the whole body & skeleton, structure and functions of various joints in the body, structure and functions of various types of muscles in the body, skeletal muscle, cardiac muscle, smooth muscle etc.

**UNIT-IV: Cardiovascular System/Circulatory System 05hrs**
**Part I**: Structure of heart, arteries, veins blood vessels and lymphatic system

**Part II**: Function of heart, regulation of heart rate and blood pressure, regional circulation with special reference to coronary circulation and ischemic heart disease.

**UNIT-VII: Respiratory System** **05hrs**

**Part I**: Structure of nose, larynx, trachea, bronchi and lungs.

**Part II**: Functional anatomy of respiratory system and mechanisms of respiration, regulation of respiration, anoxia, cyanosis, dyspnea and pulmonary function tests.

**UNIT-VIII: Digestive System** **05hrs**

**Part-I**: Basics of mouth, pharynx, esophagus and whole of gastrointestinal tract and glands associated, liver, gallbladder, pancreas and spleen.

**Part II**: Composition, mechanism of action and regulation of salivary and gastric secretions, bile, pancreatic juice and intestinal secretions, gastro-intestinal tract movement and absorption, functions of liver.

**UNIT-IX: Excretory System** **05hrs**

**Part I:** Basics of kidney, ureters, bladder, urethra, and skin and sweat gland.

**Part II:** Functions of kidney, mechanism of urine formation, mechanisms of excretion of urine and other toxins, function of the skin and sweat gland, temperature regulation.

**UNIT-X: Endocrine System** **04hrs**

**Part I**: Introduction to endocrine glands.

**Part II**: Endocrine and their functions, regulation of endocrine secretions, endocrine disorders.

**UNIT-XI: Nervous System and Special Senses** **05hrs**

**Part I:** Basics of brain, spinal cord, nerves, autonomic nervous system, eye, ear and nose.

**Part II:** Neuron conduction of nerve impulses, synaptic transmission and reflex action, sensory organs and different tracts, regulation of tone and posture, physiology of cerebellum and basal ganglia, the cerebral cortex, physiology of vision, the special sensation-auditory, tests and olfaction, constancy of milieu interior.

**UNIT-XII: Reproductive System** **05hrs**

**Part I:** Structure of male reproductive system, structure of female reproductive system.

**Part II:** Physiology of reproduction, reproductive failure, infertility, assisted reproduction, basis of use of various contraceptive devices.

**Teaching and Learning Methods**

Didactic lectures or interactive lectures
Seminars
Guest lectures
Workshops
Journal club
Symposium
Integrated teaching

**References/Textbooks**


- Richard S. Snell. Clinical Anatomy for Medical Students. 7th Edition. Wolters Kluwer Publisher.
- Kieth L. Moorie, Arthur F. Dalley II, and Anne. M.R. Agur. Clinically Oriented Anatomy, 4th edition, Williams and Wilkins Publisher, Baltimore.
- Datta A.K. Essentials of human anatomy: Thorax and Abdomen, 6th edition Vol. I. Current Book International, Calcutta.
- Scott F. Gilbert and Michael J.F. Barresi. Developmental Biology, 11th edition, Sinauer publishers.
- Arthur C. Guyton and John E. Hall. Textbook of Medical Physiology, 11th edition, Elsevier publishers.
- Gerard J. Tortora and Bryan Derrickson. Principles of Anatomy and Physiology, 11th edition, Wiley publishers.
- Inderbir Singh. Textbook of Human Histology with Colour Atlas. 6th edition, Jaypee publishers.
- Richard D.A. Mitchell W.V.M. Gray's Anatomy for students, 3rd edition, Elsevier publishers.
- Keith L. Moore and Persaud T.V.N. The developing human, clinically oriented embryology. 6th edition, Saunders press.
- Sarada S.K. Madhavan Kutty and Singh H.D. Textbook of Human Physiology. 1st edition, Chand & Company.
- Sujit K. Chaudhuri. Concise Medical Physiology.1st edition unit V, New Central Book agency.
- Cyril A. Keele, Eric Neil, and Norman Joels. Samson Wright's Applied Physiology, 13th edition, Oxford University Press.
- Tobin C.E. Basic Human Anatomy, Mcgraw Hill Book Co. New York
- John Gibson, Modern Physiology & Anatomy for nurses. Blackwell, Publisher. The University of Michigan.

## PAPER-HCT 1.2. BIOCHEMISTRY

**TOTAL LECTURES: 52HRS** **TOTAL CREDITS: 04**

**UNIT-I: Introduction** **02hrs**

Principles of biophysical chemistry: pH, buffer, temperature, chemical kinetics, thermodynamics, enthalpy, redox potential, free energy and entropy, colligative properties.

Cell: Structure & function of cell membrane; subcellular organelles and their functions.

**UNIT-II: Physiological Fluids** **03hrs**

Structure and functions of biomolecules, biological fluids and solvents, body fluid compartments, composition, size, capillary, structure and filtration across capillary wall, pH and buffer system, principle of homeostasis, blood and blood components, plasma proteins, bone marrow, erythrocytes formation and fate, white blood cells, platelets, homeostasis, mechanisms of coagulation and fibrinolysis, blood types and blood transfusion.

**UNIT-III: Carbohydrates** **08hrs**

Introduction, Classification, Structures, functions, derivatives and their biological significance, glycolysis, gluconeogenesis, glycogenesis, glycogenolysis, Krebs cycle, mechanism and significance of hexose monophosphate shunt, mitochondrial electron transport chain, oxidative phosphorylation, couple's reaction, and associated disorders.

**UNIT-IV: Proteins** **07hrs**

Introduction, classification of amino acids and proteins, structure and functions, biologically significance, peptides, amino acids, plasma proteins, immunoglobulins, essential amino acids and their physiological functions; biosynthesis amino acids, protein and amino acids metabolism, regulations of protein metabolism, transamination, urea cycle, and amino acids/protein deficiencies and disorders.

**UNIT-V: Lipids** **07hrs**

Introduction, classification, structures, functions, and biological significance of lipids, lipid biosynthesis, metabolism of lipids, regulation of lipid metabolism, lipoproteins, essential fatty acids and their physiological functions, structure and functions of cholesterol, types of cholesterol, biological functions of cholesterol, cholesterol metabolism and associated disorders.

**UNIT-VI: Nucleic Acids** **06hrs**

Introduction, structure (DNA/RNA) types, functions and biological importance of nucleic acids, purine and pyrimidine catabolism, biosynthesis of purine & pyrimidine and associated disorders—Inborn errors of metabolisms, bioenergetics etc.

**UNIT-VII: Enzymes, Vitamins and Minerals** **10hrs**

Introduction to enzymes, enzyme kinetics, enzyme regulation, mechanism of enzyme catalysis, pro-enzymes, isozymes, allosteric enzymes and feedback control, diagnostic and therapeutic importance of enzymes.

Introduction to vitamins, classification, sources, required daily allowance, activation, absorption, transport, storage, biochemical function, their coenzyme activity and their deficiency associated disorders.

Introduction to minerals, Calcium, Phosphorous, Sodium, Potassium, Chloride, Iron, Copper, Iodine, RDA, sources, biochemical function, Deficiency manifestations and diagnosis, and deficiency associated disorders.

**UNIT-VIII: Clinical Biochemistry** **09hrs**

Introduction to clinical biochemistry, genetic disorders, blood disorders, endocrine system diseases and disorders, and liver disorders.

Clinical diagnosis: Interpretation and reference values of blood glucose, urea, creatinine, uric acid, cholesterol, calcium, proteins, albumin & A/G ratio. Routine blood and urine analysis, enzyme assays, liver function tests, cell free biopsies, non-invasive testing, HPLC and diagnostic laboratory instruments.

**Teaching and Learning Methods**

Didactic lectures or interactive lectures
Seminars
Guest lectures
Workshops
Journal club
Symposium
Integrated teaching

**References/Textbooks**


- Lubert Stryer, Jeremy M, Berg and John L. Tymoczko. Biochemistry. 6th edition, W.H. Freeman & Company, New York.
- David L. Nelson and Michael M. Cox. Lehninger Principles of Biochemistry. 7th edition, W.H. Freeman & company.
- Robert K. Murray, Daryl K. Grammer, Peter A. Mayer, and Victor W. Rodwell, Harper's Biochemistry, 28th edition, Tata McGraw- Hill publishing company limited, New Delhi.
- Donald Voet, Judith G. Voet, and Charlotte W. Pratt. Fundamentals of Biochemistry, Life at the molecular level. 4th edition, John Wiley & Sons, Inc.
- Geoffrey Zubay. Biochemistry, 4nd edition, WC publishers.
- Thomas M. Devlin. Textbook of Biochemistry with Clinical Correlations, 7th edition, John Wiley& sons, Inc.
- Benjamin Lewin. Genes VI, 6th edition, Oxford University Press.
- Talwar G.P. and Srivastava L.M. Textbook of Biochemistry and Human Biology, 3rd Edition, Phi Learning Publisher.
- D.M. Vasudevan, Sreekumari S and Kannan Vaidyanathan. Textbook of Biochemistry for Medical students, 8th edition, Jaypee Brothers Medical Publishers (P) Ltd.
- Denise R. Ferrier. Lippincotts' Illustrated reviews Biochemistry, 7th edition, Wolters Kluwer Publishers.
- Gupta S.K. Biochemistry for MBBS, 1st edition, Avichal Publishing Company.
- Pankaja Naik. Biochemistry, 4th edition, Jaypee Brothers Medical Publishers (P) Ltd.
- Dinesh Puri. Textbook of Medical Biochemistry, 4th edition, Elsevier India.
- Namrata Chhabra. A Case oriented approach towards Biochemistry, Jaypee publications.
- Divya Shanti D'sa and Sowbhagya Lakshmi - An easy guide to Practical Biochemistry, Jaypee Brothers Medical Pub (P) Ltd.
- T.N. Pattabhiraman. Laboratory manual and Practical Biochemistry, 4thedition, All India Publishers & Distributors.
- Alisa Peet, Michael A. Lieberman and Allan Marks. Maeks' Basic medical biochemistry, 4th edition. LWW.

## PAPER- HCT 1.3. MICROBIOLOGY

**TOTAL LECTURES: 52HRS** **TOTAL CREDITS: 04**

**UNIT-I: Basics of Microbiology** **07hrs**

Introduction and history background of microbiology, microscopic methods for observing microorganisms, organization and ultra-structure of microorganism, taxonomy, nomenclature and identification, microorganism culture media and culture techniques, sterilization and disinfection, antimicrobial chemotherapy and chemotherapeutic agents, mode of action, interpretation of susceptibility tests, resistance spectrum of activity and bacterial genetics, safety in microbiology laboratory.

**UNIT-II: Applied Microbiology** **24hrs**

**Bacteriology:** Morphology, normal human flora, classification of bacteria according to pathogenicity, pathogenesis and virulence factor of bacteria, mode of transmission, methods of prevention, laboratory diagnosis of bacterial diseases, human diseases caused by bacteria, respiratory tract infection, urinary tract infection, genital tract infection, gastrointestinal tract infection, blood stream & CNS infection, epidemiology of bacterial diseases, antibacterial agents and their mode of action and antibiotic resistance. **(07hrs)**

**Virology:** Basic structure and broad classification of viruses, pathogenesis and pathology of viral infections, immunity and prophylaxis of viral diseases, principles of laboratory diagnosis of viral diseases, bacteriophage with relation to virulence mechanisms, history, epidemiology, diagnosis, clinical feature, treatment & prevention of viral diseases, smallpox, herpes, adenovirus, arbovirus, picornavirus, myxovirus, coronaviridae family, antiviral agents and their mode of action**.** **(06hrs)**

**Mycology:** General properties of fungi, classification based on pathogenicity and pathology, general principles of fungal diagnosis, medical laboratory diagnosis of fungal diseases, common fungal diseases of human, rash disease, ringworm, subcutaneous & systemic mycosis, antifungal agents and their mode of action.

**(05hrs)**

**Parasitology:** Introduction to parasites-protozoans, helminthes, nematodes, medical entomology with reference to vectors and human parasitic diseases-malaria, toxoplasmosis, cryptosporidiosis, amoebic dysentery, sleeping sickness, tricomoniasis, Chaga's disease leishmaniasis, giardiasis, pneumocystis pneumonia, intestinal, worm infection, fiarisis, schistosomiasis, hydatid disease, anti-parasitic agents and their mode of action. (**06hrs)**

**UNIT-III: Agricultural, Environmental and Aquatic Microbiology 05hrs**

Soil as an environment for microorganisms. microbial interactions, microbial interactions between plants, bacterial diseases of agricultural crops, introduction to bio-fertilizers and bio-insecticides, role of microbes in biogeochemical cycles, aerobiology, assessment of air quality, water microbial communities and interactions, types of wastes, solid and liquid wastes treatment and production of biogas from waste.

**UNIT-IV: Food Microbiology 05hrs**

Introduction to food microbiology, microorganisms and food, food spoilage/preservation, food safety, microbiological quality assurance**,** microorganisms and food materials, micro-organisms in the atmosphere, microorganisms of soil, microorganisms of water, micro-organisms of plants, micro-organisms of animal origin, factors affecting the growth and survival of microorganisms in foods, microbiology of food preservation, production of fermented foods, food spoilage**,** food poisoning and food borne diseases.

**UNIT-V: Industrial Microbiology 07hrs**

An introduction to fermentation process, classification of fermentation types, genetic control of fermentation, selection and improvement of strain for fermentation, recombinant DNA technique for strain development, preservation methods of cultures, types and design of bioreactors, mode of operation, instrumentation and computer application in fermentation, fermentation of microbial product, anaerobic and aerobic fermentation, types of fermentation process-Solid state, semi-solid and liquid state fermentation, single cell protein, antibiotics, vitamins, hormone, enzyme, and biogas production; downstream processing–cell disruption methods, precipitation, filtration, centrifugation, chromatography, membrane process, drying, crystallization; quality control and evaluation of industrial products and packaging.

**UNIT-VI: Biological Threats and Human Security/National Security 04hrs**

Definition of biological threat, organisms used in bioterrorism:

**Category A**- Tularemia or rabbit fever, Anthrax, Smallpox, Botulinum toxin, Bubonic plague, Viral hemorrhagic fevers.

**Category B**- Brucellosis, Epsilon Toxin of *C. Perfringens*, Food safety threats, Galnders, Melioidoses.

**Category C-** Nipah virus, Hantavirus.

**Teaching and learning methods**

Didactic lectures or interactive lectures
Seminars
Guest lectures
Workshops
Journal club
Symposium
Integrated teaching

**References/Textbooks:**


- Ananthanarayan R. and Jayram Paniker. C.K. Textbook of Microbiology, 8th edition, Universities Press.
- Collee J.G., Andrew G.F. and Marmion A.O. Anthony Simmons. Mackie and McCartney Practical Medical Microbiology, 14th edition, Churchill Livingstone.
- Patricia Tille. Bailey and Scott's Diagnostic Microbiology 9th edition, C V Mosby, St. Louis.
- Geo F. Brooks, Karen C. Carroll, Janet S. Butel, and Stephen A. Morse. Medical Microbiology, (Jawetz, Melnick, & Adelberg's Medical Microbiology), 24th edition, Mcgraw Hill.
- Leslie Collier and Dr. Brian Mahy. Topley and Wilson's Microbiology and microbial infections Vol 1to 7, 9th edition, Hodder Arnold.
- Koneman E.W., Allen S.D., Schreckenberg P.C. and Winn W.C (Ads). Atlas and Textbook of Diagnostic Microbiology, 4th edition, J B Lippincott, Philadelphia.
- Murray P. R., Baron E. J., Pfaller M. A., Tenover P. C. and Yolken R. H. Manual of Clinical Microbiology, 6th edition. American Society for Microbiology, Washington, DC.
- Parija S. C. Textbook of Practical Microbiology. 1st edition, Ahuja Publishing House, New Delhi, India.
- Woods G.L. and Washington. J. A. The Clinician and the Microbiology Laboratory, Mandell.
- G. L. Bennett and J. E. Dolin. R. Principles and Practice of Infectious Disease, 4th edition, Churchill Livingstone, New York.
- Ray B. Fundamental Food Microbiology. 2nd edition. CRC Press. New York. USA.
- Jay J. M. Modern Food Microbiology. 6th edition, Chapman & Hall, New York.
- https://emergency.cdc.gov/agent/agentlist-category.asp
- https://www.ncbi.nlm.nih.gov/books/NBK216161/
- http://needtoknow.nas.edu/id/challenges/bioterrorism/

## PAPER-SCT 1.4. IMMUNOLOGY

**TOTAL LECTURES: 52HRS** **TOTAL CREDITS: 04**

**UNIT-I: Immune System & Immune Response** **12hrs**

Introduction, historical review, innate and acquired immunity, active and passive immunity, natural and artificial immunity; lymphoid tissue - primary or secondary organs, lymphocyte traffic, lymphocytes, mononuclear phagocyte, antigen- presenting cells, polymorphs and mast cells, cluster differentiation (CD): Ag specific receptors, cytokines network, molecular basis of t-cell activation, structure and function of various cytokines, cytokine receptors, cytokine production from TH1 and TH2 CD4+ T-cells; Complement system: nomenclature, activation pathways and its biological effects; major histocompatibility complex**:** structure and function of MHC, genomic organization of the MHC locus in mice and human, factors responsible for immune variations, adjuvants and its mechanisms.

**UNIT-II: Humoral Immunity** **06hrs**

Definition, immunoglobulin, structure and functions of different types of immunoglobulins, clonal selection theory, antibody effector mechanism, antibody receptors, antibody diversity, immunoglobulin gene recombination, antibody class switching, isotype switching, effect of somatic mutations on the antibody diversity, primary and secondary immune responses, affinity maturation & memory cells development.

**UNIT-III: Antigen-Antibody Reactions** **05hrs**

Definition, mechanism, structure and assembly of MHC molecules/peptide complexes, antigen processing and presentation through APCs to identify by T-lymphocytes (CD4+ and CD8+), clinical applications of Ag-Ab reactions like agglutination, precipitation, complement fixation test (CFT), neutralization, fluorescent immune test, opsonization, ELISA test etc.

**UNIT-IV: Cell Mediated Immune Response** **04hrs**

T-Cell independent and dependent defense mechanisms, cell mediated cytotoxicity

**UNIT-V: Hypersensitivity** **04hrs**

Hypersensitive reactions, Coomb's/Gell/Sell's/Chase classification of hypersensitivity, process and mechanism involved in hypersensitivity, chemical factors affecting the reaction, role of IgE, mast cells, genetic allergic response, prevention and treatment.

**UNIT-VI: Autoimmunity** **05hrs**

Autoimmunity origin, general principles of autoimmunity, classification of autoimmunity disease and its causes, pathogenesis of autoimmune disease, clinical features, diagnosis and treatment and current therapies for autoimmune disease.

**UNIT-VII: Immunology of Transplantation and Malignancy** **07hrs**

Definition of transplantation, autograft, isograft or syngraft, allograft, xenograft, role of immune response in allograft rejection, clinical characteristic of allograft rejection, graft v/s host interactions, tumor antigens and onco-development.

**UNIT-VIII: Immunohematology and Pathology** **09hrs**

Definition of immunohematology, agglutination, hemolysis complete & incomplete antibodies, blood group systems, H antigen, Rh blood group, other blood group systems and its importance, transfusion testing, hemolytic diseases, complications of blood transfusion, *Erythroblastosis fetalis*, genetic and acquired autoimmune, immunodeficiency disorders (e.g. AIDS). **Immunotherapeutics and Vaccines:** Introduction, principles, types of Immuno-therapeutics and vaccines, method of preparation, mechanism of action and applications.

**Teaching and Learning Methods**

Didactic lectures or interactive lectures
Seminars
Guest lectures
Workshops
Journal club
Symposium
Integrated teaching

**References/Textbook**


- Peter J. Delves, Seamus J. Martin, Dennis R. Burton and Ivan M. Roitt. Roitt's Essential Immunology, 13th edition, Wiley Blackwell.
- Richard A., Barbara A. Osborne, Thomas J. Kindt, and Janis Kuby. Kuby Immunology, 8th edition, Goldsby. W H Freeman & Co.
- Abul K. Abbas and Andrew H. Lichtman. Cellular and Molecular Immunology, 7th edition, Elsevier Science Health Science div.
- Ivan Roitt, Jonathan Brostoff and David K. Immunology, 7th Edition, Elsevier Inc
- Dusly Fatima and N. Arumugam. Sara's Immunology, Saras Publication.
- Raj Khanna. Immunology, 1st edition, Oxford University Press.
- Rao C.V. Immunology A textbook, 1st edition, Alpha Science International Ltd.
- Sudha Gangal, and Shubhagi Sontakke. Textbook of Basic and Clinical immunology, Kindle Edition, Universities Press (India) Pvt. Ltd.
- Khan (Fathima Halim). The elements of immunology, Pearson Ed Khan

## PAPER-PRT 1.5. PRACTICAL: HUMAN ANATOMY AND PHYSIOLOGY & BIOCHEMISTRY

**TOTAL PRACTICAL: 52HRS** **TOTAL CREDITS: 04**

### HUMAN ANATOMY AND PHYSIOLOGY

1. Demonstrations
   - Bones of skull and vertebral column
   - Brain and spinal cord
   - Cross-sectional anatomy
2. Radiological anatomy
3. Study of tissue of human body
   - Epithelial tissue
   - Muscular tissue
   - Connective tissue
   - Nervous tissue
4. Hemocytometer and microscope Basics; Identification of parts. Cleaning and maintaining the microscope.
5. Determination of WBC count of blood.
6. Determination of RBC count of blood.
7. Determination of Erythrocyte sedimentation rate, hemoglobin content of blood, bleeding time and clotting time.
8. Study of appliances used in experimental physiology.
9. Microtome and hematoxylin and eosin staining.
10. Tissue processing and staining methods.

## BIOCHEMISTRY

1. To learn principles, function, operation and maintenance of Laboratory equipment/instrument.
2. Preparation of buffers solution and measurement of pH of different buffer solutions.
3. Analysis of body fluids e.g. blood, urine and saliva.
4. To perform qualitative tests for detection of carbohydrate, amino acids, proteins and lipids from a given sample.
5. Extraction of Casein proteins from biological samples/milk.
6. Extraction of protein by ammonium sulphate fractionation method.
7. Estimation of proteins by Biuret method, Lowry method and Bradford assay method.
8. Enzyme activity analysis: salivary amylase, lactate dehydrogenase and alkaline phosphatase.
9. Gel filtration techniques.
10. Determination of reducing sugars by 3, 5, di-nitro salicylic acid.

## PAPER-PRT 1.6. PRACTICAL: MICROBIOLOGY AND IMMUNOLOGY

**TOTAL LECTURES: 52HRS** **TOTAL CREDITS: 04**

### MICROBIOLOGY

1. Sterilization techniques, media preparation and isolation techniques
2. Morphological, Microscopic and biochemical test of the isolates
3. Microbial staining techniques (simple and differential staining, cell wall, endospores, intracellular lipids, acid-fast, flagella, viability) and Microbial motility test
4. Studies on bacteria, fungi from water, food, soil and milk sample
5. Antimicrobial susceptibility test and to study the minimal concentration of antibiotic assay on microbial culture.
6. Bacterial growth: growth curve, condition for growth; temperature requirements, aerobes/anaerobes.
7. To determine commercial sterility of processed canned foods.
8. Production of wine from grapes in the laboratory.
9. Isolation of Azotobacter from soil and rhizobium from legume root nodules.
10. Isolation and characterization of halophiles, alkalophiles and acidophiles.

### IMMUNOLOGY

1. Preparation of antigen.
2. Raising of antisera for agglutination test.
3. Raising of antisera for precipitation test.
4. Gel diffusion test

a. Radial diffusion test.
b. Ouchterlany diffusion test.
c. Rocket electrophoresis.
d. Immuno-electrophoresis.

5. Slide agglutination test.
6. Tube agglutination test / Passive agglutination.
7. ELISA Test
8. SANDWICH ELISA.
9. Complement fixation test.
10. Demonstration of anaphylactic shock method.

# SEMESTER–II

## PAPER-HCT 2.1. CELL BIOLOGY

**TOTAL LECTURES: 52HRS** **TOTAL CREDITS: 04**

**UNIT-I: Membrane Structure and Function** **07hrs**

Structure of model membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, membrane pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes

**UNIT-II: Structural Organization and Function of Intracellular Organelles** **07hrs**

Cell wall, nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast, structure & function of cytoskeleton and its role in motility.

**UNIT-III: Organization of Genes and Chromosomes** **07hrs**

Genetics aspects, Operon, unique and repetitive DNA, interrupted genes, gene families, structure of chromatin and chromosomes, heterochromatin, euchromatin, transposons.

**UNIT-IV: Cell Division and Cell Cycle** **04hrs**

Mitosis and meiosis, their regulation, steps in cell cycle, regulation and control of cell cycle.

**UNIT-V: Microbial Physiology** **06hrs**

Growth yield and characteristics, strategies of cell division, stress response.

**UNIT-VI: Cell Signaling** **07hrs**

Hormones and their receptors, cell surface receptors, signaling through G-protein coupled receptors, signal transduction pathways, second messengers, regulation of signaling pathways, bacterial and plant two component systems, light signaling in plants, bacterial chemotaxis and quorum sensing.

**UNIT-VII: Cellular Communications** **07hrs**

Regulations of hematopoiesis, general principles of cell communications, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins, neurotransmission and its regulation

**UNIT-VIII: Programmed Cell Death, Aging and Senescence 07hrs**

History, types of cell death, apoptosis, autophagy, mechanism-PCD in normal tissue development, adult homeostasis and aging, suppression of PCD in cancerous and senescent cells, life span regulation of PCD, atrophic factors, other types, clinical significance.

**Teaching and Learning Methods**

Didactic lectures or interactive lectures
Seminars
Guest lectures
Workshops
Journal club
Symposium
Integrated teaching

**References/Textbook**


- David L. Nelson and Michael M. Cox. Lehninger Principles of Biochemistry. 7th edition, W.H. Freeman & company.
- Geoffrey M. Cooper and Robert E. Hausman. Cell: A molecular approach. 4th edition, ASM Press.
- Thomas D. Pollard and William C. Earnshaw. Cell biology. 2nd edition, Saunders.
- Alberts B., Bray D., Lewis J., Raff M., Roberts K. and Watson J.D. Molecular Biology of the Cell. Garland Publishing Inc.
- Cooper G.M. Sunderland. The Cell. A Molecular Approach, 1st Edition, Sinauer Associates, Inc.
- De Robertis, E.D.P. & De Robertis E.M.F.B.I. Cell and Molecular Biology, 1st edition, Waverly Pvt. Ltd.
- Gilbert S.F. Developmental Biology 1st Edition, Sinauer Associates, Inc.
- Lodish H., Berk A. Zipursky, S.L. Matsudaira P. and Baltimore D. Molecular cell Biology. 1st edition. WH Freeman & Co.
- Karp G. and John Harris D. Cell and Molecular Biology. Concepts and experiments, 1st edition, Wiley & sons.
- Kleinsmith L.J. and Kish V.M. Principles of Cell and Molecular Biology, 1st edition, HarperCollins Publishers.

## PAPER-HCT 2.2. MOLECULAR BIOLOGY

**TOTAL LECTURES: 52HRS** **TOTAL CREDITS: 04**

**UNIT-I: DNA Replication** **07hrs**

Prokaryotic and eukaryotic DNA replication, mechanics of DNA replication, enzymes & accessory proteins in DNA replication. Fidelity of replication, extrachromosomal replicons, Replication of telomere, replication in QX174, M-13, T-odd and even phages, DNA damage and repair mechanisms.

**UNIT-II: Transcription** **07hrs**

Prokaryotic and eukaryotic transcription, RNA polymerases of pro- and eukaryotes, subunits, different sigma factor related to stress, viral infection etc., transcription of mRNA, rRNA and tRNA, initiation, elongation and termination (in pro- & eukaryotes), transcription factors, rho dependent and independent termination, regulatory elements of transcription and mechanisms, transcription activators and repressors.

**UNIT-III: Post-transcriptional Modifications** **07hrs**

Post transcriptional modification of RNA capping, RNA processing, RNA editing, splicing, polyadenylation, structure and function of different types of RNA, RNA transport, 5' capping & 3' end processing and polyadenylation, splicing and editing of RNA, exon shuffling, nuclear export of mRNA, mRNA stability, processing of tRNA and rRNA.

**UNIT-IV: Translation Process** **07hrs**

Prokaryotic and eukaryotic translation machinery, experimental evidences of the mechanisms of prokaryotic and eukaryotic initiation (cap-dependent and IRES mediated), elongation and termination, wobble hypothesis, codon bias, regulation of translation, co- and post-translational modifications of proteins.

**UNIT-V: Control Gene Expression** **06hrs**

Control of gene expression at transcription and translation level: Regulation of phages, viruses, prokaryotic and eukaryotic gene expression, role of chromatin in regulating gene expression and gene silencing, general discussion or snRNAs (snurps, snorps), ribozymes, antisense RNA, siRNA, miRNA, DNase and DNA enzymes.

**UNIT-VI: Nucleic Acids** **06hrs**

Principle and methods, genomic DNA isolation, plasmid isolation, restriction digestion, DNA ligation, and agarose gel electrophoresis, quantification, RNA isolation and purification methods.

**UNIT-VII: Nucleic Acid Analysis Technologies** **07hrs**

PCR principle, procedure, types and applications, cDNA synthesis and cloning, DNA primers, linkers, adapters, cDNA library construction and screening, DNA fingerprinting, chromosome walking and chromosome jumping, RFLP maps, RAPD, micro satellites, SCAR (Sequence characterized amplified region), DNA sequencing methods–principle, types, automated process, next-generation sequencing (NGS), Genomic Editing: Engineered nuclease, meganuleases, ZFN, TALEN and CRISPR.

**UNIT-VIII: Hybridization Techniques** **05hrs**

Principle of hybridization. Southern, Northern, in-situ hybridization, whole genome analysis, DNA microarray, gene mapping and applications, transcriptome and proteome analysis, protein microarrays, advantages and disadvantages of DNA and protein microarrays, role of transcriptomic, proteomic and metabolomic profiles as diagnostic markers. Gibson's Assembly.

**Teaching and Learning Methods**

Didactic lectures or interactive lectures
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Integrated teaching

**References/Textbooks:**


- Michael M. Cox, Jennifer Doudna, Michael O'Donnell. Molecular biology: Principles and Practice 2nd edition. W.H. Freeman Publisher.
- Manuel M Muller. Post Translational modifications of Protein backbones: unique functions, Mechanisms, and Challenges. ACS Publications
- Christopher T. Walsh. Posttranslational Modification of Proteins. Roberts and Company Publishers.
- James D. Watson A. Baker Tania P. Bell Stephen, Gann Alexander, Levine Michael and Losick Richard. Molecular biology of gene, 7th edition, Pearson Education.
- Benjamin Lewin. Genes VI, 6th edition, Oxford University Press.
- David Freifielder. Molecular Biology, 2nd edition, Jones & Bartlett.
- Alberts B., Bray D., Lewis J., Raff M., Roberts K and Watson J.D. Molecular Biology of the cell, 5th edition, Garland Science Inc., New York.
- Brachet J. Molecular Cytology. Academic Press New York
- Celis J.E. Cell Biology: A Laboratory Handbook, 1st edition, Vol I & II Academic Press.
- Dale W.J. and Park F.S. Molecular Genetics of Bacteria, 5th edition, John Wiley & sons ltd., England.
- Despo P., Alison S., William H. Elliott. and Daphne C. Elliott. Biochemistry and Molecular Biology, 6th edition, Oxford University Press.
- Gerald Karp. Cell and Molecular Biology, 6th edition, John Wiley and Sons. Inc.
- Halli K.B. and Hallgrimsson B. Evolution. 4th edition, Jones and Bartlett Publishers, Canada.
- Lodish H., Berk A., Zipursky L., Matsudaira P., Baltimore D. and Darnell J. Molecular cell Biology, 4th edition, W. H. Freeman.
- Pollard T.D. and Earnshaw W.C. Cell Biology, 1st edition, Saunders.
- Wolfe. A. Chromatin structure and function, 3rd edition, Academic press; New York.

## PAPER-SCT 2.3- BIOSTATISTICS AND BIOINFORMATICS

**TOTAL LECTURES: 52HRS** **TOTAL CREDITS: 04**

### SECTION-I: BIOSTATISTICS: 20HRS

**UNIT-I: Fundamentals of Biostatistics** **07hrs**

Basic terminologies, measures of central tendency and dispersion of population sample, sampling methods, variables, parameters, classification of data, frequency distribution, tabulation, graphic and diagrammatic representation, mean, median, mode, GM, HM, quartiles and percentiles, measures of dispersion, range, variance, standard deviation, coefficient of variation, symmetry: measures of skewness and kurtosis.

**UNIT-II: Probability and Distributions** **06hrs**

Concept and probability distribution, normal distribution density curves, applications and statistical tables, concept of significance tests, parametric and nonparametric tests, standard error and confidence intervals.

**UNIT-III: Bivariate Data** **07hrs**

Scatter plot, correlation coefficient ®, properties (without proof), interpretation of r, linear regression, fitting of lines of regression, regression coefficient, coefficient of determination. Hypothesis testing: hypothesis, critical region, and error probabilities, Z-test, 't'-test, Chi-square test for independence, P-value of the statistic, confidence limits, introduction to analysis of variance.

### SECTION-II: BIOINFORMATICS: 32HRS

**UNIT-IV: Collecting and Storing Sequences** **06hrs**

Various file formats for bio-molecular sequences: GenBank, FASTA, GCG, MSF, NBRF-PIR etc., Database searching: Using BLAST, FASTA and other sequence analysis tools to assign homology, BLAST algorithms, various versions of basic BLAST, utilization of these tools for sequence analysis and interpretation of results—online and standalone.

**UNIT-V: Dynamic Programming Algorithm & Phylogenetic tree 07hrs**

Pairwise alignment methods such as Smith-Waterman and Needleman-Wunsch, concepts behind multiple sequence alignment, ClustalW, TCoffee, sequence patterns and profiles: basic concept and definition of sequence patterns, motifs and profiles, various types of pattern representations viz. consensus, regular expression (prosite-type) and profiles, neighbour joining, UPGMA, use of Hidden Markov model (HMM) in assigning homology, advantages and disadvantages of various sequence analysis methods, Bio-python, Biopearl etc.

**UNIT-VI: Introduction to Genomics and Proteomics 07hrs**

NCBI, SRS, biological databases, nucleic acid sequence databases-EMBL, DDBJ, GenBank, primary protein sequence databases: PIR, MIPS, Swiss–PROT, TrEMBL, NRL–3D, composite protein sequence databases: NRDB, OWL, MIPSx, SWISS-PROT+ TrEMBL, secondary protein databases: PROSITE, PRINTS, BLOCKS, PROFILES, Pfam, IDENTIFY, Uniprot, MHCpep, Ensembl, Knowledgebase. Structure classification databases: SCOP, CATH, PDBsum, structural databases: PDB, NDB, MMDB.

**UNIT-VII: Sequence Analysis Methods 06hrs**

Methods, algorithms, tools and applications of pairwise sequence analysis and multiple sequence analysis, phylogenetic analysis, elements of phylogeny, methods of phylogenetic analysis, phylogenetic tree of life, phylogenetic analysis tools-Phylip, ClustalW, Clustal Omega, Multialign, ExPASy, MAFFT,T-COFFEE and COBALT.

**UNIT-VIII: Homology Modeling 06hrs**

Homology modeling, prediction of protein structure from sequences, secondary structure, three- dimensional structure prediction, validation of 3-D structure (Ramchandran plot), molecular modeling: introduction, molecular mechanics, force field, potential energy functions, energy minimization, single point calculations, full-geometry optimization, conformational search, docking, molecular dynamics simulations, molecular modeling packages.

**Teaching and Learning Methods**

Didactic lectures or interactive lectures
Seminars
Guest lectures
Workshops
Journal club
Symposium
Integrated teaching

**References/Textbooks:**


- Ewens W.J. and Grant G.R. Statistical Methods in Bioinformatics: An Introduction. Springer-Verlag.
- Devore J.L. Probability and Statistics, 5th edition, Thomson Asia.
- Paul G. Hoel, Sidney Port, and Charles Stone. Introduction to Statistics, Houghton Mifflin.
- Richard A. Johnson. Miller & Freund's Probability and Statistics for Engineers, 7th edition, Prentice Hall.
- Chung Kai Lai and Farid AitSahlia. Elementary Probability Theory with Statistical Processes (Student Edition) Springer International.
- Gupta S.C. and Kapoor. V.K. Fundamentals of Mathematical Statistics: Sultan Chand & Sons, Saurabh Jain.
- Claverie J.M. and Notredame C. Bioinformatics for Dummies, 2nd edition, Wiley Editor.
- Letovsky S.I. Bioinformatics. Kluwer Academic Publishers.
- Baldi P. and Brunak S. Bioinformatics, 2nd edition, The MIT Press.
- Setubal C. and Meidanis J. Introduction to Computational Molecular Biology, 1st edition, PWS Publishing Co., Boston.
- Lesk A.M. Introduction to Bioinformatics, 5th edition, Oxford University Press.
- Rastogi S.C., Mendiratta N. and Rastogi P. Bioinformatics: Methods & Applications (Genomics, Proteomics and Drug Discovery), 4th Edition, PHI Learning.
- Fogel G.B. and Corne D.W. Evolutionary Computation in Bioinformatics, 1st edition, Morgan Kaufmann.
- Patterson B.K. Techniques in Quantification and Localization of Gene Expression, Birkhauser; 2000 edition.
- Mont D.W. Bioinformatics: Sequence and Genome Analysis, 2nd revised edition, Cold Spring Harbor Laboratory Press, U. S.
- Pierre Baldi and Soren Brunak. Bioinformatics: The Machine Learning Approach (Adaptive Computation and Machine Learning series), 2nd edition, A Bradford Book

## PAPER-OET 2.4. NUTRITIONAL IMMUNOLOGY

**TOTAL LECTURES: 52HRS** **TOTAL CREDITS: 04**

**UNIT-I: Introduction to Nutritional Immunology** **01hrs**

**UNIT-II: Basic Concepts in Nutrition** **03hrs**

Basic terms used in nutrition, relationship between food, nutrition and health, functions of foods; basic food groups and concept of balanced diet, factors affecting nutritional requirements, nutraceutical aspects of food..

**UNIT-III: Nutrients** **10hrs**

Energy, units of energy, concept of energy balance (energy imbalances-excess & deficiency-acute and chronic, physiological adaptations to over and under nutrition), macronutrients-carbohydrates and dietary fiber, lipids, proteins, micronutrients-vitamins (fat & water soluble) and minerals (macro- and trace minerals) and water.

**UNIT-III: An Overview of immune system** **06hrs**

Overview of immune system, immune mechanisms and physical barrier to infectious agents, immune disorders (inflammation, allergy & autoimmunity), immune system training (exercise, nutrition and immunization).

**UNIT-IV: Nutrition and immune system** **18hrs**

Role of nutrition in the immune system function, Macronutrients and immune system, micronutrients and immune system, probiotics-prebiotics-synbiotics and immunity, food allergy and immune system, food toxicology & immune system, ayurvedic herbs/ phytochemicals/nutraceuticals and immune system, immunonutrition and antinutritional factors of food.

**UNIT-V: Gut microbiome and immune system** **04hrs**

Gut microbiome, gastrointestinal immune system-gut associated lymphoid system (GALT), importance of gut health.

**UNIT-VI: Clinical Nutrition/Dietetics** **06hrs**

Malnutrition-under-nutrition and over-nutrition; immunometabolic disorders, concept of preventive and therapeutic nutrition; nutritional support for different clinical situations, critical illness and nutritional assessment.

**UNIT-VII: Nutrition and Immune function during life cycle 04hrs**

Maternal nutrition and immunity, nutrition and immunity of infants and children, nutrition and immunity in the elderly and geriatric.

**Teaching and Learning Methods**

Didactic lectures or interactive lectures
Seminars
Guest lectures
Workshops
Journal club
Symposium
Integrated teaching

**References/Textbooks**


- Srilakshmi B. Nutritional Science, 2nd edition New Age International Publishers.
- Chatterjee M.N. and Rana Shinde. Textbook of Medical Biochemistry, 7th edition, Jaypee Brothers.
- Rama Rao A.V.S. A Textbook of Biochemistry, 9th edition, UBS Publisher's Distribution Pvt. Ltd.
- Gordon M. Wardlaw and Margaret Kessel. Perspectives in Nutrition, 5th edition, Mc Graw Hill Publication.
- Vincent Hegarty. Decisions in Nutrition - Human Nutrition, 11th edition, Elsevier Publications.
- Srilakshmi B. Dietetics, 5th edition, New Age International Publishers.
- Eric Gershwin M, Penelope Nestel, Carl L. Keen. Handbook of Nutrition and Immunity. Humana Press.
- Fuller R., Perdigon G. (eds.). Gut flora, nutrition, immunity, and health. Blackwell publication.
- L. Kathleen Mahan, Janice L Raymond. Krause's Food & Nutrition Therapy. Krause's Food & the Nutrition Care Process. 14th edition. Saunders Publishing.
- Janice L Raymond, Kelly Morrow. Krause and Mahan's Food & the Nutrition Care Process. 15th edition. Saunders Elsevier Publishing.
- Maryam Mahmoudi, Nima Rezaei. Nutrition and Immunity. Springer International.
- Prakash Shetty. Nutrition, Immunity and Infection. CABI publishing.
- Roy Fuller, Gabriela Peridigón. Gut Flora, Nutrition, Immunity and Health-Wiley-Blackwell Publishing.
- Vishwanath S. Introduction to Clinical Nutrition. 3rd Edition, CRC Press publishing.
- Michael J. Gibney, Ian A. Macdonald, Helen Roche. Nutrition and Metabolism (The Nutrition Society Textbook Series), 2nd Edition. John Wiley & Sons.

## PAPER-PRT 2.5. PRACTICAL: CELL BIOLOGY & MOLECULAR BIOLOGY

**TOTAL LECTURES: 52HRS** **TOTAL CREDITS: 04**

### CELL BIOLOGY

1. Microscopy, micrometry, microtomy.
2. Study of mitosis and meiosis in plants and animals.
3. Preparation of mitotic chromosomes and karyotyping.
4. Staining techniques: Staining blood cells, total count and differential count.
5. Histology and differential staining (cellular organelles and components).
6. Brush border membrane.
7. Studies on nerve impulses.
8. Determination of osmotic fragility of RBC.
9. Isolation of peroxisomes and determination of catalase assay.
10. Isolation of mitochondria and Determination of succinate dehydrogenase activity.

### MOLECULAR BIOLOGY

1. Isolation of bacterial, fungal genomic DNA, RNA, Plasmid and Quantification.
2. Electrophoresis Techniques: Agarose gel, Formaldehyde and PAGE.
3. PCR techniques
4. Preparation of competent cells from DH5α cells.
5. Restriction digestion
6. Ligation and Bacterial Transformation.
7. B-galactosidase assays.
8. Gibson's Assembly
9. Southern Blotting
10. Northern Blotting

## PAPER-PRT 2.6. PRACTICAL: BIOSTATISTICS AND BIOINFORMATICS & NUTRITIONAL IMMUNOLOGY

**TOTAL LECTURES: 52 HRS** **TOTAL CREDITS: 04**

### BIOSTATISTICS AND BIOINFORMATICS

1. Study of sampling techniques using biological data: Mean, Median, Mode, Mean deviation, Standard deviation, Variance, Coefficient of Variance (using MS. Excel) Graphical representation of biological data (using MS. Excel) and Chi-square test
2. Introduction to Genomic Database - EMBL, DDBJ, GENBANK
3. Introduction to Protein Database - PIR, SWISS-PROT, PRINTS, PFAM
4. Structure of database entry/submission.
5. Search engines: Entrez, SRS.
6. Analysis of biological data using: BLAST, FASTA, Clustal-W, Treeview, Phylip.
7. Primer designing/analysis using Primer3/Oligo/ApE/SnapGene
8. Automated gene prediction using any 3 tools.
9. Vector construction using software.
10. Protein structure visualization using Rasmol/pyMol

### NUTRITIONAL IMMUNOLOGY

1. Assessment of nutritional status, planning balanced diets for normal and therapeutic nutrition.
2. Formulation of nutrient rich foods.
3. Assessment of nutritional quality of food.
4. Estimation of BMI and other nutritional status parameters
5. Proximate analysis of foods; calorific value of foods; TSS; pH; acidity; estimation of browning intensity; determination of vitamin C and beta-carotene, sugars; estimation of calcium, phosphorus and iron; anti-nutritional factors in foods.
6. Test of adulteration,, Fat, SNF, ash, Fat protein, AC, FFATBA value, Lactose contain, Solubility Standardization numerical based on Pearson’s squire
7. Identification of food sources for various nutrients using food composition tables.
8. Estimation of crude fiber/dietary fiber content in cereals and their products
9. Estimation of anthocyanin in food sample
10. Preparation and evaluation of probiotic/prebiotic foods

# SEMESTER-III

## PAPER-HCT 3.1- STEM CELLS AND REGENERATIVE MEDICINE

**TOTAL LECTURES: 52HRS** **TOTAL CREDITS: 04**

**UNIT-I: Human development -From Embryo to Cell Lineage Determination 06hrs**
Fertilization, embryogenesis, gastrulation, germ layers, inner cell mass, organogenesis.

**UNIT-II: Introduction to Cells 03hrs**
Structure and functions of cells, components of cell, different types of cells and specialized cells.

**UNIT-III: Introduction to Stem Cell Biology 10hrs**
Properties of stem cells, different types of stem cells, plasticity of stem cells, sources and derivation of stem cells, classification of stem cells, stem cell niche, Molecular basis of pluripotency, cell cycle regulators and mechanisms of self-renewal in stem cells, differentiation of stem cells, stem cells epigenetics and cancer stem cells.

**UNIT-IV: Applications of Stem Cells 10hrs**
Potential and limitations of stem cells, stem cells in basic research, stem cells in tissue engineering, stem cells in toxicological studies/drug screening, in-vivo organ regeneration, therapeutic applications, Ethical and regulatory issues in the use of stem cells.

**UNIT-V: Principles of Regenerative Medicine 10hrs**
Regenerative medicine, recent advances in regenerative medicine, cell therapy, cellular reprogramming, tissue engineering and recent advances in tissue engineering.

**UNIT-VI Advanced Technologies in Stem Cell Research and Applications 10hrs**
Introduction to cell culture facility, cell culture basics, derivation of stem cells from various sources, characterization of stem cells, stem cells culture system, maintenance and cryopreservation of stem cells, differentiation of stem cells, cellular reprogramming, organoid culture, 3D tissue culture, gene therapy.

**UNIT-VII: Regenerative Pharmacology 03hrs**
Introduction to regenerative pharmacology, Applications of regenerative pharmacology, regenerative pharmacology and stem cells.

**Teaching and Learning Methods**

Didactic lectures or interactive lectures
Seminars
Guest lectures
Workshops
Journal club
Symposium
Integrated teaching

**References/Textbooks**


- Ian Freshney R. Culture of Animal Cells. A manual of basic technique and specialized application, 7th edition, Wiley-Blackwell.
- Pollack R. Readings in Mammalian cell culture. 2nd edition, Cold Spring Harbour Laboratory.
- Anthony Atala & Robert Lanza. Handbook of Stem Cell, 2nd edition. Academic Press.
- Lanza R, Weissman I, Thomson J, Pedersen R, Hogan B, Gearhart J, Blau H, Melton D, Moore M, Verfaillie C, Thomas ED and West M. Handbook of Stem Cells. Volume 1 & 2. Academic Press.
- Stewart Sell. Stem Cells Handbook, 2nd edition. Humana Press.
- Arlene Y. Chiu and Mahendra S. Rao. Human Embryonic Stem Cells. Humana Press.
- Indumathi S. Stem Cell Therapy for Organ Failures. Springer Verlag.
- Jonathan M. W. Slack. The Science of Stem Cells. Wily Blackwell
- Zipori D. Biology of Stem Cells and the Molecular Basis of the Stem State. Humana Press
- Warburton D. Stem Cells, Tissue Engineering and Regenerative Medicine. World scientific publishing.
- Hong CC, Ada S. AO & Hao J. Chemical Biology in Regenerative Medicine-Bridging Stem Cells and Future Therapies. Wiley
- Kursad Turksen. Cell Biology and Translational Medicine: Volume 1-Stem Cells in Regenerative Medicine Advances and Challenges-Springer International
- Zavan B and Bressan E. Dental Stem Cells: Regenerative Potential. Humana Press
- Essam M. Abdelalim. Recent Advances in Stem Cells- From Basic Research to Clinical Applications. Humana Press
- Charles J. Malemud, & Eben Alsberg. Mesenchymal Stem Cells and Immunomodulation. Humana Press
- Krishnarao Appasani & Raghu K. Appasani. Stem Cells & Regenerative Medicine-From Molecular Embryology to Tissue Engineering. Humana Press

- Phuc Van Pham & Achim Rosemann. Safety, Ethics and Regulations. Stem cells in clinical applications. Humana Press.
- Alain A. Vertès, Nasib Qureshi, Arnold I. Caplan, Lee E. Babiss. Stem cells in Regenerative Medicine Science-Regulation and Business Strategies. John Wiley & Sons
- George J. Christ & Karl-Erik Andersson. Regenerative Pharmacology. Cambridge University Press
- Ranjna C. Dutta and Aroop K. Dutta. 3D Cell Culture: Fundamentals and Applications in Tissue Engineering and Regenerative Medicine. Pan Stanford Publishing.

## PAPER-HCT 3.2- CANCER BIOLOGY AND PRECISION MEDICINE

**TOTAL LECTURES: 52HRS** **TOTAL CREDITS: 04**

**UNITI: Introduction to Cancer Biology** **04hrs**
Defining cancer, hallmarks of cancer, type of cancer, pathogenesis of cancer, histological types and variants of carcinoma

**UNIT-II: Cellular Basis and Cell Signaling of Carcinogenesis** **07hrs**
Cell cycle regulation and the importance of apoptosis, cell immortalization and tumorigenesis, growth factors and their receptors, other elements of cell signaling

**UNIT-III: Causes of Cancer and Multi-Step Carcinogenesis** **07hrs**
Cellular oncogenes, tumor suppressor genes, mutation and cancer, viral causes of cancer. The importance of DNA repairs systems. the main stages of carcinogenesis- an overview, early steps characterized in colon cancer, cellular principles of invasion and metastasis, stromal micro-environment and carcinogenesis

**UNIT-IV: Other Genetics aspects of Cancers and Chemotherapy** **08hrs**
Genetic instability of tumor cells, alteration of genetic mechanisms in cancer, inherited predisposition to cancer, principal applications of genetic testing in cancer. History of cancer chemotherapy, drugs used in cancer chemotherapy role of chemotherapy in cancer, mechanism of cancer chemotherapy, various facets of cancer chemotherapy, side effects of chemotherapy, Principles of combination therapies and drug resistance

**UNIT-V: Modern Treatment Modalities for Cancer** **08hrs**
Tumor immunology and immunotherapy, novel approaches arising from cancer cell biology

**UNIT-VI: Clinical Applications of Precision medicine - Precision Health** **08hrs**
Reviews knowledge and applications of precision medicine diagnosis and treatment considerations of concepts in monogenic diseases and complex diseases. Important concepts include susceptibility genomics, diagnostic approaches, laboratory testing, and treatment considerations for genomic medicine, diseases include cystic fibrosis, monogenic diabetes, Marfan syndrome, Huntington's disease, as well as cardiovascular, metabolic, neurologic, mental health disorders and addiction, and others.

**UNIT-VII: Clinical applications of Precision Medicine Oncology 06hrs**

Reviews knowledge and clinical applications of precision medicine approaches and technologies in diagnosing or treating cancer, including the genetics of cancer, targeted cancer treatments, somatic testing, current and future research and clinical trends and other information

**UNIT-VIII: Patient Education & Communication on Precision Medicine 04hrs**

Guidance on patient education and communication about genomic medicine information, including informed consent, patient education, documentation, future trends and ethical, legal and social issues.

**Teaching and Learning Methods**

Didactic lectures or interactive lectures
Seminars
Guest lectures
Workshops
Journal club
Symposium
Integrated teaching

**References/Textbooks:**


- McKinnell R.G., Parchment R.E., Perantoni A.O., Barry Pierce G. and Damjanov I. The Biological Basis of Cancer. 2nd Edition, Cambridge University Press.
- Weinberg R.A. The Biology of Cancer. 2nd edition, Garland Science.
- Pelengaris S. and Khan M. The Molecular Biology of Cancer. 2nd edition, Wiley-Blackwell Publication.
- Malcolm R. Alison. The Cancer Handbook. Nil edition, Palgrave.
- Blair G.E. Virology: A Practical Approach. Maly B.W.J. Ed, IRL l Press, Oxford.
- Dummock N.J. and Primrose S.B. Introduction to Modern Virology. 1st edition, Wiley-Blackwell Scientific Publications, Oxford.
- David P. Clark, and Nanette J. Pazdernik. Biotechnology-Applying genetic revolution. Elsevier, New York.
- Geoffrey M. Cooper and Robert E. Hausman. The Cell - A molecular Approach. 6th edition, Sinauer Associates, Inc.

## PAPER-SCT 3.3. FUNDAMENTAL CONCEPTS OF PHARMACOLOGY AND TOXICOLOGY

**TOTAL LECTURES: 52HRS** **TOTAL CREDITS: 04**

**UNIT-I: General Pharmacology** **02hrs**
Introduction to general pharmacology:

**UNIT-II: Pharmacokinetics** **04hrs**
Introduction about the branches of pharmacokinetics, drug absorption, distribution, metabolism and exertion.

**UNIT-III: Pharmacodynamics** **06hrs**
General introduction about pharmacodynamics, FDC, general mechanism of drug action, receptor pharmacology, drug interactions.

**UNIT-IV: Neuropharmacology** **06hrs**
Antiepileptic drugs, local anesthetics and general anesthetics

**UNIT-IV: psychopharmacology** **04hrs**
Antipsychotics, antidepressants, sedative hypnotics

**UNIT-IV: Cardiovascular Pharmacology** **06hrs**
Antihypersensitive drugs, antianginal drugs, cardiotonics, coagulants and anticoagulants

**UNIT-IV: Chemotherapy** **08hrs**
General principles of chemotherapy, drugs used in tuberculosis, antimalarial drugs, anti-HIV drugs, miscellaneous- antifungal, anti-leprosy, drugs used in amoebiasis, Kala-Azar, enteric Fever

**UNIT-V: Toxicology** **08hrs**
Toxicity studies-acute toxicity & chronic toxicity, general principles of treatment of poisoning, heavy metal toxicity and chelating agents, management of over dosage with commonly used therapeutic agents.

**UNIT-VIII: Clinical Pharmacology and Rational Drug Use** **08hrs**
Essential drug concept, drugs used in children and pregnancy, drugs in geriatrics, pharmacovigilance, therapeutic drug monitoring, drug resistance, ADR monitoring and reporting, clinical use of drugs in hepatic and renal failure, GCP, GLP, preclinical studies and clinical trials.

**Teaching and Learning Methods**

Didactic lectures or interactive lectures
Seminars
Guest lectures
Workshops
Journal club
Symposium
Integrated teaching

**References/Text Books**


- Goodman and Gilman. Manual of Pharmacology and Therapeutics, 2nd Edition, McGraw Hill Education Publisher.
- Laurence L. Brunton, John S. Lazo and Keith L. Parker Goodman and Gilman's The Pharmacological Basis of Therapeutics, 11th edition, McGraw-Hill Education / Medical.
- Ghosh M.N. Fundamentals of Experimental Pharmacology, 7th edition , Hilton & Company
- Bikash Medhi and Ajay Prakash, Advanced Pharmacology , 5th edition, Pharma Med Press
- Tripathi KD. Essential of Medical Pharmacology, 8th edition, Jaypee Brothers Medical Publishers
- Laurence D.R., Bennett P.N. and Morris J. Brown. Clinical Pharmacology, 8th edition Churchill Livingstone. Shargel L.S. and Wu-Pong A. Applied Bio-pharmaceutics & Pharmacokinetics, 5th edition, McGraw-Hill Medical.
- Bertram G. Katzung. Basic and Clinical Pharmacology, 14th edition, McGrow-Hill medical.
- Notari R.E. Bio-pharmaceutics and Pharmacokinetics: An Introduction, 2nd edition, M. Dekker.
- Gibaldi M. Biopharmaceutics and clinical pharmacokinetics, 4th edition, Pharma Book Syndicate.
- Wagner J.G. Bio-pharmaceutics and Relevant Pharmacokinetics, Drug Intelligence Pubons.
- Niazi S.K. Textbook of Bio-pharmaceutics and Clinical Pharmacokinetics, BSP Books Private Limited.
- Schnitzer R.J. and Frank Hawking. A text book of Chemotherapy, Kindle Edition, Academic Press.
- ICH Guidelines.
- OECD Guidelines.
- USFDA Guidelines.
- Schedule Y

## PAPER-OET 3.4- RESEARCH METHODOLOGY & REGULATORY AFFAIRS

**TOTAL LECTURES: 52HRS** **TOTAL CREDITS: 04**

**UNIT-I: Introduction and Techniques in Research Methodology 07hrs**

Definition and objectives, types of research, descriptive research, experimental method of research, inter and multi-disciplinary research, design of research: basic principles of experimental designing strategies, literature search & formulation of research project, interview, the questionnaire & the case study method v/s survey methods, sampling techniques: sampling design, random sample and complex random sample design and data collection.

**UNIT-II: Research Report/Paper Writing 08hrs**

Types of reports, steps in report writing, meaning and techniques of interpretations, dissertation/ thesis writing, introduction, review of literature, materials and methods, experimental results, discussion/interpretation of results in the light of earlier research findings, summary and bibliography, application of information technology in research, digital learning, statistical analysis using computer packages/software: Minitab, SPSS etc.

**UNIT-III: Bioethics 07hrs**

Historical perspectives and introduction to bioethics, principle of essentiality, informed consent, confidentiality, minimization of risk accountability and responsibility, responsible conduct of research, ethics related to clinical trials - drug trials, vaccine trials & medical devices, surgical procedures, use of radioactive materials, organ transplantation and stem cell therapy, legal and socioeconomic impact of the products and techniques in biotechnology, bioethics in genetic engineering, ethical issues in healthcare, biopiracy and ethical conflicts.

**UNIT-VII: Biosafety and Genetically Modified Organisms 08hrs**

Historical background introduction to biological safety cabinet's primary containment for biohazards biosafety levels, biosafety levels of specific microorganisms, recommended biosafety levels for infectious agents and infected animals' biosafety guidelines, government of India. Definition of GMOs & LMOs, Roles of institutional biosafety committee: RCGM GEAC etc. for GMO applications in food and agriculture environmental release of GMOs, risk analysis, risk assessment, risk management and communication, overview of national regulations and relevant international agreements.

**UNIT-IV: Regulatory Affairs** **08hrs**

Historical perspective, ethical issues, ICG-GCP guidelines, Schedule Y, regulatory framework and guidelines for responsible conduct of research on human subject, review processes, institutional committees, ethics, biosafety & animal ethics committees and composition, review procedures, ICMR-DBT guidelines for biomedical research, and regulatory guidelines of biomedical research and applications: a global scenario.

**UNIT-V: Introduction to IPR** **06hrs**

Intellectual property rights, origin of the patent regime early patents act & Indian pharmaceutical industry, types of patents, patent requirements, application preparation filing and prosecution, patentable subject matter industrial design, protection of GMO's IP as a factor in R&D, IP's of relevance to biotechnology and few case studies.

**UNIT-VI: Patent Filing Procedures** **08hrs**

National & PCT filing procedure, time frame and cost, status of the patent applications filed precautions while patenting, disclosure/non-disclosure, financial assistance for patenting, introduction to existing schemes patent licensing and agreement patent infringement meaning, scope, litigation, case studies.

**Teaching and Learning Methods**

Didactic lectures or interactive lectures
Seminars
Guest lectures
Workshops
Journal club
Symposium
Integrated teaching

**References/Textbooks**


- Gupta S.P. Statistical Methods. Sultan Chand & Sons.
- Kothari C.R. Research Methodology (Method and Techniques). 2nd revised edition, K B center.
- Santosh Gupta. Research Methodology and Statistical Techniques, Laurier Books, Limited.
- Krishan Prasanth B., Vlarmathi S., Aravindha Babu N. and Deva Malika MS. Guide to Research Methodology and Biostatistics CBS Publishers and Distributors.

- Gupta P.K. Elements of Biotechnology, Rastogi Publications.
- Singh B.D. Textbook of Biotechnology, Kalyani Publishers.
- ICH Guidelines
- Schedule Y
- OECD Guidelines
- US FDA Guidelines
- ICMR Guidelines
- DBT Guidelines
- Fleming D.O. Biological Safety Principles and Practices 3rd edition, American Society for Microbiology Publisher
- Gupta P.K. Elements of Biotechnology, Rastogi Publications
- Deepa Goel and Shomini Parashar. IPR, Biosafety and Bioethics, 1st edition, Pearson.

## PAPER-PRT 3.5. PRACTICAL: STEM CELLS AND REGENERATIVE MEDICINE & CANCER BIOLOGY AND PRECISION MEDICINE

**TOTAL LECTURES: 52HRS** **TOTAL CREDITS: 04**

### STEM CELLS AND REGENERATIVE MEDICINE

1. Sterilization techniques involved in the cell culture
2. Handling cell culture equipment and laboratory maintenance
3. Preparation of cell culture media and buffers
4. Development of primary cells culture
5. Continuous suspension cell line Culture and Passaging
6. Continuous adherent cell line Culture and Passaging
7. Identification of contamination in cell culture
8. Trypan Blue Dye exclusion method - cell counting and viability
9. MTT assay
10. Cryopreservation and retrieval of cells

### CANCER BIOLOGY AND PRECISION MEDICINE

1. Sample collection of various hematological and clinical pathological investigations, anti-coagulants.
2. Theoretical aspects of Hb-estimation, Blood indices, ESR, L.E. cell, reticulocyte, normal Values in hematology.
3. Immuno-histochemical staining (oncogene expression).
4. Study of malignant and benign tumor (diagrammatic).
5. Study of metastasis and angiogenesis (diagrammatic).
6. Study of cancer cell behavior in culture medium.
7. Study of cancer treatment methods (chemotherapy, radiation therapy and immunotherapy).
8. In vitro assay of drugs, predictive test for anticancer drugs.
9. Case study of treatment of any disease using gene therapy.
10. Case study of treatment of any disease using stem cell therapy.

## PAPER-PRT 3.6. PRACTICAL: FUNDAMENTALS OF PHARMACOLOGY AND TOXICOLOGY & RESEARCH METHODOLOGY AND REGULATORY AFFAIRS

**TOTAL LECTURES: 52HRS** **TOTAL CREDITS: 04**

### FUNDAMENTALS OF PHARMACOLOGY AND TOXICOLOGY

**UNIT-I: Experimental Pharmacology**

1. Maintenance of laboratory animals as per CPCSEA guidelines
2. Preparation of standard solution: Ringer solution, Tyrode solution, Krebs & normal saline solution
3. Plot the dose response cure of Acetylcholine (Ach) & to study the effects of increasing doses of acetylcholine (Ach), modification of response of Ach by anticholinesterase (e. g. physostigmine) & drug antagonism by Vecuronium on frog's rectus
4. Study the effects of drugs on Rabbit's eye
5. Dog BP experiment video
6. Anticonvulsant effect of drugs by MES and PTZ method

**UNIT- II: Clinical Pharmacy**

1. Dosage forms, preparation and dispensing
2. Dosage calculations

**UNIT – III: Clinical Pharmacology**

1. Pharmacovigilance and ADR reporting

**UNIT- IV: Chemical Pharmacology**

1. Identification of unknown pharmacological substances

## RESEARCH METHODOLOGY AND REGULATORY AFFAIRS

1. Access to various scientific journals and data retrieval.
2. Preparation and presentation of scientific posters for conferences using PowerPoint.
3. Preparation of manuscript for publication and plagiarism check.
4. Preparation of informed consent for the experiment.
5. To prepare an outline of clinical trial proforma and preparation of documents for the ethical issues of health products.
6. Preparation of ICH-GCP guidelines and Schedule Y.
7. Preparation of India regulatory of GMP grade laboratory.
8. Preparation of guideline for Institutional ethical committee (IEC), Animal Ethics Committee (AEC) and Biosafety committee for Institute (IBSC).
9. Procedure and filing of patent application.
10. Case study on the trademark, copyright, industrial design, geographical indication.

# SEMESTER-IV

## PAPER-HCT 4.1- BIOMEDICAL APPLICATIONS OF NANOTECHNOLOGY

**TOTAL LECTURES: 52HRS** **TOTAL CREDITS: 04**

**UNIT-I: Introduction** **07hrs**

Importance of nanotechnology-history of nanotechnology-opportunity at the nano scale-length and time scale in structures-energy landscapes-interdynamic aspects of intermolecular forces -classification based on the dimensionality- nanoparticles-nanoclusters-nanotubes-nanowires and nanodots- semiconductor nanocrystals-carbon nanotubes- Influence of nano structuring on mechanical, optical, electronic, magnetic and chemical properties

**UNIT-II: Characterization of Nanomaterials** **07hrs**

X-ray diffraction, thermal analysis methods, differential thermal analysis and differential scanning calorimetry, spectroscopic techniques, UV-Visible spectroscopy, IR spectroscopy, microwave spectroscopy, Raman spectroscopy, electron spin resonance spectroscopy, NMR spectroscopy, particle size characterization: zeta potential measurement, particle size analysis, x-ray photoelectron spectroscopy,

**UNIT-III: Nanotechnology and Imaging Techniques** **06hrs**

Fundamentals of the technique's experimental approaches and data interpretation applications/limitations of optical microscopy scanning electron microscopy, transmission electron microscopy, atomic force microscopy, scanning tunneling microscopy, Bio-imaging: Radiography (X-ray), MRI, CT, Fluroroscopy, Endoscopy, Ultrasound Echocardiography, Electroencephalography, Magentoencephalography, PET, SPECT and Biosensors.

**UNIT-IV: Bio-Nanotechnology** **06hrs**

Advances in nanobiotechnology, bio-nanomachines in action. Molecular recognition & cellular communication, current research & future aspects, DNA nanomechanical devices.

**UNIT-V: Modern Biomaterials** **06hrs**

Proteins, Nucleic acids, lipids, polysaccharides, natural bio-nano machinery, protein folding, self-assembly and self- organization, molecular recognition and flexibility.

**UNIT-VI: Advances in Biomolecular Design** **05hrs**

Molecular modeling and biomolecular structure determination, DNA-Protein nanostructures, DNA directed immobilization, DNA gold nanoparticles conjugates-chip based DNA detection assays, microarray technologies, protein microarrays, luminescent quantum dots for biological labeling, emerging materials.

**UNIT-VII: Advances in Functional Aspects of Bio-nanotechnology 05hrs**

Biomolecular motors, biomolecular sensing, information driven nano-assembly, energetics, chemical transformation, regulation, bio-nanotechnology- future capabilities, nanomedicine today, DNA computers, hybrid materials, artificial life and biosensors.

**UNIT-VIII: Nanotechnology in Biomedical Industry 10hrs**

Nanoparticles and microorganism biosensors- bio-receptors and their properties biochips- integrated nanosensor networks for detection and response- DNA based biosensors and diagnostics, natural nanocomposite systems; spider silk, bones, shells nano-materials in bone substitutes and dentistry implants and prosthesis tissue engineering neuroscience neuro electronic interfaces nanorobotics photodynamic therapy protein engineering nano-sensors in diagnosis drug delivery-cancer therapy and other therapeutic applications.

**Teaching and Learning Methods**

Didactic lectures or interactive lectures
Seminars
Guest lectures
Workshops
Journal club
Symposium
Integrated teaching

**References/Textbooks**


- Chattopadhyay K.K. and Banerjee A.N. Introduction to Nanoscience and Nanotechnology. Prentice hall India learning private limited.
- Ramachandra Rao M.S. and Shubhra Singh. Nanoscience and Nanotechnology: Fundamentals to Frontiers. Wiley.
- Asim K. Das and Mauhua Das. An Introduction to Nanomaterials and Nanoscience. CBS Publishers.
- Paras N. Prasad. Introduction to Nanomedicine and Nano bioengineering. Wiley.
- Thomas J. Webster. Nanomedicine technologies and applications. 1st edition. Woodhead Publishing.
- Robert A. and Freitas Jr. Nanomedicine books series. Nanomedicine Vol. I, Landes, Austin, Tx,
- Zhang M. Nanomedicine A Systems Engineering Approach 2009 edition, Pan Stanford Publisher.

- Reisner D.E. Bio-nanotechnology: Global Prospects. 1st edition, CRC Press.
- Kim E. Barrett, Susan M. Barman, Scott Boitano and Heddwen L. Brooks. Ganong's Review of medical Physiology, 25th edition, McGraw-Hill Education / Medical.
- Ethical Guidelines for Biomedical Research on Human Subjects, Indian Council of Medical Research, New Delhi.

## PAPER-HCT 4.2- INTRODUCTION TO OMICS TECHNOLOGIES AND APPLICATIONS

**TOTAL LECTURES: 52HRS** **TOTAL CREDITS: 04**

**UNIT-I: Genomics** **06hrs**

Sanger sequencing-principle, methodology and applications, history of genome sequencing, human genome sequencing project; Analysis of gene expression-qPCR, northern blot, southern blot; transcriptome profiling; DNA microarrays, copy number variation, sequence repeats, SNV, haplotype, and their relevance in diseases.

**UNIT-II: Genes and Genomes** **08hrs**

Gene-eukaryotic and prokaryotic gene structure, genome databases, coding regions (genes) and non-coding regions (intergenic sequences), gene and related sequences– NTS, ETS and ITS, 3' UTR, 5' UTR, pseudogenes, repeat sequences: a) interspersed repeats: LINES, SINES, LTR elements; SINES types: ALU elements, MIR, MIR3; b) tandem repeats: transposons; c) microsatellites, genetic mapping, physical mapping (contig maps, restriction maps, DNA sequence maps, FISH), molecular markers for genome analysis-restriction enzyme sites, EST, STS, microsatellites.

**UNIT-II: Metagenomics and Population Genomics** **08hrs**

Overview of metagenomics principles, microbial and ecological aspects underlying metagenomic experiments, applications and limitations of metagenomics, differences between metagenomics and single-cell genomics, definition and principle of population genomics, difference between metagenomics and population genomics, applications of population genomics.

**UNIT-III: Epigenomics** **06hrs**

Introduction and overview to epigenomics, chip-seq technology, miRNA, siRNA and piRNSs, DNA methylation, HATs and HDACs in the context of gene expression regulation, chromatin topology analysis, challenges of epigenomics assessment.

**UNIT-IV: Transcriptomics** **05hrs**

Introduction to transcriptomics, overview of non-coding RNAs and iCLIP, ScRNA- seq, coding RNA and bulk, metatranscriptomics, small RNA, ribosome profiling assembly and annotation.

**UNIT-V: Proteomics** **05hrs**

Introduction and history of proteomics, quantitative proteomics interaction proteomics, organellar proteomics, ubiquitome, biomarker analysis and activity-based protein profiling for drug development.

**UNIT-VI: Phosphoproteomics** **04hrs**

Extractions of proteins; enrichment of phosphopeptides using TiO2, mass spectrometric analysis of phosphopeptide enriched samples, Mass Spectrometry-Molecular networking.

**UNIT-VII: Metabolomics** **04hrs**

Metabolomics-an overview, basic sample preparation strategies-extraction, derivatization, workflow for lipidomics, introduction to mass spectrometry and modes of data acquisition, data repositories, targeted vs untargeted metabolomics; development of targeted assays for small molecules.

**UNIT-VIII: Integrated OMICS Data Analysis** **06hrs**

Proteogenomic data analysis using integrative genomics viewer; biological interpretation of OMICs data, gene set enrichment analysis, pathway analysis, network analysis and introduction to Artificial Intelligence.

**Teaching and Learning Methods**

Didactic lectures or interactive lectures
Seminars
Guest lectures
Workshops
Journal club
Symposium
Integrated teaching

**References/Textbooks**


- Brown T.A. Gene cloning and DNA analysis: An introduction.7th edition, Wiley-Blackwell.
- Green M.R. and Sambrook J. Molecular cloning - A laboratory manual. 4th edition, Cold Spring Harbor Laboratory Press.
- Karp G. Cell and Molecular Biology: Concepts and Experiments, 7th edition. John Wiley & Sons.
- Lodish H., Berk A. and Kaiser C.A. Molecular cell biology. 6st edition, W. H. Freeman publisher.
- Miller K. and Levine J.A. Textbook of Molecular Biology. 2nd edition, Pearson publisher.
- Wilson K. and Walker J. Principles and techniques of biochemistry and molecular biology. 7th edition. Cambridge University Press.
- Baxevanis A.D, and Ouellette BFF0. Bioinformatics A practical guide to the analysis of genes and proteins. 3rd edition, Wiley.
- Fan T.W., Lane A.N. and Higashi R.M. The handbook of metabolomics, Humana Press.
- Gross J. H. Mass spectrometry - A textbook, 1st edition, Springer.
- Kulkarni S. and Pfeifer J.A. Text book of Clinical genomics, 1st edition, Academic Press.
- Leung H.C.E. Integrative proteomics. 1st edition, In-Tech publisher.
- John C. Lindon, Jeremy K. Nicholson and Elaine Holmes. The handbook of metabonomics and metabolomics. 1st edition, Elsevier science.
- Primrose S.B. and Twyman R.M. Principles of gene manipulation and genomics, 7th edition, Oxford.
- Reece R.J. Analysis of genes and genomes. 1st edition, John Wiley & Sons Ltd.
- Simpson R.J. Proteins and proteomics: A laboratory manual, Lab manual edition, Cold Spring Harbor Laboratory Press.

## PAPER-PRT.4.3. PRACTICAL: BIOMEDICAL APPLICATIONS OF NANOTECHNOLOGY & INTRODUCTION TO OMICS TECHNOLOGIES AND APPLICATIONS

**TOTAL PRACTICAL: 52HRS** **TOTAL CREDITS: 04**

### BIOMEDICAL APPLICATIONS OF NANOTECHNOLOGY

1. Synthesis of nanoparticles by chemical method.
2. Synthesis of nanoparticles by biological method.
3. Analysis of nanoparticles by UV-Vis spectrophotometer.
4. Study of chemical kinetics using UV spectroscopy.
5. Handling of Atomic Force Microscopy.
6. Determination of size of nanoparticles by FTIR.
7. Determination of structure and size of synthesis nanoparticles by Scanning Electron Microscope.
8. Anti-bacterial activity of bio nanoparticles-microbial culture, co-culture of microbes and biogenic, survival observation.
9. Anti-fungal activity of bio nanoparticles- microbial culture, co-culture of microbes and biogenic, survival observation.
10. Synthesis and characterization of silver nano composite.

### INTRODUCTION TO OMICS TECHNOLOGIES AND APPLICATIONS

1. PCR amplification and gene sequencing.
2. Gene sequence translation and domain prediction.
3. Genome Annotation and mapping.
4. Protein homology and docking.
5. Study OMICs database.
6. Extraction of Protein, Purification and assay.
7. Chromatography
8. Western Blotting
9. NMR
10. MALDI-TOF

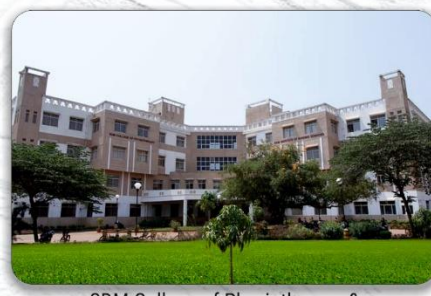
## MP.4.4: MAJOR PROJECT

**TOTAL LECTURES: 52HRS** **TOTAL CREDITS: 04**

# RESEARCH PROJECT/DISSERTATION

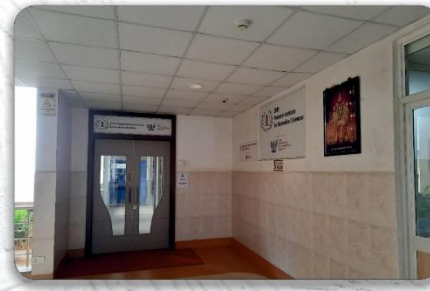
SDM College of Medical Sciences & Hospital

SDM College of Dental Sciences & Hospital

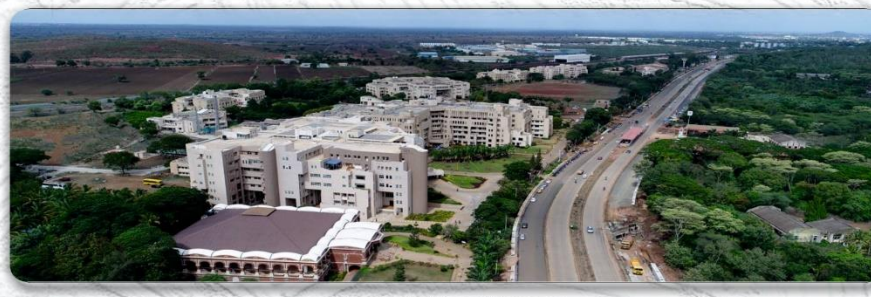


SDM College of Physiotherapy &
SDM Institute of Nursing Sciences

Shri Dharmasthala Manjunatheshwara University



SDM Research Institute for Biomedical Sciences



Panoramic View of Campus