# Pravara Institute of Medical Sciences
## (Deemed University)

Loni Bk - 413 736, Tal. Rahata, Dist. Ahmednagar (M.S.)

NAAC Re-accredited with 'A' Grade (CGPA 3.17)

Established Under Section 3 of UGC Act 1956, Vide Govt. of India Notification No. F.9-11/2000-U.3, dated 29th September, 2003

# Syllabus

## M.Sc. (Independent) Medical Biotechnology

## Implemented from 2016-2017

## CBCS Pattern

## Center for Biotechnology

Approved Vide Academic Council Resolution No. AC/2016/12 dated 26th August, 2016

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# REGULATIONS FOR CHOICE BASED CREDIT SYSTEM (CBCS) OF CENTRE FOR BIOTECHNOLOGY (M. Sc. Medical Biotechnology Course)

UNDER

PRAVARA INSTITUTE OF MEDICAL SCIENCES
DEEMED UNIVERSITY

TO BE IMPLEMENTED FROM ACADEMIC SESSION
2016-17

Course Structure: M.Sc (Independent) Medical Biotechnology (2016-17)

| SEMESTER I | Subjects | Hours of Teaching/ Practical per week | Credits |
|---|---|---|---|
| **Subject Code** | **Title of Paper/Practical** | **L/P** | |
| BP 101 | Cell Biology | 4 | 4 |
| BP 102 | Molecular Biology | 4 | 4 |
| BP 103 | Human Biochemistry | 4 | 4 |
| BP 104 | Animal Tissue Culture | 4 | 4 |
| * BP 110 | **Practical Course** | **16** | **8** |
| **SEMESTER II** | **Title of Paper/Practical** | **Hours of Teaching/ Practical per week** | **Credits** |
| BP 105 | Human Physiology | 4 | 4 |
| BP 106 | Microbiology | 4 | 4 |
| BP 107 | Industrial Biotechnology | 4 | 4 |
| BP 108 | Bioinformatics | 4 | 4 |
| *BP 111 | **Practical Course** | **16** | **8** |
| **Summer Training/ Workshop/ Mini project** | | | **2** |
| **Co & Extra Curricular Activity (Open elective** 1.Poster presentation 2.Paper presentation 3.Participation in Conference/seminar/CME 4.Extension activity | | | **2** |
| **SEMESTER III** | **Title of Paper/Practical** | **Hours of Teaching/ Practical per week** | **Credits** |
| BP 201 | Genetic Engineering | 4 | 8 |
| BP 202 | Immunology | 4 | 8 |
| BP 203 | Medical Microbiology | 4 | 8 |
| BP 204 - Any one of the Following electives | | | |
| BP 204 EL1 | Clinical Research | 4 | 8 |
| BP 204 EL2 | Developmental Biology and Stem Cells | 4 | 8 |
| BP 204 EL3 | Human Genetics | 4 | 8 |
| * BP 210 | **Practical Course** | **16** | **8** |
| **SEMESTER IV** | **Title of Paper/Practical** | **Hours of Teaching/ Tutorials per week** | **Credits** |
| BP 205 | Research Methodology and Socio- Ethical aspects of Biotechnology | 4 | 8 |
| BP 206 | Pharmaceutical Biotechnology | 4 | 8 |
| *BP 211 | **Practical Course** | **8** | **4** |
| BP 207 | Project work/ Dissertation | | **12** |
| | | | **Total=100** |

* BP110, BP 111, BP210 & BP 211 - Practical Course

# PRAVARA INSTITUTE OF MEDICAL SCIENCES
# (D E E M E D  U N I V E R S I T Y)

## RULES AND REGULATIONS
## FOR THE
## INDEPENDENT MASTER OF SCIENCE PROGRAM IN MEDICAL BIOTECHNOLOGY

1. **General:**
   These rules and regulations are framed as per the directives of UGC and P.I.M.S. – Deemed University.

2. **Faculty:**
   This course will be under The Faculty of Allied Health Sciences.

3. **Nomenclature of Degree:**
   Master of Science Degree in Medical Biotechnology (M.Sc.)

4. **Conditions for admission to the independent Master of Science Program in Medical Biotechnology:**
   4.1 Candidates who have passed the B.Sc. examination with minimum 50% marks (45% for the candidates belonging to SC/ST/OBC) in Microbiology/ Biochemistry/ Chemistry/Life Sciences (Zoology/ Botany) Physics with Biophysics specialization from any Statutory University in India or its equivalent.
   4.2 Candidates who have appeared for and are expecting their results on or before 31st May of year of admission, of the respective final qualifying examinations.

5. **Duration of the Program:**
   Duration of this program will be two calendar year.

6. **Selection of Students for the independent Master of Science Program in Medical Biotechnology:**
   6.1 The selection of the students will be based on the merit of the marks obtained in the B.Sc. examination from any Statutory University in India or its equivalent

7. **Program Objective:**
   7.1 Candidates will be trained in the advance and current art of medical biotechnology and in the skills of research methodologies, critical evaluation, problem recognition and problem solving in science.

   7.2 Candidates will have:

   1. Hands-on experience of handling most of the commonly used experimental protocols in molecular biology, genetics, protein and nucleic acid chemistry
   2. Experience of independently designing, executing, observing and interpreting the results of experiments and build a hypothesis.

1. **Preamble**

Centre for Biotechnology, a constituent unit of Pravara Institute of Medical Sciences- Deemed University is gearing up with several initiatives towards academic excellence, quality improvement & administrative reforms. In a view of this, semester system is already introduced & as per UGC circular no. D. O. No. F.1-1/2012(Secy) grading system & credit system is initiated.

The Choice Based Credit System (CBCS) enables a student to obtain a degree by accumulating required number of credits prescribed for that degree. The number of credits earned by the student reflects the knowledge or skill acquired by him/her. Each course is assigned with a fixed number of credits based on the contents to be learned. The student also has choice in selecting courses out of those offered by institute. The grade points earned for each course reflects the student's proficiency in that course.

2. **Scope**

1. The CBCS is applicable to all full-time Post Graduate Programs of study approved by the Academic Council.

2. The learning and evaluation is on Semester pattern.

3. It permits the students to learn in their own pace.

4. It will also permit the student to choose electives from a wide range of elective subjects.

3. **Definitions**

**Academic Year** Two consecutive (one odd + one even) semesters constitute one academic year

**Choice Based Credit System (CBCS)**

The CBCS provides choice for students to select from the prescribed courses (core, elective or minor or soft skill courses).

**Credit Based Semester System (CBSS)**

Under the CBSS, the requirement for awarding a degree or diploma or certificate is prescribed in terms of number of credits to be completed by the students.

**Credit**

A unit by which the course work is measured. It determines the number of hours of instructions required per week. One credit is equivalent to one hour of teaching (lecture or tutorial) or two hours of

practical work/field work per week.

Contact hours will include all the modes of teaching and it includes forms like lectures / tutorials / laboratory work / fieldwork or other forms.

In each of the courses, credits will be assigned on the basis of the number of lectures / tutorials / laboratory work and other forms of learning required for completing the course contents in maximum 18 week schedule.

The instructional days as worked out by the UGC for one academic year are 180 working days i.e. 90 days per semester.

**Credit Point** — It is the product of grade point and number of credits for a course.

**Cumulative Grade Point Average (CGPA)** — It is a measure of overall cumulative performance of a student over all semesters. The CGPA is the ratio of total credit points secured by a student in various courses in all semesters and the sum of the total credits of all courses in all the semesters. It is expressed up to two decimal places.

**Grade Point** — It is a numerical weight allotted to each letter grade on a 10-point scale.

**Letter Grade** — It is an index of the performance of students in a said course. Grades are denoted by letters O, A+, A, B+, B and F.

**Programme** — "Programme" means a set of required number of semesters leading to award of a UG or PG degree/diploma of PIMS-DU.

**Semester Grade Point Average (SGPA)** — It is a measure of performance of work done in a semester. It is ratio of total credit points secured by a student in various courses registered in a semester and the total course credits taken during that semester. It shall be expressed up to two decimal places.

**Semester** — "Semester" means a term consisting of a minimum of 450 contact hours distributed over 90 working days spread over 18 weeks of five-day duration each and five contact hours per day.( 18 X 5 X 5= 450 )

Depending upon the duration, each academic year will be divided into two semesters.

Semesters will be known as either odd semesters or even semester. The odd semester from August to December will be semesters I, III, V, VII or IX depending upon the programme duration and similarly the semester from January to July will be semesters II, IV, VI or VIII.

## 4. Introduction of Course

**Course Structure**

The Course Structure shall prescribe the minimum eligibility, Semester wise list of courses, total credits for each program, including, Theory, Practical, Project work and Viva- voce examinations, etc.

Detailed syllabus for all courses offered by the institute shall be prepared in a specific number of units along with full details of Text Books, Reference Books, Web based resources, Reference Reprints of papers, e-Books etc. relevant to the course and printed made available to teachers and students.

The Course Structure and Syllabus of each PG programme shall be approved and recommended by the Committee to Board of Studies (BOS) and then the Academic Council.

**Course**

Usually referred to, as 'papers' is a component of a programme. All courses need not carry the same weight. The courses should define learning objectives and learning outcomes. A course may be designed to comprise lectures/ tutorials/laboratory work/ field work/ outreach activities/ project work/ vocational training/viva/ seminars/ term papers/assignments/ presentations/ self-study etc. or a combination of some of these.

**Course Code**

Each course shall have a title and course code. The course code shall consist of two alphabets – representing the degree & level of the course, and three numerals. The first numeral stands for year of the course, the second & third numerals stands for number of paper. For example, **BP 201** stands for Biotechnology Postgraduate course, for 2nd year with paper one.

**Core Course**

Core courses are those, knowledge of which is deemed essential for students registered for a particular Programme. Core courses shall be spread over all the semesters.

**Elective Courses**

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 subject of study or which provides an extended scope or which enables an exposure to some other subject/domain or nurtures the candidate's proficiency/ skill is called an Elective Course.

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 to2-4 credits is called Minor Project work. A project work of 6 to 8 credits is called Major

## 7 point Scale

| | |
|---|---|
| 50-54 | F |
| 55-60 | B |
| 61-64 | B+ |
| 65-70 | A |
| 71-74 | A+ |
| 75-80 | A++ |
| >80 | O |

Project Work. Dissertation work has given 12 credits.

5. **Evaluation-marks & grading system**

Evaluation will be done on a continuous basis. The Student's performance in a course will be evaluated by assigning a letter grade.

All subjects in a PG programme shall carry an Internal Assessment component to the extent of 30 marks and End Semester for 70 marks.

For each course the passing marks will be 50% aggregate.

**Internal Assessment**

A schedule of Internal Assessment tests shall be prepared at the very beginning of the semester. Internal Assessment marks shall be displayed within a week from the date of conduct of examination and all corrected answer papers shall be given back to students with comments, if any. It is mandatory for all students to participate in all the Internal Assessment tests and in various course-work related activities for award of the above marks.

**End Semester/ University Examination**

1. An End Semester examination shall be conducted for all courses offered in the institute. The duration of the end semester examination shall be for 3 hours.
2. A schedule of End Semester examinations be prepared by the university and displayed by the institute at least one- month ahead of the conduct of the examination.
3. No student who has less than 75% attendance in any course shall be permitted to attend the end-semester examination and he shall be given grade of FA-failure due to lack of attendance. He shall be asked to repeat that course the next time it is offered.

# Pravara Institute of Medical Sciences- DU

Loni 413 736, Tal: Rahata, Dist: Ahmednagar
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## Choice Based Credit System 2016-17

### Scheme of Examination and Declaration of Results

**Grade Point:**

As per the University Grant Commission (UGC) guidelines the Grade point are based on absolute or normalized grading system in 10 point scale. Pravara Institute of Medical Sciences- DU has approved the absolute grade point calculation based on marks scored for each of the course with specified credits. For example. if a student is scoring 74% in a given course or paper, the grade point will be 7.4.

**Credit Point:**

The grade point calculated to a given course multiplied by the number of credits for the said course will be the credit point for the said course.

**Semester Grade Point Average (SGPA):**

It is a measure of performance of work done in a semester. It is ratio of total credit points secured by a student in various courses registered in a semester and the total course credits taken during that semester. It shall be expressed up to two decimal places.

**Cumulative Grade Point Average (CGPA):**

It is a measure of overall cumulative performance of a student over all semesters. The CGPA is the ratio of total credit points secured by a student in various courses in all semesters and the sum of the total credits of all courses in all the semesters. It is expressed up to two decimal places.

**Computation of SGPA & CGPA:**

Performance in a semester will be expressed as a Semester Grade Point Average (SGPA).

Cumulative performance of all the semesters together will reflect performance in the whole programme and it will be known as Cumulative Grade Point average (CGPA). Thus CGPA is the real indicators of a student's performance.
The formula for calculation of SGPA & CGPA is given below:

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

$$\mathbf{SGPA\ (Si) = \Sigma(Ci \times Gi) / \Sigma ci}$$

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

ii) The CGPA is also calculated in the same manner taking into account all the courses undergone by a student over all the semesters of a programme, i.e.

$$\mathbf{CGPA = \Sigma(Ci \times Si) / \Sigma\ Ci}$$

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

**Grading system:**

**Conversion of marks to Grade Point & Letter Grade**
(Performance of student in a paper/course)

| Range of Marks | Grade Point | Letter Grade | Description |
|---|---|---|---|
| 95-100 | 9.5-10.0 | O | Outstanding |
| 90-94 | 9.0-9.4 | | |
| 85-89 | 8.5-8.9 | $A^+$ | Excellent |
| 80-84 | 8.0-8.4 | | |
| 75-79 | 7.5-7.9 | | |
| 70-74 | 7.0-7.4 | A | Very Good |
| 65-69 | 6.5-6.9 | | |
| 60-64 | 6.0-6.4 | | |
| 55-59 | 5.5-5.9 | $B^+$ | Good |
| 50-54 | 5.0-5.4 | B | Above Average |
| 00-49 | | F | Fail |

## Classification of final results:

| CGPA | Letter Grade | Description |
|---|---|---|
| 9.50-10.0 | O | First Class with Distinction* |
| 9.00-9.49 | | |
| 8.50-8.99 | A+ | |
| 8.00-8.49 | | |
| 7.50-7.99 | | |
| 7.00-7.49 | A | First Class |
| 6.50-6.99 | | |
| 6.00-6.49 | | |
| 5.50-5.99 | B+ | Second Class |
| 5.00-5.49 | B | |
| 0.0-4.99 | F | Fail / Reappear |

* The candidates who have passed in the first appearance and within the prescribed semester of the PG programme (Core, Elective) are eligible. for declaration of class.

(K V Somasundaram)
Director, CSM

(Dr. Sonali Das)
I/C Director, CBT

(Dr. Subhash Khatri)
Principal, APJAK COPT
& Dean, Allied Health Sciences

| | | |
|---|---|---|
| | **Extra Credits** | Extra Credits may be awarded to a student for achievements in extra & co-curricular activities carried outside the regular class hours, as decide by the university. These credits shall not be counted while considering the minimum credits for completing the programme.<br>The extra credits will include following activities :<br>**Summer Training/ Workshop/ Mini project = 2 credits**<br>**Co & Extra Curricular Activity (Open elective) = 2 credits**<br>1.Poster/Paper presentation<br>2.Participation in Conference/seminar/CME<br>3.Extension activities |
| **8.** | **Grade Card or Certificate** | Based on the grades earned, a grade certificate shall be issued to all the registered students after every semester. The grade certificate will display the course details (code, title, number of credits, grade secured) along with SGPA of that semester and CGPA earned till that semester. |

**ASSESMENT OF COURSE (M.Sc. (Independent) Medical Biotechnology)**

**EVALUATION SCHEME (THEORY)**

**Semester I**

| Semester | No. of subjects | Theory | Marks | | | |
|---|---|---|---|---|---|---|
| | | | Theory | Practical | Viva | Total |
| Sem I | 4 | 100 per paper (70+30) | 400 | 150 | 50 | 600 |
| Sem II | 4 | 100 per paper (70+30) | 400 | 150 | 50 | 600 |
| Sem III | 4 | 100 per paper (70+30) | 400 | 150 | 50 | 600 |
| Sem IV | 2 | 100 per paper (70+30) | 200 | 150 | 50 | 400 |
| | 1 (Project) | 100 (Dissertation) + 25 + 25 (Synopsis & Final Presentation) | 150 | | 50 | 200 |

**Grand Total = Sem. I + Sem. II + Sem.III + Sem. IV**
**i.e. 600M + 600M + 600M + 600M = 2400Marks**
**600 M (100 each theory + 150 practical/project + 50 viva (Internal 10 marks + external 40 marks at university examination)**

**SEMESTER EXAMINATION PATTERN = 70:30 (70 EXTERNAL + 30 INTERNAL)**

**Internal Examination includes two tests**

**Test One (Mid Sem.) + Test Two (Preliminary examination) = 30 Marks**

- **5 questions out of 6 questions**
- **Questions can be sub divided**

**External Examination (University Examination) = 70 Marks**
**Total = 30 (Internal Examination) + 70 (University Examination)**

- **Each question carries 14 marks.**
- **5 questions out of 6 questions**
- **Questions can be sub divided**

**EVALUATION SCHEME (PRACTICAL)**

All subjects having practical course will be evaluated as a single paper during that semester.

Internal Examination includes one practical test of 150 marks which will be converted to 30 marks + 10 Marks Seminar + 10 Marks Journal Club = 50 Marks

External practical examination (University Examination) = 100Marks

1 long question of 50 marks
2 short questions of 20 marks each
1 minor question of 10 marks

Total = 50 marks(Internal Examination) + 100 marks (University Examination) =150 Marks

Viva voce = 10 marks (Internal Viva) + 40 marks (University Viva)= 50 Marks

**Practical examination mark system:**

Internal (50 Marks) + University (100 Marks) + Viva (50Marks) =200 Marks

**PASSING SCHEME**

- External University examination of 50% out of 70 marks
- Internal examination of 50% out of 30 marks
- Eligibility to appear to the final university examination is 50%

**GRADES AND GRADE POINTS**

| % Marks Range | Grade Point | Grade |
|---|---|---|
| 80 & Above | 10 | O **(Outstanding)** |
| 75-80 | 9 | $A^+$ **(Excellent)** |
| 60-74 | 8 | A **(Very Good)** |
| 55-59 | 7 | B+ **(Good)** |
| 50-54 | 6 | B **(above Average)** |
| Less than 50 | 0 | F **(Fail)** |
| | Ab | **Absent** |

**Formula to calculate SGPA (Si) = $\sum$ (Ci x Gi) / $\sum$ Ci**

**Formula to calculate CGPA = $\sum$ (Ci x Si) / $\sum$ Ci**

**Transcript (Format): Based on Letter grade, grade points and SGPA and CGPA, the authority may issue the transcript for each semester and a consolidated transcript indicating the performance in all semester.**

**Course Structure: M.Sc (Independent) Medical Biotechnology (2016-17)**

| SEMESTER I | Subjects | Hours of Teaching/ Practical per week | Credits |
|---|---|---|---|
| **Subject Code** | **Title of Paper/Practical** | **L/P** | |
| BP 101 | Cell Biology | 4 | 4 |
| BP 102 | Molecular Biology | 4 | 4 |
| BP 103 | Human Biochemistry | 4 | 4 |
| BP 104 | Animal Tissue Culture | 4 | 4 |
| | **Practical Course** | **16** | **8** |
| **SEMESTER II** | **Title of Paper/Practical** | **Hours of Teaching/ Practical per week** | **Credits** |
| BP 105 | Human Physiology | 4 | 4 |
| BP 106 | Microbiology | 4 | 4 |
| BP 107 | Industrial Biotechnology | 4 | 4 |
| BP 108 | Bioinformatics | 4 | 4 |
| | **Practical Course** | **16** | **8** |
| **Summer Training/ Workshop/ Mini project** | | | **2** |
| **Co & Extra Curricular Activity (Open elective** 1.Poster presentation 2.Paper presentation 3.Participation in Conference/seminar/CME 4.Extension activity | | | **2** |
| **SEMESTER III** | **Title of Paper/Practical** | **Hours of Teaching/ Practical per week** | **Credits** |
| BP 201 | Genetic Engineering | 4 | 8 |
| BP 202 | Immunology | 4 | 8 |
| BP 203 | Medical Microbiology | 4 | 8 |
| BP 204 - Any one of the Following electives | | | |
| BP 204 EL1 | Clinical Research | 4 | 8 |
| BP 204 EL2 | Developmental Biology and Stem Cells | 4 | 8 |
| BP 204 EL3 | Human Genetics | 4 | 8 |
| | **Practical Course** | **16** | **8** |
| **SEMESTER IV** | **Title of Paper/Practical** | **Hours of Teaching/ Tutorials per week** | **Credits** |
| BP 205 | Research Methodology and Socio- Ethical aspects of Biotechnology | 4 | 8 |
| BP 206 | Pharmaceutical Biotechnology | 4 | 8 |
| | **Practical Course** | **8** | **4** |
| BP 207 | Project work/ Dissertation | | **12** |
| | | | **Total=100** |

## SEMESTER I

## CELL BIOLOGY (BP 101)

| Course Code | Category | Course Name | L | T | P | Hr | C |
|---|---|---|---|---|---|---|---|
| BP 101 | Major | Cell Biology | 4 | 0 | 4 | 48 | 6 |

**Objective:**

The objective of the course is to familiarize the students with the fundamentals of cell biology.

| Sr. No. | Topic | Detail of syllabus | Hrs. |
|---|---|---|---|
| **Unit I** | **Cell Structure** | Introduction to Prokaryotes and eukaryotes<br>Prokaryotic cell structure<br>Eukaryotic cell structure | 8 |
| **Unit II** | **Cytoskeleton** | Muscle contraction & ciliary movements<br>General features of microtubles and actin filaments<br>Microtubule organizing centers and microtubule-associated proteins<br>Actin filaments and actin-binding proteins<br>Intermediate filaments<br>Organization of the cytoskeleton | 8 |
| **Unit III** | **Cell Differentiation and the maintenance of tissues** | Maintenance of the differentiated state<br><br>Tissues with permanent cells: Renewal by simple duplication, Renewal by stem cells- epidermis, Renewal by pluripotent stem cells- blood cell formation<br><br>Quiescent stem cells – skeletal muscle, Soft cells and tough matrix – growth turnover and repair in skeletal connective tissue | 8 |
| **Unit IV** | **Cell Growth and Division** | The control of cell division<br>Tumor viruses as tools for studying the control of the cell cycle<br>Events in the S phase<br>The logic of the cycle<br>Cell division | 4 |
| **Unit V** | **Cell adhesion and extra cellular matrix** | Cell adhesion & cell junctions<br>Cell –cell interaction & cell matrix interaction<br>Extracellular matrix | 4 |
| **Unit VI** | **Chemical signaling** | Cell surface, hormone receptor<br>Signal Transduction, Secondary messengers | 8 |
| **Unit VII** | **Cancer** | Tumor cells and the onset of cancer | 8 |

| | | | |
|---|---|---|---|
| | | Proto-oncogenes and tumor-suppressor genes<br>Oncogenic mutations affecting cell proliferation<br>Mutations causing loss of cell-cycle control | |

## METHODOLOGY

The course would be taught through lectures, demonstrations and practical classes.

**Books recommended:**

- Cell and Molecular Biology by De Robertis.
- Molecular Biology of Cell by Bruce Alberts 2002.
- The cell by Cooper 2000
- Cell Biology, Genetics, Molecular Biology, Evolution and
- Ecology by P. S Verma and VK Agarwaal. Publisher S. Chand and Comp. 2005
- Cell Biology by Powar

## PRACTICAL IN CELL BIOLOGY (4 hrs per week)

## LIST OF EXPERIMENTS

1. Microscopes- Compound microscopes
2. Observations of permanent slide
   · Different types of Animal Cell
3. Mitosis cell division in Onion Root-Tip Cells
4. Meiotic cell division in grasshopper testis
5. Buccal smear – Identification of Barr Body
6. Isolation of Mitochondria/chloroplast
7. Counting of cells using Haemocytometer
8. Permanent slide preparation

## MOLECULAR BIOLOGY (BP 102)

| Course Code | Category | Course Name | L | T | P | Total Hr | C |
|---|---|---|---|---|---|---|---|
| BP 102 | Major | Molecular Biology | 4 | 0 | 4 | 48 | 6 |

**Objective:**

The objective of the course is to familiarize the student with the fundamentals concepts and technique in molecular biology and its use in the medical research.

| Sr. No. | Topic | Description | Hrs |
|---|---|---|---|
| **Unit I** | **Introduction** | Gene, DNA as a genetic material, Messelson and Stahl experiment; Semi conservative mode of DNA replication | 3 |
| **Unit II** | **Structure and maintenance of genome** | Structure of DNA, types and alternatives forms of DNA. Structure of RNA. Genome organization in prokaryotes and eukaryotes | 5 |
| **Unit III** | **DNA Replication** | Replication of DNA in prokaryotes-, Origin of replication, types of DNA polymerases, details of DNA synthesis process<br>Eukaryotic DNA replication- multiple replicons, eukaryotic DNA polymerases, ARS in yeast, Origin Recognition Complex (ORC), regulation of replication | 8 |
| **Unit IV** | **DNA damage, repair and mutation** | a.Different types of DNA damages<br>b. Mutation, types of mutation, spontaneous and induced mutation, Detecting mutation<br>c. Nucleotide excision repair, Base excision repair, mismatch repair, recombination repair, SOS operon, Double strand break repair, transcription coupled repair | 6 |
| **Unit V** | **Recombination** | Homologous and site specific recombination, Models for homologous recombination<br>Proteins involved in recombination: RecA, B, C, D, Ruv A, B, C<br>Gene conversion | 6 |
| **Unit V I** | **Mobile DNA elements:** | General features of Transposable elements, Transposable elements in prokaryotes-IS element, Retroviruses Retrotransposon- Ty elements in yeasts, SINES and LINES | 4 |
| **Unit VII** | **Transcription** | Transcription in Prokaryotes: RNA polymerase, sigma factor, Initiation,elongation, termination, Transcription in Eukaryotes: RNA polymerases,transcription of protein coding sequences by RNA polymerase-II, post- | 6 |

| | | | |
|---|---|---|---|
| | | transcriptional modification, RNA splicing and RNA editing | |
| **Unit VIII** | **Translation** | Genetic code, Translation in Prokaryotes and eukaryotes, post translational process-protein translocation | 5 |
| **Unit IX** | **Control of Gene Expression** | Gene regulation in Prokaryotes, Operon model, Gene regulation in eukaryotes, gene activators, enhancers and silencers | 4 |

**METHODOLOGY**

The course would be taught through lectures, demonstrations and practical classes.

**Books Recommended:**

1. Benjamin Lewin. (2008) Genes IX, Jones and Bartelett Publishers Inc.
2. Bruce Alberts, Dennis Bray, Julian Lewis, Martin Raff, Keith Roberts, and James D. Watson (2004), Molecular Biology of the Cell, 4th Edition, Garland Publishing
3. Raff, Keith Roberts, Peter Walter, (2003) Essential Cell Biology, 2nd Edition, Garland Publishing
4. Watson James D., Tania Baker, Stephen P. Bell, Alexander Gann, Michael Levine, Richard Lodwick (2004) Molecular Biology of the Gene, 5th Edition, Pearson Education, Inc. and Dorling Kindersley Publishing, Inc.
5. Weaver R., (2007) Molecular Biology, 4th Edition, McGrew Hill Science.

**PRACTICAL IN MOLECULAR BIOLOGY (4 hrs per week)**

**LIST OF EXPERIMENTS**

1. Isolation of Genomic DNA from *E.coli* DH5α
2. Purification of isolated genomic DNA
3. Quantification of DNA by UV Spectrophotometer
4. To perform Agarose Gel Electrophoresis
5. Replica Plate Techniques
6. Polymerase Chain Reactions
7. Isolation of genomic DNA from blood sample/tissues/any bio material

## HUMAN BIOCHEMISTRY (BP 103)

| Course Code | Category | Course Name | L | T | P | Total Hr | C |
|---|---|---|---|---|---|---|---|
| BP103 | Major | Human Biochemistry | 4 | 0 | 4 | 48 | 6 |

**Objective:**

The Objective of the course is to familiarize the students with the fundamental and advances in Human Biochemistry.

| Sr.No. | Topics | Detail syllabus | Hrs. |
|---|---|---|---|
| **Unit I** | **Macromolecules** | Water & pH<br>Amino Acids & Peptides<br>Proteins: Myoglobin & Hemoglobin<br>Carbohydrates of Physiologic Significance<br>Lipids of Physiologic Significance | 6 |
| **Unit II** | **Bioenergetics** | First and second law of thermodynamics, internal energy,enthalpy,entrophy, concept of free energy, standard free energy change of chemical reaction, redox potential, ATP and high energy phosphate compounds<br>The Respiratory Chain & Oxidative Phosphorylation | 5 |
| **Unit III** | **Pathways of Hexose and Pentose Metabolism** | • Glycolysis & the Oxidation of Pyruvate<br>• The Citric Acid Cycle: The Catabolism of Acetyl-CoA<br>• Gluconeogenesis & Control of the Blood Glucose<br>• The Pentose Phosphate Pathway & Other Pathways of Hexose Metabolism | **8** |
| **Unit IV** | **Metabolism of Glycogen** | • Biosynthesis and degradation of glycogen and its regulation<br>• Starch and cellulose biosynthesis | **4** |
| **Unit V** | **Lipid metabolism and cholesterol synthesis, transport, excretion** | • Biosynthesis of Fatty Acids<br>• Oxidation of Fatty Acids: Ketogenesis<br>• Metabolism of Unsaturated Fatty Acids & Eicosanoids<br>• Cholesterol Synthesis, Transport, & Excretion | **6** |
| **Unit VI** | **Biosynthesis and degradation of amino** | • Biosynthesis of the Nutritionally Nonessential Amino Acids<br>• Catabolism of Proteins & of Amino Acid | **6** |

| | | | |
|---|---|---|---|
| | **acids** | Nitrogen<br>• Catabolism of the Carbon Skeletons of Amino Acids<br>• Conversion of Amino Acids to Specialized Products | |
| **Unit VII** | **Metabolism of purine and pyrimidine nucleotides** | • Nucleotides<br>• Biosynthesis and degradation purine and pyrimidine nucleotides,regulation | **4** |
| **Unit VIII** | **Hormonal Action** | • Hormonal regulation and fuel metabolism | **3** |
| **Unit IX** | **Enzymes** | • Enzymes nature and classification<br>• Enzyme function:<br>• Enzymes affect reaction rates not equilibria, Reaction rates and equilibria , Principles behind catalytic power and specificity of enzymes, Weak interaction between enzyme and substrate are optimized in transition state, Enzyme use binding energy to provide reaction specificity and catalysis, Specific catalytic groups contribute to catalysis.<br>• Enzyme Kinetics<br>• Enzyme Inhibition | **5** |

**Books Recommended:**


- Harper's Illustrated Biochemistry
- A text of biochemistry, - A.V.S.S. Rama Rao 9th ed. (UBS Publisher's and Distributors Pvt. Ltd.)
- Leninger: Principles of Biochemistry, 3nd Ed. – Nelson D. et al (Worth Publishers)
- Biochemistry, 5th, - Ed. Breg, J.M. Tymoczko J.L. and Stryer L. (W.H. Freeman & Co.)
- Lubert Stayer,(Latest) Biochemistry,II edition ,W.H.Freeman and CO.NY


**PRACTICALS IN BIOCHEMISTRY (4 Hrs. per Week)**

**LIST OF EXPERIMENT**

1. Calibration of pH meter
2. Estimation of Proteins By Biuret Method
3. Estimation of Protein By Lowry Method
4. Estimation of Serum Albumin By BCG Method
5. Estimation of SGOT
6. Estimation of SGPT
7. Estimation of Serum Alkaline Phosphatase
8. Estimation of Serum Creatinine
9. Estimation of Urea Nitrogen
10. Estimation of Cholesterol By Zak's ferric Chloride Method
11. Estimation of Carbohydrates By Anthrone Method
12. Estimation of Carbohydrates By DNSA Method
13. Estimation of Carbohydrates By Phenol Sulphuric acid Method

## ANIMAL TISSUE CULTURE (BP 104)

| Course Code | Category | Course Name | L | T | P | Total Hr | C |
|---|---|---|---|---|---|---|---|
| BP 104 | Major | Animal Tissue Culture | 4 | 0 | 4 | 48 | 6 |

**Objective:**

The objective of the course is to familiarize the students with the basics of Animal Tissue Culture Techniques and use in various fields of research and human welfare.

| Sr. No. | Topic | Detail of syllabus | Hrs. |
|---|---|---|---|
| **Unit I** | **Introduction to animal tissue culture** | Historical background, The application of tissue culture, Terminology, Stages in cell culture | 4 |
| **Unit II** | **Outline of the key techniques of animal cell culture** | Setting up the laboratory, Culturing cells, Maintaining the culture, Quantification of cells in cell culture, Cloning and selecting cell lines, Physical methods of cell separation, Hazards and safety in the cell culture laboratory | 8 |
| **Unit III** | **Animal cell culture media** | General cell culture media design, Natural media, Synthetic media, Further considerations in media formulation, Nutritional components of media, The role of serum in cell culture, Choosing a medium for different cell type | 8 |
| **Unit VI** | **Characterization of cell lines** | Species verification, Intra-species contamination, Characterization of cell type and stage of differentiation, Microbial contamination | 8 |
| **Unit V** | **Preservation of animal cell lines** | Variation and instability in cell lines, Preservation of cell lines, Freezing of cells, Thawing of cells, Quantification of cell viability, Cell banks | 6 |
| **Unit VI** | **Hybridoma Technology** | The limitation of traditional antibody preparation, The basis of hybridoma technology, The details of hybridoma technology, Long term storage of hybridoma cell lines, Contamination, Hybridomas from different species, Human hybridomas, Commercial scale production of monoclonal antibodies | 8 |
| **Unit VII** | **Large scale animal cell culture** | Culture parameters, Scale up of anchorage-dependant cells, Culture vessels, Suspension culture | 6 |

**METHODOLOGY**

The course would be taught through lectures, demonstrations and practical classes.

**BOOKS RECOMMENDED**

1. Cell and Tissue Culture: Lab Procedures in Biotechnology by Alan Doyle (ed) J. Bryan Griffith (ed)
2. Culture of Animal Cell by Freshney

**PRACTICALS IN ANIMAL TISSUE CULTURE (4 Hrs. per Week)**

**LIST OF EXPERIMENT**

1. Layout of Animal Tissue Culture laboratory
2. Washing of glasswares
3. Sterilization of glasswares
4. Preparation of culture media
5. Thawing of cell lines
6. Passaging of cell lines
7. Cell quantification and Cell viability
8. Cryopreservation of cell cultures

## SEMESTER II

## HUMAN PHYSIOLOGY (BP 105)

| Course Code | Category | Course Name | L | T | P | Total Hr | C |
|---|---|---|---|---|---|---|---|
| BP 105 | Major | Human Physiology | 4 | 0 | 4 | 48 | 6 |

**Objective:**

The objective of the course is to study the physiological aspects of the human systems and its role in functioning of all the major organs of the body.

| Sr. No. | Topic | Detail of syllabus | Hrs. |
|---|---|---|---|
| **Unit I** | **Basic concepts and principles** | Introduction and background (homeostasis, control systems), Biophysics of blood flow Regulation of respiration., Auto regulation of renal blood flow and the concept of clearance | 6 |
| **Unit II** | **Sensory Organs** | Eye, Ear, Nose, Tongue and Skin: Functions & Disorders | 4 |
| **Unit III** | **Digestive system** | Functions & Disorders, Pharynx, oesophagus, Stomach and Intestines, Liver & Pancreas, Peritoneum | 4 |
| **Unit IV** | **Circulation system** | Heart rate and the significance, Cardiac cycle, HR factors ECG- Machine, Recording, Abnormalities types Causative Factors Reporting & Interpretation | 6 |
| **Unit V** | **Respiration system** | Respiration, Mechanism Inspiration, Expiration Gas exchange mechanism Lung surfactant, compliance Lung volume and capacity Respiratory Exercises Artificial Respiration Basis & Techniques | 6 |
| **Unit VI** | **Genito-Urinary System** | Kidney, Urethra, bladder, Urethra, Female Reproductive System, Male Reproductive System | 6 |

| | | | |
|---|---|---|---|
| **Unit VII** | **Skeletal system** | Mechanism of contraction, Difference between 3 types of muscles, Electro myography & mechanical recording of muscle contraction, Locomotion, Diseases of muscles Dystrophies, | 6 |
| **Unit VIII** | **Nervous System** | Nerve fibres, types ,functions, injuries, impulses & velocity | 4 |
| **Unit IX** | **Endocrine system** | Hormones, Functions & Disorders | 4 |
| **Unit X** | **Genetic testing** | Genetic testing, Eugenics and Aging | 2 |

**METHODOLOGY**

The course would be taught through lectures, demonstrations and practical classes.

**Books Recommended:**

1. Textbook of Medical Physiology by C. Guyton
2. Physiology by C. Chatterjee
3. Human Anatomy & Physiolgy by Tortora
4. Medical physiology by Chaudhary
5. Anatomy and histology by Ross and Wilson
6. Human Anatomy and Physiology by Creager

**PRACTICAL IN HUMAN PHYSIOLOGY (4 hrs per week)**

**LIST OF EXPERIMENTS**

1. Blood grouping
2. Haemoglobin estimation
3. Total WBC and RBC count
4. Erythrocyte sedimentation rate
5. Differential Counting of Blood
6. PVC count

## MICROBIOLOGY (BP 106)

| Course Code | Category | Course Name | L | T | P | Total Hr | C |
|---|---|---|---|---|---|---|---|
| BP 106 | Major | Microbiology | 4 | 0 | 4 | 48 | 6 |

**Objective:**

The objective of the course is to familiarize the students with bacteria and viruses, their structures, metabolism, diseases caused by bacteria and viruses and their control.

| Sr. No. | Topic | Detail of syllabus | Hrs. |
|---|---|---|---|
| **Unit I** | **Introduction to Microbiology** | Scope and history of Microbiology. Classification and identification of microorganism. | 8 |
| **Unit II** | **Characteristics** | Cultivation of bacteria. Culture media, preservation methods of bacterial cultures and maintenance | 8 |
| **Unit III** | **Microorganism-Bacteria** | Morphology and fine structure of bacteria. Cell wall structure in details – Gram positive and gram negative bacteria. Reproduction and growth. Growth kinetics.<br>Bacterial genetics- extra chromosomal elements, gene transfer mechanisms | 8 |
| **Unit IV** | **Control of Microorganisms** | Control of by physical and chemical agents. sterilization and disinfection Role of antibiotics and chemotherapeutic agents antiviral agents, viral agents, and antiviral drugs | 8 |
| **Unit V** | **Microbes as parasites** | The host-parasite relationship<br>Symbiotic associations, Characteristics of parasitism<br>Entry, exit and transmission. Normal flora, various sites of normal flora, list of normal flora and its beneficial and adverse effects. | 8 |
| **Unit VI** | **Microbial Pathogenesis** | Types of infections - primary, secondary, nosocomial, iatrogenic, zoonotic etc<br>Mechanisms of Bacterial pathogenesis – bacterial toxins, capsules, enzymes, intracellular parasitism, antigenic variations<br>etc. leading to establishment of infections.<br>Principles of lab diagnosis of infectious diseases | 8 |

**METHODOLOGY**

The course would be taught through lectures, demonstrations and practical classes.

**Books Recommended:**


1. General Microbiology: Vol. I & 2 by Powar & Daginawala
2. Microbiology by Pelzer
3. Microbiology by Prescott
4. General Microbiology by Stanier
5. Instant notes in Microbiology by Nicklin

**PRACTICAL IN MICROBIOLOGY (4 hrs per week)**

**LIST OF EXPERIMENTS**

1. To study different types of Microscope.
2. Sterilization and disinfections
3. Preparation of culture media
4. Staining procedures
5. Monochrome staining
6. Negative staining
7. Gram Staining
8. Capsule staining
9. Motility of microorganisms
10. Fungal mounting
11. Aseptic transfer techniques
12. Streak plate method
13. Spread plate method
14. Pour plate method
15. Biochemical tests
16. IMViC test
17. Urease test
18. Triple Sugar Iron test
19. Catbohydrate fermentation test
20. Catalase test
21. Oxidase test

## INDUSTRIAL BIOTECHNOLOGY (BP 107)

| Course Code | Category | Course Name | L | T | P | Total Hr | C |
|---|---|---|---|---|---|---|---|
| BP 107 | Major | Industrial Biotechnology | 4 | 0 | 4 | 48 | 6 |

**Objective:**

To make the students aware of the overall industrial bioprocesses which requires for understanding the process and industrial demands.

| Sr. No. | Topic | Description | Hrs. |
|---|---|---|---|
| **Unit I** | **Bioreactor Technology** | Types of bioreactors: Plug flow reactors, continuously stirred tank flow reactors, loop reactors, air lift reactors, fed batch reactors, fluidized bed reactors, rotatory disc reactors.<br>Concept of Batch process, continuous process, recycled and non-recycled processes, liquid & solid state of fermentations.<br>Concept of bioreactor designing & process optimization, mass transfer, heat transfer, mixing rheology of fermentation fluids, mean resistance time, substrate utilization rate, oxygenation, oxygen sag, yield co-efficient. | 12 |
| **Unit II** | **Downstream processing** | Down stream processing: Bioseparation; filtration, membrane filtration, centrifugation sedimentation, flocculation, purification, solvent extraction, counter current extraction, ion exchange, affinity techniques, concentration, crystallization, reserve osmosis, ultrafiltration, drying, storage and packaging. | 8 |
| **Unit III** | **Immobilized systems** | Absorption, covalent bonding, entrapment, encapsulation, cross linking, types of reactors, diffusion characteristics, effective factors, instability factors, deactivation rates, relative length of half life. | 8 |
| **Unit IV** | **Scale up, unit processes** | Concept of control, basic control theory, | 6 |

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|---|---|---|---|
| | | turbidostatic & chemostatic control.<br>Basic principles of scale up, working parameters<br>UNIT processes- production of enzymes, antibiotics<br>Biosensor technology | |
| **Unit V** | **Production of Modern Biotechnology Products** | Production of recombinant proteins having therapeutic and diagnostic applications, vaccines. Bioprocess strategies in Plant Cell and Animal Cell culture. | 6 |
| **Unit VI** | **Nanotechnology in medicine** | Basics of nanotechnology, nanomaterials and nanoparticles, nanotools, Nanoparticles in cancer therapeutics, Nanodiagnostics. *In vitro* nanodiagnostics – nanobiochips and nanobiosensors, cantilever biosensors, nanoproteomics<br>In vivo nanodiagnostics– gold nanoparticles, nanotubes, quantum dots– nanobiochips and nanobiosensors, cantilever biosensors, nanoproteomics<br>In vivo nanodiagnostics– gold nanoparticles, nanotubes, quantum dots | 8 |

**METHODOLOGY**

The course would be taught through lectures and practicals.

**Books Recommended:**


1. A.H. Patel " Industrial Microbiology" Macmillan
2. Presscott, S.C. and Cecil G. Dunn, "Industrial Microbiology", Agrobios (India), 2005.
3. Cruger,Wulf and Anneliese Crueger, "Biotechnology: A Textbook of Industrial Microbiology", 2nd Edition, Panima Publishing, 2000.
4. C.F.A Bryce and EL.Mansi, Fermentation microbiology & Biotechnology, 1999.
5. K.G.Ramawat & Shaily Goyal, Comprehensive Biotechnology, 2009, S.Chand publications.
6. Bionanotechnolgy: Lesson from Nature, David S. Goodsell, Willey-Liss, First edition, 2004
7. Industrial microbiology: An introduction. Mike J. Waites, Neil Morgan, John Rackey, Gary Higton, John S. Rockey
8. Bioreactor recovery in bioprocess technology. Biotol Series
9. Principles of fermentation technology. P. F. Stanbury et al.

**PRACTICAL IN INDUSTRIAL BIOTECHNOLOGY (4 hrs per week)**

**LIST OF EXPERIMENTS**

1. Introduction to bioreactor and its parts
2. Antibiotic assay to determine MIC (Minimum inhibitory concentration)
3. Production of enzymes / industrial bio products
4. Study of Downstream processing
5. Industrial visit
6. Vitamin assay

## BIOINFORMATICS (BP 108)

| Course Code | Category | Course Name | L | T | P | Total Hr | C |
|---|---|---|---|---|---|---|---|
| BP 108 | Major | Bioinformatics | 4 | 0 | 4 | 48 | 6 |

**Objective:**

The objective of the course is to enlighten the student with basic concepts and technique in Bioinformatics and its use in the field of Medical and health care.

| Sr. No. | Topic | Detail of syllabus | Hrs. |
|---|---|---|---|
| Unit I | **Biology in the computer age: An Introduction to Bioinformatics** | How Is Computing Changing Biology?<br>Isn't Bioinformatics Just About Building Databases?<br>What Does Informatics Mean to Biologists??<br>How Do I Understand Sequence Alignment Data?<br>What Challenges Does Biology Offer Computer Scientists?<br>What Skills Should a Bioinformatician Have?<br>Why Should Biologists Use Computers?<br>How Can I Configure a PC to Do Bioinformatics Research?<br>What Information and Software Are Available?<br>Can I Learn a Programming Language Without Classes?<br>How Can I Use Web Information<br>How Do I Understand Sequence Alignment Data?<br>How Do I Write a Program to Align Two Biological Sequences?<br>How Do I Predict Protein Structure from Sequence?<br>What Questions Can Bioinformatics Answer? | 8 |
| Unit II | **Computational approaches to biological questions.** | Introduction<br>Computational Methods in Bioinformatics<br>What Biologists Model<br>Accessing 3D Molecules through a 1D Representation<br>Abstractions for Modeling Protein Structure.<br>Mathematical Modeling of Biochemical Systems.<br>Why Biologists Model | 8 |

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| **Unit III** | **Biological research on the web** | Introduction<br>Using Search Engines<br>Boolean Searching<br>Search Engine Algorithms<br>Finding Scientific Articles<br>Using PubMed Effectively<br>The Public Biological Databases<br>Data Annotation and Data Formats<br>3D Molecular Structure Data<br>DNA, RNA, and Protein Sequence Data<br>Genomic Data<br>Biochemical Pathway Data | 8 |
| **Unit IV** | **Sequence analysis, pairwise alignment, and database searching** | Introduction<br>Genefinders and Feature Detection in DNA<br>Predicting Gene Locations<br>Feature Detection<br>Pairwise Sequence Comparison<br>Scoring Matrices<br>Gap Penalties<br>Global Alignment<br>Local Alignment<br>Tools for local alignment<br>Sequence Queries against Biological Databases<br>Local Alignment-Based Searching Using BLAST<br>The BLAST algorithm | 8 |
| **Unit V** | **Multiple sequence alignments, trees and profiles** | Introduction<br>Taxonomy and Evolution<br>Concept of molecular evolution<br>Terms: Orthologs, paralogs and xenologs.<br>Multiple sequence alignment:<br>MSA by Dynamic Programming<br>MSA by progressive strategies<br>MSA by Clustal-W<br>Application of MSA<br>Phylogenetic inferences<br>Phylogenetic trees based on neighbor joining<br>Software for phylogenetic analysis<br>Profiles and motifs: General concepts | 8 |
| **Unit VI** | **Tools for genomics and proteomics** | Introduction<br>From Sequencing Genes to Sequencing Genomes<br>Analysis of Raw Sequence Data: Basecalling<br>Sequencing an Entire Genome<br>The shotgun approach<br>The clone contig approach<br>LIMS: Tracking all those minisequences<br>Sequence Assembly<br>Accessing Genome Informationon the Web<br>NCBI Genome Resources | 8 |

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| | | TIGR Genome Resources<br>EnsEMBL<br>Other Sequencing Centers<br>Organism-Specific Resources<br>Annotating and Analyzing Whole Genome Sequences<br>Genome Annotation<br>MAGPIE<br>Functional Genomics: New Data Analysis Challenges<br>Sequence-Based Approaches for Analyzing Gene Expression<br>DNA Microarrays: Emerging Technologies in Functional Genomics<br>Bioinformatics Challenges in Microarray Design and Analysis<br>Planning array experiments<br>Proteomics<br>Tools for Proteomics Analysis | |

**METHODOLOGY**

The course would be taught through lectures, demonstrations and practical classes.

**Books Recommended:**


1. Developing Bioinformatics computer skills – Gibas C and Jambeck P
2. Introduction to bioinformatics – T.K. Attwood and Parry-Smith D.J.
3. Introduction to Bioinformatics: Lesk, A.M. Oxford University press.
4. Developing Bioinformatics Computer Skill: Cynthia Gibbs and Per Jambeck. O'Reilly & Associates.


**PRACTICAL IN BIOINFORMATICS (4 hrs per week)**

**LIST OF EXPERIMENTS**

1. Introduction to SPDBV (deep view).
2. Basic exercise in protein structure visualization.
3. Basic exercise in protein structure visualization coloring.
4. To study the PubMed using internet.
5. To study the NCBI website using internet
6. BLAST
7. FASTA

## SEMESTER III

## GENETIC ENGINEERING (BP 201)

| Course Code | Category | Course Name | L | T | P | Credit Hr | C |
|---|---|---|---|---|---|---|---|
| BP 201 | Major | Genetic Engineering | 4 | 0 | 4 | 48 | 6 |

**Objective:**
To familiarize the student with emerging field of biotechnology i.e. Recombinant DNA Technology as well as to create understanding and expertise in wet lab techniques related to genetic engineering.

| Sr. NO. | Topic | Detail of syllabus | Hrs. |
|---|---|---|---|
| **Unit I** | Recombinant DNA technology | The recombinant DNA concept, Milestones in genetic engineering, Tools of Genetic Engineering; Enzymes, Nuclease, The Restriction Endonucleases, Phosphodiesterase, Polynucleotide kinase, DNA ligase, DNA polymerase I, Reverse transcriptase, Terminal deoxynucleotidyl transferase, Poly A polymerase | 8 |
| **Unit II** | **Vector System** | Salient features of cloning vector, types of cloning vectors- plasmids, cosmids, phages (lambda and M13 phages), animal (SV40, Baculo) and plant (CMV) viruses, Artificial chromosomes- YACs and MACs | 8 |
| **Unit III** | **The Means: Constructing, Cloning, and Selecting** | Ligation of foreign DNA to vectors - cohesive and blunt end methods - homopolymer tailing and adaptors, Techniques of gene transfer - transformation, transfection, micro injection, electroporation, lipofection and biolistics, Screening Cloned Populations of Recombinants, Preparation of gene libraries and c-DNA libraries | 12 |
| **Unit IV** | Molecular Mapping of genome | Chemical synthesis of DNA, DNS sequencing techniques, PCR, Mapping of genome- genetic & physical map, physical mapping and map based cloning, molecular markers in genome analysis- RFLP, RAPD & AFLP analysis, molecular markers PCR based, FISH , Microarray, Northern Blotting, Southern blotting, MicroRNAs and RNA Interference,. | 12 |

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|---|---|---|---|
| Unit V | Applications of Genetic Engineering | Transgenic & Gene knock out technologies, Targeted gene replacements, Applications of GE in medicine & industry | 8 |

**METHODOLOGY**

The course would be taught through lectures, demonstrations and practical classes.

**BOOKS RECOMMENDED:**


1. Molecular Biology of the gene - J. Watson
2. Genes VI, VII and VIII - Benjamin Lewin
3. Molecular Biotechnology Principles and application of recombinant DNA
4. Molecular Biology - Robert F. Weaver
5. Plant Molecular Biology: A practical approach. - C.H. Shaw (2006), Panima Pub. Corp.
6. Molecular cloning Vol. 1-3. Sambrook and Russel. 2001. CSH press.
7. Principles of gene manipulation. 1994. Old and Primrose, Blackwell Scientific Publ.
8. Principles and techniques of biochemistry and molecular biology, 6th Ed. Wilson Keith and Walker John
9. (2005) Cambridge University Press, New York.
10. DNA Cloning : A practical approach D.M. Glover and D.B. Hames, R.L. Press,Oxford, 1995


**PRACTICALS:**

**List of Experiments:**

1. Competent Cell Preparation
2. Transformation
3. Isolation of plasmid DNA by alkaline lysis mini preparation
4. Restriction digestion of vector DNA
5. Restriction digestion of lambda DNA
6. Gel Elusion
7. Random Fragment Length Polymorphism
8. Random Amplified Polymorphic DNA

## IMMUNOLOGY (BP 202)

| Course Code | Category | Course Name | L | T | P | Total Hr | C |
|---|---|---|---|---|---|---|---|
| BP 202 | Major | Immunology | 4 | 0 | 4 | 48 | 6 |

**Objective:**

The objective of the course is to familiarize the student with the basics of immune system and its role in disease outcome

| Sr. No. | Topic | Description | Hrs |
|---|---|---|---|
| **Unit I** | **Introduction** | Overview of Immune system:<br>History and scope of Immunology,<br>Types of immunity<br>Immune dysfunction and its consequences.<br>Cells and organs of the immune system | 8 |
| **Unit II** | **Generation of B cell and T cell responses** | Antigens<br>Antibodies: Structure and Function<br>Organization and expression of immunoglobulin genes<br>Antigen-Antibody interactions: Principles and Applications<br>Major Histocompatibility Complex<br>Antigen Processing and Presentation<br>T cell receptor<br>T cell maturation, activation, and differentiation<br>B cell generation, activation, and differentiation | 8 |
| **Unit III** | Immunoglobulins Structure and Function | Basic and fine structure of immuneglobulin: light chains, heavy chains and sequences<br>Antigen determinants on Immunoglobulin: Isotopic, allotypic, Idiotypic<br>Immunoglobulin super family | 8 |
| **Unit IV** | **Immune Effector Mechanisms** | Cytokines<br>The Complement system<br>Cell mediated effector responses<br>Leukocyte migration and inflammation<br>Hypersensitive reaction | 8 |

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|---|---|---|---|
| Unit V | Immuno techniques | Strength of antigen and antibody interactions: Antibody affinity, antibody avidity<br>· Cross reactivity<br>· Precipitation reactions, agglutination reactions (immunodiffusion and immunoelectrophoretic technique)<br>· Radioimmunoassay<br>· Enzyme linked Immunosorbant./Assay(ELISA)<br>· Western Blotting<br>· Immuno precipitation<br>· Immunofluorenscence<br>Flow cytometry and Fluorescence | 8 |
| Unit VI | The Immune System in Health and Disease | Immune response to infectious diseases<br>Vaccines<br>AIDS and other immunodeficiencies<br>Autoimmunity<br>Transplantation immunology<br>Cancer and the immune system | 8 |

**METHODOLOGY**

The course would be taught through lectures, demonstrations and practical classes.

**Books Recommended:**


1. Immunology – Kuby et.al
2. Cellular Interactions and immunobiology – BIOTOL series
3. Immunology – Roitt et. al.
4. Immunobiology – Janeway Travers et. al
5. Cellular and molecular Immunology - Abbas A.K., Lichtman A.H. and Pober, J.S.
6. Fundamental Immunology – Paul
7. Immunobiology 3rd ed. – Janeway Travers


**PRACTICAL IN IMMUNOLOGY (4 hrs per week)**

**LIST OF EXPERIMENTS**

1. Animal handling
2. Blood collection
3. Routes of drug administration
4. Dissection of mice lymphoid organ (spleen)
5. Latex agglutination method
6. Determination of Phagocytic index
7. Clinical diagnostic immunoblotting/ SDS PAGE
8. ELISA
9. Immunoassay – immuno diffusion method, rocket electrophoresis
10. ICT for malaria and HIV detection

## MEDICAL MICROBIOLOGY (BP 203)

| Course Code | Category | Course Name | L | T | P | Total Hr | C |
|---|---|---|---|---|---|---|---|
| BP 203 | Major | Medical Microbiology | 4 | 0 | 4 | 48 | 6 |

**Objective:**

The objective of the course is to familiarize the students with infectious microbial agents and clinical aspects.

| Sr. No. | Topic | Detail of syllabus | Hrs. |
|---|---|---|---|
| **Unit I** | **Bacteriology** | Bacteria of medical importance<br>Gram Positive Cocci-*Staphylococcus, Streptococcus,Pneumococcus*<br>Gram Negative Cocci- *Neissaria*<br>Gram Positive Bacilli- *Bacillus anthraxis, C. diphtheria, Clostridium*<br>Gram Negative Bacilli- members of *Enterobacteriacae , Pseudomonadaceae, Vibrio cholerae*<br>Other: *Mycoplasma, Ricketasia, Chyamadia, Mycobacteria* | 16 |
| **Unit II** | **Virology** | General properties of viruses, viral replication, viral genetics, classification of viruses, pathogenesis of viral infections and Bacteriophages. Laboratory diagnosis of viral infections, collection, storage and transport of specimen, viral cultivation, serological methods of viral diagnosis. | 8 |
| **Unit III** | **Mycology** | Structure and characteristics of fungi, differences between Bacteria and fungi, common terminologies, sporulation morphological classification, method of identification, culture and laboratory diagnosis, infections produced (Mycoses). Medical importance of fungi. | 8 |
| **Unit VI** | **Epidemiological aspects** | control of infection and disease<br>Hospital acquired infection, prevention and control | 4 |
| **Unit VI** | **The clinical manifestations of infection** | Respiratory tract infections<br>Urinary tract infections<br>Sexually transmitted diseases<br>Gastrointestinal tract infections<br>Meningitis<br>Vector-borne infections<br>Pyrexia of unknown origin<br>Zoonotic infections | 12 |

## METHODOLOGY

The course would be taught through lectures, demonstrations and practical classes.

**Books Recommended:**

1. Medical Microbiology by Mims
2. Medical microbiology by C.P. Baweja
3. Medical microbiology by Ananthnarayanan
4. Parasitology by Chatterjee
5. Mycology by Jagdish chander
6. Diagnostic microbiology by Bailey & Scott

## PRACTICAL IN MEDICAL MICROBIOLOGY (4 hrs per week)

## LIST OF EXPERIMENTS

1. **Isolation and identification of bacterial pathogen from clinical specimen**
    a. Urine sample
    b. Pus sample
    c. Blood sample/any other
2. **Antibiotic sensitivity test (Disk diffusion method and well diffusion method)**
3. **Widal test**
4. **Techniques for diagnosis of viral infections**
    a. HIV
    b. HBsAg
    c. Dengue
5. **Techniques for diagnosis of parasitic infections**
    a. Malaria
    b. Intestinal parasitic infection
6. **Techniques for identification of pathogenic fungi**
    a. Germ tube test
    b. LPCB preparation for molds
    c. Slide culture technique

## CLINICAL RESEARCH (BP 204 EL1)

| Course Code | Category | Course Name | L | T | P | Credit Hr | C |
|---|---|---|---|---|---|---|---|
| BP-204 EL1 | Elective | Clinical Research | 4 | 0 | 4 | 48 | 6 |

**Objective:**

The objective of the course is to impart the knowledge of clinical research which can be used for drug discovery and development.

| Sr. NO. | Topic | Detail of syllabus | Hrs. |
|---|---|---|---|
| **Unit I** | **Introduction to Clinical Research** | Introduction to Clinical Research<br>Terminologies and definition in Clinical Research<br>Origin and History of Clinical Research<br>Difference between Clinical Research and Clinical Practice<br>Types of Clinical Research<br>Phases of clinical research<br>Clinical Trials in India –The National Perspective<br>Post marketing surveillance<br>Pharmaceutical Industry – Global and Indian Perspective | 5 |
| **Unit II** | **Pharmacology & Drug development** | Introduction to Pharmacology<br>Concept of Essential Drugs<br>Routes of Drug Administration<br>Introduction to Drug Discovery and Development-<br>Hurdles in Drug Development<br>Sources of Drugs<br>Approaches to Drug Discovery<br>Pharmacovigilance<br>Factors affecting drug response | 8 |
| **Unit III** | **Preclinical Studies** | Guidelines For Care And Use Of Laboratory Animals<br>Introduction To Preclinical Pharmacology<br>Introductory Talk on Animal studies : present status<br>Pre – Clinical Toxicity<br>Lab Animals in Pharmacology<br>Preclinical drug testing<br>Calculation of first human dose<br>Investigational New Drug Application<br>Clinical trials<br>New Drug Application and Approval | 8 |

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| **Unit IV** | **Guidelines and Regulations in Clinical Research** | 1.International Conference on Harmonization (ICH)- Brief history of ICH, Structure of ICH, ICH Harmonization Process<br>2.Good Clinical Practice: ICH guidelines<br>3.Indian GCP guidelines (CDCSO guidelines)<br>4.ICMR Guidelines - Ethical Guidelines for Biomedical Research on Human Subjects<br>5.Schedule Y<br>6.Institutional Review Board / Independent Ethics Committee<br>Stakeholders in clinical research (Investigators, sponsors, CRO,SMO)<br>7.Clinical Trial Protocol and Protocol Amendment(S)<br>8.Investigator's Brochure<br>9. Essential Documents for the conduct of a Clinical Trial<br>• Introduction of Clinical Trial Regulation<br>• European Medicine Agency<br>• Food and Drug Administration (US FDA)<br>• Drug and cosmetic act<br>• GMP | 8 |
| **Unit V** | **Clinical Development** | Research question<br>Case report form<br>Informed Consent<br>Preparing data collection forms<br>Protocol writing<br>New drug discovery process- purpose, main steps involved in new drug discovery process, timelines of each steps, advantages and purposes of each steps, ethics in clinical research, unethical trials, Phase-I, II, III, IV trials.<br>-Introduction and designing<br>-Principles of sampling<br>-Inclusion and exclusion criteria<br>-Methods of allocation and randomization<br>-Informed consent process in brief<br>-Termination of trial<br>-Safety monitoring in clinical trials | 8 |
| **UNIT VI** | **Clinical Regulatory requirements** | Audit/ Inspection<br>Fraud and Misconduct in Clinical TrialsConflict of interest in Clinical research<br>Vaccine trails in children<br>Bioavailability and Bioequivalence<br>How to fill an ADR reporting form and methods for | 6 |

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| | | causality assessment<br>Risk to benefit ratio<br>bias and confounding factor<br>Uses of placebo | |
| **Unit VII** | **Marketing** | Promotional inputs & development of Medico-Marketing, Prescribing Information (PI) Or Package Insert (PI), Publication issues | 3 |
| **Unit VIII** | **Data management** | Clinical data management (CDM): Introduction, CRF Design, Electronic Data Capture, Data Validation, Discrepancy Management, Clinical Data Coding, SAE Reconciliation, Archiving clinical data | 2 |

**METHODOLOGY**

The course would be taught through lectures, demonstrations and practical classes.

**BOOKS RECOMMENDED**

1. Basic and Clinical Pharmacology, Prentice hall, International, Katzung, B.G.

2. Remington Pharmaceutical Sciences, Lippincott, Williams and Wilkins

3. Drug interaction, Basic Bussiness Publ, Bombay, J.K. Mehra

4. Central Drugs Standard Control Organization. Good Clinical Practices-Guidelines for Clinical Trials on Pharmaceutical Products in India. New Delhi: Ministry of Health; 2001.

5. International Conference on Harmonization of Technical requirements for registration of Pharmaceuticals for human use. ICH Harmonized Tripartite Guideline. Guideline for Good Clinical Practice.E6; May 1996

6. Ethical Guidelines for Biomedical Research on Human Subjects 2000. Indian Council of Medical Research, New Delhi

**PRACTICAL IN CLINICAL RESEARCH (4 hrs per week)**

**LIST OF EXPERIMENTS**

1. Introduction to animal house
2. Handling of lab animals
3. Various routes of drug administration (lab animals)
4. Assessment of adverse drug reaction
5. Documentation for clinical research

## DEVELOPMENTAL BIOLOGY AND STEM CELLS (BP 204 EL2)

| Course Code | Category | Course Name | L | T | P | Credit Hr | C |
|---|---|---|---|---|---|---|---|
| BP 204 EL2 | Elective | Developmental Biology and Stem Cells | 4 | 0 | 4 | 48 | 6 |

**Objective:**
The objective of the course is to develop insight of embryonic development of various organisms, with emphasis on human embryonic development. The course is designed include development at various levels.

| Sr. No. | Topic | Description | Hrs. |
|---|---|---|---|
| **Unit I** | **Introduction** | Introduction to Developmental Biology- Origins and History, Early Beliefs Gametogenesis, Fertilization, Mechanisms of Preventing Polyspermy, Fertilized-Egg Activation | 4 |
| **Unit II** | **Cleavage** | Mechanisms of Cleavage, Cleavage Patterns, Holoblastic, Cleavage: Isolecithal and Mesolecithal; Meroblastic Cleavage: Telolecithal and Centrolecithal; Cleavage Patterns in Major Groups of Organisms; Cell Specification | 6 |
| **Unit III** | **Gastrulation** | Cell Movements, Germ Layers, Gastrulation in Major Groups of Organisms | 5 |
| **Unit IV** | **Axis Formation** | Types of Axes, Axis Formation in Drosophila, Amphibians, Birds Mammals | 5 |
| **Unit V** | **Later Embryonic Development** | The Central Nervous System (CNS) and Epidermis, Mesoderm, Endoderm differentiation, Cell Death, Front Limb vs. Hind Limb Formation | 6 |
| **Unit VI** | **Post Embryonic Development** | Sex Determination, Dosage Compensation, Unusual Sex Determination, Environmental Sex Determination, Metamorphosis, Regeneration | 4 |
| **Unit VII** | **Stem cells and cellular pedigrees** | Scope of stem cells – definition of stem cells – concepts of stem cells – differentiation , maturation<br>Types, properties and sources of stem cells : Skeletal muscle stem cell – Mammary stem cells – intestinal stem cells – keratinocyte stem cells of cornea – skin and hair follicles – | 12 |

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| | | Tumour stem cells, Ebryonic stem cell biology - factors influencing proliferation and differentiation of stem cells – hormone role in differentiation. | |
| **Unit VIII** | **Applications of stem cells** | Cellular therapies – vaccines – gene therapy – immunotherapy – tissue engineering – blood and bone marrow – Fc cells | 6 |

**METHODOLOGY**

The course would be taught through lectures, demonstrations and practical classes.

**Books Recommended:**

1) Developmental Biology, Eighth Edition, Scott F. Gilbert, Susan Singer, Publisher: Sinauer Associates Inc.; ISBN-13: 978- 0878932504

2) Developmental Biology: A Very Short Introduction, Lewis Wolpert, Publisher: Oxford University, ISBN-13: 978- 0199601196

3) Essential Developmental Biology, Jonathan M. W. Slack Publisher: Wiley-Blackwell; 3 edition, ISBN-13: 978- 0470923511

4) Stem cells – Elsevier : CS Potten , 1997.

5) Essentials of stem cell biology , Robert Paul Lanza ,2006.

**PRACTICAL IN DEVELOPMENTAL BIOLOGY AND STEM CELLS**

**(4 hrs per week)**

**LIST OF EXPERIMENTS**

1. Primary cultures of cells from chick embryo
2. Isolation of Fibroblast cells from chick embryo
3. Staining and fixing of fibroblast cells
4. Isolation of cells from Rat/ liver etc.

## HUMAN GENETICS (BP 204 EL3)

| Course Code | Category | Course Name | L | T | P | Hr | C |
|---|---|---|---|---|---|---|---|
| BP 204 EL3 | Elective | Human Genetics | 4 | 0 | 4 | 48 | 6 |

**Objective:**

The objective of the course is to familiarize the students with the importance & universality of Human Genetics. The students will be familiar with sub-disciplines in Genetics and their importance in applied medical sciences.

| Sr. NO. | Topic | Detail of syllabus | Hrs. |
|---|---|---|---|
| **Unit I** | **Mendelian Genetics** | Historical views of heredity; Mendelian, Laws of Segregation, Law of Independent assortment, Trihybrid crosses; Gene-environment interactions, intralocus & Interlocus; Interactions | 6 |
| **Unit II** | **Sex determination** | Sex determination mechanisms & numerical; Genotypic Sex determination mechanisms; Environmental Sex determination mechanisms; Sex linked inheritance. Linkage and crossing over. Inactivation of the Sex chromosome | 8 |
| **Unit III** | **Non Mendelian Genetics** | Extra chromosomal inheritance; organelle heredity; Plasmid inheritance, Infectious heredity & Maternal effect | 6 |
| **Unit VI** | **Chromosomal Aberrations & genetic disorders** | Structural & numerical Chromosomal Aberrations and various genetic syndromes & disorders | 6 |
| **Unit VII** | **Population Genetics** | Genetic variability, Genotypic & allelic frequency, Hardy Weinberg's law & numerical; Factors affecting changes in allelic & genotypic frequency- Mutation; migration; selection & random genetic drift | 8 |

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| **Unit IX** | **Genetics Counseling & Pedigree Analysis** | Introduction to genetics counseling, methods prenatal diagnosis of genetic disorders invasive and non-invasive, ethical issue of genetic counseling, eugenics Online Mendelian Inheritance in Man (OMIM), NCBI Genes and Disease in humans with single gene Disease, gathering family history, pedigree symbols, construction of pedigrees, presentation of molecular genetic data in pedigrees | 12 |
| **Unit XII** | **Human Genome Project and** | Introduction and Background, Major outcome, hurdles and solution | 2 |

**METHODOLOGY**

The course would be taught through lectures, demonstrations and practical classes.

**BOOKS RECOMMENDED**


1. A text book of genetics by Sambhamurthy
2. The Human Genome: A user Guide, by R. Scott Hawley and Catherine A Mori, Academic Press.
3. Human Genetics: The Basics, By Ricki Lewise, Taylor and Francis
4. Genetics by Russel
5. Genetics by Klug
6. Genetics by Tamarind
7. Genetics by Snustad & Simmons
8. Genetics by C.B Powar
9. Genetics by B.D Singh
10. Genetics by Pierce


**PRACTICALS IN HUMAN GENETICS (4 Hrs. per Week)**

**LIST OF EXPERIMENT**

1. Induction of polyploidy in Onion root tips.
2. Methyl Green-Pyronin Staining of DNA
3. Dermatoglyphs of human fingers
4. Human Karyotype
5. ABO Blood Grouping
6. Hardy-Weingberg Law

## SEMESTER IV

## RESEARCH METHODOLOGY AND SOCIO- ETHICAL ASPECTS OF BIOTECHNOLOGY (BP 205)

| Course Code | Category | Course Name | L | T | P | Total Hr | C |
|---|---|---|---|---|---|---|---|
| BP 205 | Major | Research Methodology and Socio- Ethical aspects of Biotechnology | 4 | 0 | 4 | 48 | 6 |

**Objective:** The objective of the course is to make students aware of research methodology and biostatistics used in biotechnology research as well as to aware them the legal, safety and public policy issues raised due to the progress in Biotechnology and development of new products as well as regulatory framework governing processing of bio-products.

| Sr. No. | Topic | Detail of syllabus | Hrs. |
|---|---|---|---|
| **Unit I** | **Research Methodology** | Introduction, Defining Research Problem, Research Design, Sampling Design, Methods of Data Collection, Interpretation and report writing | 5 |
| **Unit II** | **Bioinstrumentation** | Principles and Application of:<br>Chromatographic techniques: Basic concepts, Gel filtration Chromatography, Ion Exchange Chromatography, Affinity Chromatography, Gas Chromatography, High Performance Liquid Chromatography<br><br>Electrophoresis: Concept, Agarose Gel Electrophoresis, Polyacrylamide Gel Electrophoresis, Isoelectric Focusing<br><br>Centrifugation: Basic concept, Ultra Centrifugation, Density Gradient Centrifugation, Differential Centrifugation, Isopycnic Centrifugation<br><br>Spectroscopy: Basic concept, UV/Visible Spectroscopy, Circular Dichroism (CD) & Optical Rotary Dispersion (ORD), Fluorescent Spectroscopy, Infra Red Spectroscopy, FTIR, Mass Spectroscopy, MALDI- TOF<br><br>Radiography: Tracer Elements in Biology, Radio Active isotopes, Half Life of isotopes, Autoradiography, Pulse Chase experiment, Cerenkov radiation, Liquid Scintillation Counting, Phosphor Imaging | 8 |
| **Unit III** | **Biostatistics** | Measures of central tendency: mean, mode, and median.<br>Measures of dispersion: range, mean deviation, | 11 |

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| | | standard deviation.<br>Methods of sampling, sampling error, non-sampling errors, standard error.<br>Meaning of correlation and regression. Tests of significance – F & t tests, chi-square tests, ANOVA.<br>Cluster analysis: phylogenetic clustering by simple matching coefficients.<br>Presentation of statistical data: tabulation (simple tables, frequency distribution table); charts and diagrams (bar charts, histograms, pie charts, dendrogram).<br>Research designs with basic principles and field layout. | |
| **Unit IV** | **Bioethics** | Bioethics- History & Introduction; Social, Legal & Ethical Issues in biotechnology, ethical concerns of biotechnology research, Bioethics Committees<br>Animal ethics- Norms in India-Licensing of animal house- Ethical clearance norms for conducting studies on human subjects, IAEC | 4 |
| **Unit V** | **Intellectual Property Rights** | Introduction to IPR, IPR in India, IPR in abroad, Types of IPR- Patent, Copyright, Trademark, Design & Trade Secret<br>Biotechnology & IPR- Commercial potential of biotechnology inventions; Patenting Biotechnological Inventions- Objective, Concept of novelty, Concept of inventive step, Microorganism, Moral issues in patenting biotechnological inventions.<br>Plant Varieties Protections- Objective, Justification, International position, Plant Variety Protection in India.<br>Protection of geographical indication- Objective, Justification, International position, Multilateral Treaties, National level, Indian positions<br>Protection of traditional knowledge- Objective, Concept of traditional knowledge, Bioprospecting & Biopiracy, Protectability. | 9 |
| **Unit VI** | **Biosafety** | Introduction a& development of Biosafety; Practices & Principles; General lab equipments; Definitions & Biosafety levels, 1, 2, 3, 4,; Biological safety cabinets, centrifuge; Shipment of biological specimens; Biological waste management; Decontaminations, Biosafety manuals; Medical surveillance, Emergency response. | 6 |

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| **Unit VII** | **Social Issues and the Environment** | Global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, Wasteland reclamation: Case studies. Environment protection Acts: Air (Prevention and control of Pollution) Act. Water (Prevention and control of Pollution) Act Wildlife protection Act. Forest Conservation Act. Issues involved in enforcement of environmental legislation. | 5 |

**METHODOLOGY**

The course would be taught through lectures and tutorials.

**Books recommended:**


1. Research Methodology- Methods & Techniques by C. R. Kothari
2. Principles & Techniques of Biochemistry & Molecular Biology by Wilson & Walker
3. Methods in Biostatistics by B. K. Mahajan
4. Fundamentals of Biostatistics by Khan & Khanum
5. Fundamentals of Biostatistics by U.B.Rastog
6. T. M. Murray & M. J. Mehlman, Encyclopedia of ethical, legal and policy issues in biotechnology, John Wiley & sons 2000.
7. Ethical Issues in Biotechnology by Richard Sherlock & John D. Morrey, Rowman & Littlefield Publishers
8. Agarwal, K.. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.


**PRACTICALS IN RESEARCH METHODOLOGY AND SOCIO- ETHICAL ASPECTS OF BIOTECHNOLOGY (4 Hrs. per Week)**

**LIST OF EXPERIMENT**

1. Manuscript preparation for research article.
2. Research proposal formation and submission.
3. Data analysis of case study.
4. Collection, classification and tabulation of data.
5. Measures of central tendency.
6. Student t – test.
7. Chi – square test.
8. Correlation coefficient and rank correlation.

## PHARMACEUTICAL BIOTECHNOLOGY (BP 206)

| Course Code | Category | Course Name | L | T | P | Total Hr | C |
|---|---|---|---|---|---|---|---|
| BP 206 | Major | Pharmaceutical Biotechnology | 4 | 0 | 4 | 48 | 6 |

**Objective:**

The objective of the course is to give strong base and advanced information on biopharmaceutical aspects in relation to drug development.

| Sr. No. | Topic | Description | Hrs. |
|---|---|---|---|
| **Unit I** | **Bio-processing system** | Expression system<br>Cultivation systems<br>Cultivation medium<br>Contaminants | 8 |
| **Unit II** | **Formulation of biotech products, including biopharmaceutical Considerations** | Microbiological consideration<br>Excipients used in Parental formulations of Biotech products<br>Shelf life of protein based pharmaceuticals<br>Delivery of proteins: Routes of administration and adsorption enhancement<br>Approaches for rate controlled and target site specific<br>Delivery by the parental route | 12 |
| **Unit III** | **Pharmacokinetics and Pharmacodynamics of peptide and protein drugs** | ADME of protein therapeutics<br>Bioavailability and Bioequivalency<br>Pharmacodynamics of protein therapeutics<br>Interspecies scaling<br>Heterogeneity of protein therapeutics<br>Chemical modification of protein therapeutics<br>Immunogenicity | 10 |
| **Unit IV** | **Genomics, Proteomics and additional biotechnology-related techniques** | Genomics, proteomics and pharmacogenetics/genomics<br>Genetically engineered animals<br>Protein engineering<br>Peptide chemistry and peptidomimetics<br>Nucleic acid technologies<br>Catalytic antibodies<br>Glycobiology<br>Biotechnology and drug discovery | 10 |
| **Unit V** | **Gene therapy** | *Ex vivo* versus *in vivo* gene therapy<br>Potential target diseases for gene therapy<br>Gene transfer methods<br>Non-viral gene transfer<br>Gene transfer using recombinant viruses | 8 |

**METHODOLOGY**

The course would be taught through lectures, demonstrations and tutorials classes.

**Books Recommended:**

1. Proteins: Biochemistry and Biotechnology - Gary Walsh
2. Foye's Principles of Medicinal Chemistry –William David A. and Lemke Thomas L.
3. Pharmaceutical Biotechnology, 2nd ed. by Crommelin D.J.A. & Sindelar R. D.

**PRACTICALS IN PHARMACEUTICAL BIOTECHNOLOGY (4 Hrs. per Week)**

**LIST OF EXPERIMENT**

1. Antibiotic production from biological sources.
2. To perform antibiotic assay.
3. Determination of Minimum Inhibitory Concentration (*MIC*) of given antibiotics.
4. Sterility testing of pharma products.
5. Toxicity testing.
6. Industrial visit.

**PROJECT WORK/ DISSERTATION (BP 207)**

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|---|---|
| BP 207 | M.Sc. Dissertation Project: Each candidate needs to complete a short dissertation project. Prior to proposing a project, the students must have identified a research topic and a mentor who is familiar with their prospective inquiry and who is willing to provide guidance and oversee the project. |