



**Chettinad**

Academy of Research & Education

(Deemed to be University Under Section 3 of the UGC Act 1956)

**Chettinad Academy of Research & Education**

**Faculty of Allied Health Sciences**

**(Deemed to be University under section 3 of the UGC Act 1956)**



**REGULATIONS & SYLLABUS**

**B.Sc. (Medical Genetics)**

**(2016 – 17 batch)**

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## Programme Outcome

<b>Programme Name</b>	Medical Genetics
<b>Programme Award</b>	B.Sc.(Medical Genetics)
<b>Programme Aims</b>	<p>Broadly A flexible teaching and learning program of high quality for stimulating the students to merge their knowledge in genetics for improvements in medical science</p> <p>Specifically</p> <ul style="list-style-type: none"> <li>• Understanding the role of genes in health and disease</li> <li>• Improve practical skills in chromosome and gene analysis</li> </ul>
<b>Programme Learning Outcomes: Knowledge and Understanding</b>	<ul style="list-style-type: none"> <li>• Have an appreciation of role of genetics to improve human health and disease management</li> <li>• Advance knowledge in areas of genetics and medicine to develop products and S&amp;T tools for improved human health</li> <li>• Develop insight into fundamental genetic systems, including genomics</li> </ul>
<b>Programme Learning Outcomes: Intellectual Skills</b>	<ul style="list-style-type: none"> <li>• Read and analyze scientific papers, grasp essential points to develop new research projects</li> <li>• Develop an ability to manage time in subject understanding and enhancing knowledge through better reading and analysis</li> </ul>
<b>Programme Learning Outcomes: Subject Practical Skills</b>	<ul style="list-style-type: none"> <li>• Theoretical and practical techniques in genetics</li> <li>• Planning and executing experiments</li> <li>• Report writing</li> <li>• Understand, retrieve information from databases</li> </ul> <p>Students will gain hands on training and perform</p> <ul style="list-style-type: none"> <li>• Various analytical techniques, various biochemical tests</li> <li>• Molecular biological techniques</li> <li>• Practical aspects of cytogenetics</li> <li>• Sample collection and processing for immunological analysis</li> <li>• Technical skill in the culture of cells</li> <li>• rDNA technological aspects</li> <li>• Training in the field of bioinformatics</li> </ul>
<b>Programme Learning Outcomes: Transferable/Key Skills</b>	<ul style="list-style-type: none"> <li>• Communicate orally with clarity and coherence, concepts and arguments in medical genetics</li> <li>• Communicate in writing concepts of medical genetics</li> <li>• Demonstrate use of IT skills for better understanding of the subject</li> </ul>



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## 1. Introduction:

B. Sc. (Medical Genetics) is a three year course under inter-disciplinary program in emerging areas. This course aims to provide training for the new generation of students to arm them with the skills needed for this new era, and to prepare them for careers in health care, pharmaceutical, environment, food industries and academics. This B.Sc. program comes under CBCS system and provides a thorough training to the candidates through formal lectures, seminars and practical classes with a choice for the students to opt for electives of their choice.

## 2. Short Title and Commencement:

These Regulations shall be called the "Regulations for B.Sc. (Medical Genetics) Course" of Chettinad Academy of Research and Education. These regulations are subject to modifications as may be approved by the Academic Council from time to time.

## 3. Eligibility for Admission:

A candidate desiring to join the program leading to the degree B. Sc. (Medical Genetics) should have passed HSC/CBSE/ISC or equivalent examination with one of the following subject combinations:

- i) Physics, Chemistry, Biology
- ii) Physics, Chemistry, Botany and Zoology.

Candidates who have passed the HSC in vocational streams are also eligible to apply.

A candidate shall, at the time of admission submit to the Head of the Institution, a certificate of medical fitness from an authorized Medical Officer certifying that the candidate is physically fit to undergo the academic course and does not suffer from any disability or contagious disease.

## 4. Age limit for admission:

A candidate should have completed the age of 17 years as on 31<sup>st</sup> December of the year of admission.

## 5. Eligibility Certificate:

Candidates, who have passed any qualifying examination other than the Higher Secondary Course examination conducted by the Government of Tamil Nadu, shall obtain an Eligibility Certificate, from Chettinad Academy of Research and Education and produce the same at the time of admission.



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**6. Registration:**

A candidate admitted to the course shall register his/her name with the University by submitting the application form for registration, duly filled in along with the prescribed fee, through the Head of the Institution within the stipulated date.

**7. Duration of the course:**

The duration of the B.Sc. (Medical Genetics) Degree Course shall be 3 years comprising of 6 semesters. The candidate is required to pursue the course on a full time basis, and must complete the course within five years from the date of provisional registration.

**8. Commencement of the Course:**

The course shall ordinarily commence on 1<sup>st</sup> August of the academic year. Admission for the said course shall be completed by 31<sup>st</sup> August.

**9. Curriculum:**

The three years course will be conducted according to the scheme attached to the regulations.

**10. Medium of Instruction:**

English shall be the medium of instruction for all the subjects of study and for examination.

**11. Working Days:**

Each semester shall consist of not less than 90 working days and each academic year shall have a total of 180 working days.

**12. Attendance:**

The candidate shall have not less than 80% attendance in Theory and Practical separately. Each semester shall be taken as a unit for the purpose of calculating the attendance. The candidate lacking attendance in a subject shall be denied permission to appear for the University Examination in that subject.

**13. Condonation of Lack of Attendance:**

The discretionary power of condonation of shortage of attendance to appear for University Examination rests with the University.

Lack of attendance can be condoned up to a maximum of 5% of the minimum attendance required in the following exceptional circumstances:



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- (i) Any illness / accident (for which Medical certificate from a registered medical practitioner must be produced)
- (ii) Any unforeseen tragedy in the family (should produce the letter from the parent / guardian)
- (iii) Participation in NCC / NSS and other co-curricular activities representing the Institution / University. (Certificate from competent authority is required)

For any of the above reasons, request shall be made by the candidate with prescribed fees to the Controller of Examination through proper channel, ten days prior to the commencement of the theory examination.

#### 14. Commencement of the examinations:

There shall be two sessions of University examinations in an academic year, viz., December and June.

#### 15. Cut-off dates for admission to the examinations:

The candidates admitted from 1<sup>st</sup> August to 31<sup>st</sup> August of the academic year shall be registered to take their first semester examination in the month of December of that academic year after fulfilment of the stipulated regulations.

#### 16. Credits:

The term credit is used to describe the quantum of syllabus for various programs in terms of hours of study. It indicates differential weightage given according to the contents and duration of the courses in the curriculum design. The minimum credit requirement for B.Sc. (Medical Genetics) Course shall be 138.

#### 17. Course Weightage:

For this course, credits will be assigned on the basis of the lectures / tutorials / practicals and other forms of learning. A course carrying one credit for lectures will have instruction of one hour per week during the semester.

E.g.:- If three hours of lecture is necessary in each week, then 3 credits will be the weightage.

Credits assigned for the whole semester (not less than 90 working days).

- i. One credit for each lecture hour per week.
- ii. One credit for each tutorial hour per week.
- iii. One credit for every two hours of laboratory or practical work per week.
- iv. One credit for one and a half hours of project work in a week.
- v. One credit for every two hours of seminar.

#### 18. Grading system:

All assessments of a course shall be done on absolute marks basis. However, for the



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purpose of reporting the performance of a candidate, letter grades, each carrying certain points, will be awarded as per the range of total marks (out of 100) obtained by the candidate, as detailed below:

Marks	Grade Points	Letter grade
90- 100	10.0	O
80 – 89	9.0	A+
70 – 79	8.0	A
60 – 69	7.0	B+
50 – 59	6.0	B
40-49	5.0	C+
< 40	0	RA
Not appeared	0	NA

**“RA” Reappearance - denotes failure and the candidate is required to reappear for that examination.**

"NA" Not appeared - denotes that the student did not appear for the examination although eligible.

"O" Outstanding

All assessments of a course shall be done on absolute marks basis. However, for the purpose of

After results are declared, Grade Statement will be issued to each student which will contain the following details:

- The college in which the candidate has studied
- The list of subjects enrolled during the semester and the grades scored.
- The Credits awarded and accumulated.
- The Grade Point Average (GPA) for the semester and
- The Cumulative Grade Point Average (CGPA) of all subjects enrolled from first semester onwards.

GPA is the ratio of, the sum of the products of the number of credits of subjects (C) and the grade points scored in those subjects (GP), to the sum of the credits of all the subjects in that semester

$$GPA = \frac{\text{Sum of [C x GP]}}{\text{Sum of C}}$$



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CGPA will be calculated using the above formula, considering all the subjects enrolled from first semester onwards. "RA", "I" and "NA" grades will be excluded for calculating GPA and CGPA.

## 19. Classification of successful candidates:

The CGPA arrived at the completion of the program shall be the criteria for the classification of successful candidates as below:

CGPA (Percentage)	Classification
10.0 (90-100%)	First class with honours
8.0 – 9.9 (75-89%)	First class with Distinction
6.5 to 7.9 (60-74%)	First class
4.5 to 6.4 (40-59%)	Second class

a) Successful candidates who secure 75% marks and above as a program aggregate in the first appearance taking University theory, practical, project/dissertation evaluation and viva shall alone be awarded Distinction. This will also apply for award of University rank.

b) Successful candidates who secure 60% marks and above as a program aggregate in the University theory, practical, project/dissertation evaluation and viva shall be awarded First Class.

c) All others who secure 40-59% in gross percentage will be classified to have passed in Second Class

## 20. Continuous Assessment:

### *Theory:*

- Written tests (75%), Assignment (15%) and Attendance (10% - 95 -100 % shall be given 100% marks, 90 - 94% and shall be given 65% marks, 85 - 89% attendance shall be given 35% marks).
- Written tests shall be the average of the best two out of three tests,
- The second Internal Examination shall be multiple choice test / online computer based test.
- Third Internals will be similar to the end semester University examinations. Students are encouraged to take this examination without fail.

### *Practical:*

- Observation record (50%), Practical examination (35%) and Viva (15%)



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- f. Day to day record of observation note based on their regular performance and attendance during practical hours.
- g. Two Internal practical examinations will be held- one each during first and third theory internal examinations.

**21. Internally Evaluated End – Semester University Examination:** The examination in B.Sc. (Medical Genetics) shall consist of Written Theory examinations and Practical Examinations. The Internally Evaluated End - Semester University Examination shall be conducted at the end of each semester.

- a) Papers for which Internal Examination is recommended by the Board of Studies and approved by the Academic Council, the following criteria shall be followed.
  - i) The weightage for Continuous Assessment and Internally Evaluated End – Semester University Examination shall be 25% and 75% respectively.
  - ii) The Continuous (Internal) Assessment marks shall be the average of the best two out of three. The date of Semester - End Examinations (Internal examinations) shall be as per the University guidelines

**22. Pattern of Internally Evaluated - End Semester University Examination/Department):**

**Examination Pattern – I (for subjects with theory and practical components)**

<b>A) THEORY</b>	<b>Max. Marks – 60</b>	<b>Duration: 2 hours</b>
i) <b>Section-A</b> Short questions (10 x 1)		10 marks
ii) <b>Section- B</b> Short Notes (5 x 3) [Choice based / either or from the same unit]		15 marks
iii) <b>Section- C</b> Descriptive type questions (5 x 7) [Choice based / either or from the same unit]		35 marks



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## B) PRACTICAL

i) Practical (including Oral) **15 marks**

## C) CONTINUOUS ASSESSMENT

**25 marks**

i) Theory 20 marks  
ii) Practical 5 marks

## GRAND TOTAL

**100 marks**

### Examination Pattern – II (for subjects with theory and practical components)

#### A) THEORY

**Max. Marks - 30**

**Duration: 1 hour**

i) **Section-A**

Short questions (5 x 1) 5 marks

ii) **Section- B**

Short Notes (3 x 3) 9 marks  
[Choice based / either or]

iii) **Section- C**

Descriptive type questions (2 x 8) 16 marks  
[Choice based / either or]

#### B) PRACTICAL

i) Practical (including Oral) **15 marks**

#### C) CONTINUOUS ASSESSMENT

**15 marks**

i) Theory 10 marks  
ii) Practical 5 marks

## GRAND TOTAL

**60 marks**

### Examination Pattern– III (for subjects with theory component alone)

#### A) THEORY

**Max. Marks - 60**

**Duration: 2 hours**

i) **Section-A**

Short questions (10 x 1) 10 marks

ii) **Section- B**

Short Notes (5 x 3) 15 marks  
[Choice based / either or from the same unit]

iii) **Section- C**

Descriptive type questions (5 x 7) 35 marks



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[Choice based / either or from the same unit]

## **B) CONTINUOUS ASSESSMENT**

**20 marks**

### **GRAND TOTAL**

**80 marks**

#### **23. Marks Qualifying for a Pass:**

For passing the University / End-Semester Examination from Semester I to Semester VI, the candidate shall secure the marks as stated below,

- a) 40% minimum in the End-Semester examination as well as 40% aggregate marks (continuous assessment and End- Semester examination). There is no minimum mark for passing the internal assessment examination.
- b) For theory papers which are internally evaluated the same distribution of 25% for Continuous Assessment and 75% for Semester - End Examination (which shall be conducted by the respective Department) shall be followed.
- c) For Practical papers which are internally evaluated with the distribution of 40% for Continuous Assessment and 60% for Semester - End Examination (which shall be conducted by the respective Department) shall be followed.

#### **24. Requirements for proceeding to subsequent semesters:**

- (a) Candidates shall be permitted to proceed from the First Semester up to the Final Semester irrespective of their failure in any of the semester examination, subject to the condition that the candidates should register for all the arrear subjects of earlier semesters along with current semester subjects.
- (b) Candidates shall be eligible to proceed to the subsequent semester, only if they earn sufficient attendance as prescribed in regulation No.12 and 13 above.
- (c) If the candidate has non-condonable lack of attendance in any subject then the candidate shall be required to repeat the respective subject and fulfill the requirements of attendance as per Clause No. 12 & 13 to be eligible to appear for the examination in the subject.
- (d) Candidate who has failed in a University theory or practical examination or in project evaluation shall reappear for that particular component only. Candidate is permitted to proceed to the next semester irrespective of his / her failure in the earlier semester.

#### **25. Revaluation of answer papers\***

There shall be no revaluation of answer papers of failed candidates. Failed candidates are however, permitted to apply to the University within fifteen days of publication of the results for retotalling.

\*(Amended as follows as per resolution passed in the XXXV meeting of Academic Council on 10.03.2020 and 46th meeting of the Board of Management on 20.03.2020.)



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Students are permitted to apply for photocopy of the answer script or apply for revaluation of answer script (after applying for photocopy) as per the norms of the institute for all examinations from June 2020 session onwards in supersession of the above clause.

## 26. Temporary break of study:

- (a) A candidate is not normally permitted to temporarily break the study.
- (b) If a candidate is continuously absent from the institute for four or more weeks,
  - i) having notified the Dean / Director / Principal within this period, this absence shall be treated as "Temporary Break of Study".
  - ii) without notifying the Dean / Director / Principal, his/her name will be removed from the institute rolls.
- (c) If a candidate is compelled to temporarily break the study for valid reasons (such as accident or hospitalization due to prolonged ill health), he / she shall apply for condonation of the break to the Dean / Director / Principal through the Head of the Department.
- (d) For condonable break of study:
  - i) if the lack of attendance is within condonable limits as per Clause No. 13 & 14, the candidate shall be permitted to write the examination for the current semester.
  - ii) if there is non-condonable lack of attendance, the candidate shall rejoin the program at the respective semester as and when it is offered after the break and shall be governed by the rules and regulations in force at the time of rejoining.
- (e) The total period for completion of the programme reckoned from the commencement of the semester to which the candidate was first admitted shall not exceed the maximum period specified in Clause No.6 irrespective of the period of break of study in order that he / she may be qualified for the award of the degree.
- (f) In any case, a candidate shall be permitted to temporarily break the study only once during the entire duration of the program. The candidate shall forfeit the registration in case of a second break or in case of a non-condonable break of study.
- (g) Without prejudice to the above rules, the candidate who has completed the attendance requirement for a semester, but has proceeded on a condonable break of study without appearing for the University Examination, shall be permitted to appear for the examinations without repeating the semester and thereafter continue the subsequent semester.

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## Scheme of Examination

Semester – I									
S.No	Papers	Hours per Semester		Evaluation (Marks)					
		L	P	Continuous Assessment		End Semester Examination (University/ Department Exams)		Total	Credits
				T	P	T	P		
1.	<b>UEAPo64/</b> Anatomy and Physiology (GE)	60	30	20	5	60	15	100	5
2.	<b>UCCBo02 /</b> Cell Biology (CC)	60	-	20	-	60	-	80	4
3.	<b>UCBCH58/</b> Chemistry for Biomedical Sciences (CC)	60	30	20	5	60	15	100	5
4.	<b>UCBPH59 /</b> Physics for Biomedical Sciences (CC)	60	30	20	5	60	15	100	5
5.	<b>UCEN105 /</b> English – I (AECC)	60	-	20	-	60	-	80	4
6.	<b>UCFC006 /</b> Fundamentals of Computing (AECC)	30	30	10	5	30	15	60	3
<b>Credits = 26</b>									

Semester II									
S.No	Papers	Hours per Semester		Evaluation (Marks)					
		L	P	Continuous Assessment		End Semester Examination (University/ Department Exams)		Total	Credits
				T	P	T	P		
1.	<b>UCBC013/</b> Biochemistry (CC)	60	-	20	-	60	-	80	4
2.	<b>UCPFG051/</b> Fundamentals of Genetics (UE)	60	30	20	5	60	15	100	5
3.	<b>UEBS065/</b> Biostatistics (GE)	60	-	20	-	60	-	80	4
4.	<b>UCESD10/</b> Environmental Science and Disaster Management (AECC)	60	-	20	-	60	-	80	4
5.	<b>UCEN211/</b> English – II (AECC)	60	-	20	-	60	-	80	4



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6.	<b>ULBC019/</b> Practical I – Biochemistry (CP)	-	90	-	30	-	30	60	3
<b>Credits = 24</b>									

Semester IV									
S. No	Papers	Hours per Semester		Evaluation (Marks)					
		L	P	Continuous Assessment		End Semester Examination (University/ Department Exams)		Total	Credits
				T	P	T	P		
1.	<b>UCCG053/</b> Cytogenetics (SEC)	60	-	20	-	60	-	80	4
2.	<b>UCMG056/</b> Medical Genetics (CC)	60	-	20	-	60	-	80	4
3.	<b>UCIM062/</b> Immunology and Molecular Diagnostics (CC)	60	-	20	-	60	-	80	4
4.	Elective 2* (GE)	60	-	20	-	60	-	80	4
5.	<b>ULIM063/</b> <b>Practical IV:</b> Immunology and Molecular Diagnostics (CP)	-	90	-	30	-	30	60	3
6.	<b>ULCG055/</b> <b>Practical V:</b> Cytogenetics (SEC)	-	90	-	30	-	30	60	3

Elective 2: **UEBGP16/**Basic concepts of Genomics and Proteomics or **UETT025/**Transgenic Technology or **UENSS18/**National Service Scheme (GE) **Credits = 22**

Semester III									
S. No	Papers	Hours per Semester		Evaluation (Marks)					
		L	P	Continuous Assessment		End Semester Examination (University/ Department Exams)		Total	Credits
				T	P	T	P		
1.	<b>UCAT007 /</b> Analytical techniques (SEC)	60	-	20	-	60	-	80	4
2.	<b>UCMB014/</b> Molecular Biology (CC)	60	-	20	-	60	-	80	4
3.	<b>UCMM021/</b> Developmental genetics (CC)	60	-	20	-	60	-	80	4
4.	Elective 1*(GE)	60	-	20	-	60	-	80	4



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5.	<b>ULAT012/</b> <b>Practical II:</b> Analytical techniques (SEC)	-	90	-	30	-	30	60	3
6.	<b>ULMB020/</b> <b>Practical III:</b> Molecular Biology (CP)	-	90	-	30	-	30	60	3
*Elective 1: <b>UEBBI24/</b> Bioethics, biosafety and IPR or <b>UEPE017/</b> Principles of Enzymology or <b>UEHBG33/</b> Human Biochemical Genetics or <b>UECWM26/</b> Chemical Weapons of Mass destruction and their disarmament (GE)									<b>Credits - 22</b>

## Semester V

S. No	Papers	Hours per Semester		Evaluation (Marks)				Total	Credits
		L	P	Continuous Assessment		End Semester Examination (University/ Department Exams)			
				T	P	T	P		
1.	<b>UCTC029/</b> Tissue Culture Technology (CC)	60	-	20	-	60	-	80	4
2.	<b>UCGE030/</b> Genetic Engineering (CC)	60	-	20	-	60	-	80	4
3.	<b>UCIGC60/</b> Introduction to Genetic Counseling or <b>UEPE069/</b> Population and Evolutionary genetics (DSE)	60	-	20	-	60	-	80	4
4.	Elective 3* (DSE)	60	-	20	-	60	-	80	4
5.	<b>ULGE035/</b> Practical VII: Genetic Engineering (CP)	-	90	-	30	-	30	60	3
6.	<b>ULTC034/</b> Practical VI: Tissue Culture Technology (CP)	-	90	-	30	-	30	60	3

\* Elective 3: **UECTM39/**Clinical Trial and Management or **UEBP032/**Biopharmaceuticals or **UEPM040/** Personalized Medicine (DSE) Credits = 22

## Semester VI

S. No	Papers	Hours per Semester		Evaluation (Marks)				Total	Credits
		L	P	Continuous Assessment		End Semester Examination (University/ Department Exams)			
				T	P	T	P		
1.	<b>UCBI036/</b> Bioinformatics (CC)	60	-	20	-	60	-	80	4
2.	<b>UCSCB37/</b> Stem Cell Biology (CC)	60	-	20	-	60	-	80	4



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3.	<b>UERC70/</b> Reproductive and Cancer Genetics	60	-	20	-	60	-	80	4
4.	<b>ULBI041/</b> Practical VIII - Bioinformatics (UE)	-	90	-	30	-	30	60	3
5.	<b>UEPJo68/</b> Project /Dissertation(DSE)	-	180	-	50	-	50	100	8
<b>Credits = 23</b>									<b>Total Credits: 139</b>

**\*\* Can be individual or group based (not more than 4 in a group)**

**Amended in XXI meeting o Academic council dt 22.07.2015**

SEM - I	UeAPo64/Anatomy and Physiology (Credits -5)	L	P	T	J
		4	2	0	0
<b>Requisite</b>	<b>Expected to have a basic knowledge in Biology at higher secondary level</b>				
<b>Objective</b>	<b>To impart basic knowledge in human organ systems and their functional relevance</b>				
<b>Modules</b>	<b>Contents</b>				<b>Hr</b>
Unit-I	<b>Introduction to human body:</b> Definition and subdivision of anatomy, skeletal system - Cartilage Type and basic feature. Bones: definition and classification, Joints – Definition and types with example, Muscular system- Types and Parts of skeletal muscle, Nervous system - Subdivisions of the nervous system, Spinal cord –location, external features and blood supply, Brain-subdivision, location, external features, Sense organs - Location and features of nose, tongue, eye, ear and skin, Endocrine system-Names of the endocrine glands, Location and features.				<b>15</b>
Unit-II	<b>Anatomical aspects of Cardio vascular, Respiratory, Digestive, Urinary and Reproductive systems:</b> Cardio vascular system:Types and general features of blood vessels. Shape, size, location, external and internal features of Heart. <i>Respiratory system</i> - organs of respiration. <i>Digestive system</i> -parts of the alimentary canal and accessory organs, <i>Urinary system</i> - Location and features of organs, <i>Reproductive system</i> - Location and features.				<b>15</b>
Unit-III	<b>General Physiology:</b> Cell structure and functions Transport across membranes. Body and body fluids - Blood composition and functions, Plasma proteins – Types and functions, Blood coagulation – Mechanism and name of anticoagulants, Blood groups – Basis of ABO & Rh grouping, Erythroblastosis Foetalis. Muscle physiology, Muscles – Classification & structure of striated, nonstriated & cardiac muscle, Digestive system - Salivary glands, Parts of stomach, Pancreatic juice – composition & functions, Bile – composition & functions, Excretory system- Kidney, Formation of urine, Reabsorption & secretion.				<b>15</b>
Unit-IV	<b>Basic Physiology of Endocrine, Cardio vascular, Respiratory and Reproductive systems::</b> Posterior pituitary hormones and its actions, Anterior pituitary hormones, Thyroid hormones, Parathyroid hormones , Reproductive system - Male reproductive organs and Female reproductive organs, Respiratory system - Mechanics of respiration, Oxygen transport, Carbon-di-oxide transport, Cardiovascular system - innervations of heart, Cardiac cycle, Nervous system - Structure of neuron and functions.				<b>15</b>
Unit-V	<b>Lab Anatomy:</b> Gross Spotters 1. Identification of viscera – Spinal cord, Brain, Tongue, Heart, Lungs, Kidney, Testis, Ovary, Liver, Spleen, Stomach and Pancreas. 2. Identification of Muscles – Biceps, Deltoid, Gluteus maximus, Sternocleidomastoid, Diaphragm, Intercostal muscles. 3. Identification of Blood Vessels – Common carotid artery, Brachial artery, Femoral artery, Arch of aorta.4. Identification of Bones – Skull, Humerus, Femur, Sternum, Tibia, Radius, Ulna, Ribs, Mandible. <b>Lab Physiology:</b> Haematology: i) Enumeration of RBC count ii) Enumeration of WBC count iii)				<b>30</b>



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Differential count iv) Estimation of Hemoglobin v) Determination of blood group vi) Determination of bleeding time and clotting time .Clinical physiology: i) Measurement of blood pressure ii) Determination of Radial pulse
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**Text Books:** 1. Handbook of Anatomy for Nurses by P.Saraswathi, 2<sup>nd</sup> Edn. 2011, JP Medical Publishers, India.  
2. Human Physiology for BDS by A.K.Jain, 4<sup>th</sup> Edn, 2010, Avichal Publishing Co., India.

**Reference Books:**

1. Manipal Manual for Allied Health Sciences by Sampath Madhyastha, 2<sup>nd</sup> Edn. 2014, CBS Publishers. India.

**Specific learning Outcome (SLO):**

- Learners are introduced about various organs of the human body and their functions
- Learn the relationship between them
- Gain knowledge in the overall physiological functions of each system
- Be able to understand the intricacies of endocrine functions in homeostasis and reproductive physiology
- Have the physical views of organs in the laboratory and develop skill to measure certain vital profiles that distinguishes altered physiological functions in health and disease

SEM - I	UCCBoo2/Cell Biology (Credits- 4)	L	P	T	J
		4	0	0	0
<b>Requisite</b>	<b>Expected to have a basic knowledge in cell structure, organelles and their functions</b>				
<b>Objective</b>	<b>To impart knowledge on cellular structure and functions and the mechanisms to keep alive cells, the functional units of living organisms</b>				
<b>Modules</b>	<b>Contents</b>				<b>Hr</b>
Unit-I	<b>Cell as a Basic unit of Living Systems:</b> Introduction to the Cell, classification of cell types - cell theory - organization of plant and animals cells, Structural organisation of prokaryotes and eukaryotes.				<b>12</b>
Unit-II	<b>Cellular Organelle:</b> Structure and functions of cell organelles-Endoplasmic reticulum, Golgi complex, Mitochondria, Chloroplasts, Ribosomes, Lysosomes, Peroxisomes, Nucleus, cell wall, Vacuole, Cytosol and cytoskeleton.				<b>12</b>
Unit-III	<b>Chromosomes:</b> Discovery, Basic structural features, Types of chromosomes, chromosomal numbers, chromosomal banding, molecular organization of eukaryotic chromosome, structural organization of centromeric region, kinetochore, telomere. Effects of radiations on chromosomes, techniques in the study of chromosomes and their applications				<b>12</b>
Unit-IV	<b>Cell division:</b> Definition-Why do cells divide; Overview of the Process, errors, comparison of Mitosis and meiosis, cell cycle,				<b>12</b>
Unit-V	<b>Tools and techniques in cell biology:</b> Basic concepts of microscopy-light microscope, Phase contrast microscope, Fluorescence and electron microscope. Cell culture, cell fractionation, gel electrophoresis, Lab: 1. Study of human peripheral blood cells. 2. Human metaphase chromosome preparation from peripheral blood lymphocytes. 3. Onion root tip for mitosis 4. Study of morphology of drosophila melanogaster a) Male and female b) Dissection of sex comb, wings and mouth parts. c) Study of phenotypic mutations of drosophila - eye colour, wing shape. d) Demonstration and identification of mouse abnormal sperms (pictorial)				<b>12</b>



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**Text Book:**

1. Cell Biology by S C Rastogi, 3<sup>rd</sup> Edn. 2005, New Age International, India.

**Reference Books:**

1. Essential Cell Biology by Bruce Alberts, Dennis Brav and Karen Hopkin, 3<sup>rd</sup> Edn 2010, Garland Science, USA.
2. Cytology Genetics and Evolution by P.K. Gupta, 8<sup>th</sup> Edn. 2014, Rastogi Publications, India.

**Specific learning Outcome (SLO):**

- Learn the organization of a cell, types of cells and their similarities and differences
- Learn to know that cell is a complete organism with various organelles to perform specific functions
- Learn in details about the structure of chromosomes and their types
- Learn the significance of cell division and its role in proliferation and gametogenesis
- Learn to know the relevance of specific tools to study cell and cellular organelles



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SEM - I	UCbCH58/Biomedical Chemistry (Credits -5)	L	P	T	J
		4	2	0	0
<b>Requisite</b>	<b>Expected to have knowledge in chemistry since chemicals are inseparable from the structure and functions of various organ systems in the body</b>				
<b>Objective</b>	<b>To impart knowledge on the derivations of biomolecules, their chemical reactions and acid-base balance in the sustenance of life</b>				
<b>Modules</b>	<b>Contents</b>				<b>Hr</b>
Unit-I	<b>Chemical kinetics:</b> Distinction between Order and Molecularity - derivation of First order rate equation - half life period of first order reaction - determination of rate constant of hydrolysis of ester. Catalysis - catalyst - auto catalyst - enzyme catalyst - promoters - catalytic poisoning - Active center - Distinction between homogeneous and heterogeneous catalysts - Industrial application of catalysts. Arrhenius equation and calculation of parameters.				<b>15</b>
Unit-II	<b>Stereochemistry:</b> Dissymmetric Molecules: Different types of Isomerism, Structural Isomers, Geometrical, Stereoisomerism, Configurational Isomers, Conformational Isomers, Concept of asymmetric carbon atom, Enantiomers, Diastereoisomers, Stereogenic atom / center, Chirotopic / Achirotopic Centre, Prottereoisomerism.				<b>15</b>
Unit-III	<b>Reaction mechanism:</b> Nucleophile, electrophile, Acid base reaction, nucleophilic addition, nucleophilic substitution, electrophilic addition, electrophilic substitution reaction.				<b>15</b>
Unit-IV	<b>Thermodynamics :</b> Basic concepts in thermodynamics, first law of thermodynamics, enthalpy, calorimetry, standard heat capacity, measurement of $\Delta U$ , enthalpy changes, Hess's Law, standard enthalpies of formation, bond enthalpies and calculations based on them.				<b>15</b>
Unit-V	<b>Lab:</b> Safety precautions in laboratory in chemistry lab 1. Calibration of pipette and burette 2. Preparations of lab solutions i. Percentage ii. Normality iii. Morality 3. Determination of pH 4. Phosphate buffer preparations and verifying the pH 5. Determination of strength of HCl 6. Titration of an Antacid				<b>30</b>

**Text Book:**

1. Chemistry for Degree Students by RL Madan, 1<sup>st</sup> Edn. 2012, S Chand Publications, India

**Reference Books:**

- College Chemistry- An Introductory of General Chemistry by Linus Pauling; 2<sup>nd</sup> Edn. 1957, W H Freeman Publishing Co., USA.
- University General Chemistry by CNR Rao, 4<sup>th</sup> Edn. 1973, Mc. Millan Publications, India.

**Specific learning Outcome (SLO):**

- Learn to know the chemicals, their reactions, life-span etc
- Allows students to acquire knowledge on the structure and functional interrelationship of biochemicals
- Learn the significance of the physical properties of chemicals in determining cellular chemical reactions
- Gain practical skill in measuring normality, molarity, ionic concentration of chemicals in solution



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SEM - I	UCBPH59/ Biomedical Physics (Credits -5)	L	P	T	J
		4	2	0	0
<b>Requisite</b>	<b>Expected to have knowledge in certain basics of Physics as numerous physical principles are involved in the field of medicine</b>				
<b>Objective</b>	<b>To impart knowledge in the fundamentals of physics To empower the learners with required knowledge in the principles and application of physics</b>				
<b>Modules</b>	<b>Contents</b>				<b>Hr</b>
Unit-I	<b>Laser:</b> Nature of light - reflection – refraction - total internal reflection - Fiber optics - optical fibers - applications in medicine – Laser - principles - applications in medicine - laser hazards and safety measures.				<b>15</b>
Unit-II	<b>Radiation Physics:</b> Introduction to nuclear physics – radioactivity - X-rays - properties - Radiation damage in matter - radiation protection principles - radiation detection and measuring instruments - Ultrasound – principle.				<b>15</b>
Unit-III	<b>Introduction to Imaging Technique:</b> Simple microscope - compound microscope - Radiography - x-ray – fluoroscopy - CT scan – MRI – Ultrasonography - principle - ultrasound scan – Doppler scan - Radio isotopes - Uses - scintillation detectors - gamma camera - positron camera.				<b>15</b>
Unit-IV	<b>Biopotential Recording Systems:</b> Introduction to bioelectric potential – Electrodes and surfaces – Biopotential amplifier – Frequency ranges of various biopotential signals – Working principles of bio potential recording systems – Electrocardiography – Electroencephalograph – Electromyography.				<b>15</b>
Unit-V	<b>Lab:</b> 1. Refraction of light: Determination of refractive index of a glass using glass slab 2. Determination of equivalent resistance of given resistors when connected in series and parallel. 3. Resistors connected in series and parallel combination 4. Current – Voltage characteristics of Light Emitting Diode (LED) – Forward and Reverse bias condition 5. Current – Voltage characteristics of PN -Junction Diode (PNJ) – Forward and Reverse bias condition 6. Current – Voltage characteristics of Zener Diode – Forward and Reverse bias condition 7. Determination of viscosity of a given liquid using Ostwald Viscometer 8. Determination of surface tension of a given liquid using Stalagmometer 9. Assessment of Sine, Triangular and Square wave functions using Cathode Ray Oscilloscope (CRO) 10. Determination of crystal structure using X-ray Diffraction – Demonstrations.				<b>30</b>
<b>Text Books:</b> 1. Christensen's Physics of Diagnostic Radiology by Thomas S. Curry III, Robert C Murry Jr., James E. Dowdey, 4 <sup>th</sup> Edn. 1990, Lippincott Williams & Wilkins, USA. 2. A Textbook of Applied Physics by AK Jha, Vol 1 & Vol 2 2009, IK International Publishing House Pvt. Ltd., India					
<b>Reference Books:</b> 1. New Understanding Physics for Advanced Level by Jim Breithaupt, 4 <sup>th</sup> Edn. 2000, Nelson Thornes Ltd, UK. 2. Fundamentals of Physics by Halliday, Resnick and Walker, 9 <sup>th</sup> Edn. 2009, John Wiley & Sons, USA . 3. Design and Development of Medical Electronic Instrumentation by David Prutchi and Michael Norris, 2005, John Wiley & sons, USA.					
<b>Specific learning Outcome (SLO):</b> <ul style="list-style-type: none"> <li>➤ Basic exposure to science of light propagation leading to an understanding of revolutions in optics and awareness of use of lasers in the field of medicine</li> <li>➤ To create awareness on the role of radiation</li> <li>➤ Importance of imaging for definite understanding of subject of interest</li> </ul>					



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➤ Basic introduction to understand the amount of energy via ion flow in a living organism

SEM - I	UCEN105/English – I (Credits -4)	L	P	T	J
		4	0	0	0
<b>Requisite</b>	<b>Expected to have knowledge in English reading and writing</b>				
<b>Objective</b>	<b>To impart skill in various modes of communication using English</b>				
<b>Modules</b>	<b>Contents</b>				<b>Hr</b>
Unit-I	<b>Basic English:</b> <ul style="list-style-type: none"> <li>Review of Grammar</li> <li>Sentence formation</li> <li>Building Vocabulary</li> <li>Phonetics</li> </ul>				<b>12</b>
Unit-II	<b>Writing Skills:</b> <ul style="list-style-type: none"> <li>Paragraph Writing</li> <li>Letter Writing</li> <li>Notes Taking</li> <li>Report Writing</li> <li>Applying for job</li> <li>Covering Letter</li> <li>Resume / CV</li> </ul>				<b>12</b>
Unit-III	<b>Listening Skills:</b> <ul style="list-style-type: none"> <li>Types of Listening (theory / definition)</li> <li>Tips for Effective Listening</li> <li>Academic Listening- (lecturing )</li> <li>Listening to talks and presentation</li> </ul>				<b>12</b>
Unit-IV	<b>Spoken English:</b> <ul style="list-style-type: none"> <li>Oral Report</li> <li>Discussion</li> <li>Debate</li> <li>Telephone conversation</li> </ul>				<b>12</b>
Unit-V	<b>Listening Comprehension:</b> <ul style="list-style-type: none"> <li>Media, audio, video, speeches etc.</li> </ul>				<b>12</b>

#### Text Books:

1. Reading and Study Strategies Book 1 by Bellare Nirmala, 1997, Oxford University Press, New Delhi.
2. Teaching and Learning English: A Sourcebook for Teachers & Teacher-Trainers by Tickoo M L, 2003, Orient Longman, India.

#### Reference Books:

1. Communication Skills- A Practical Approach by Hema Srinivasan, Alamelu Ramakrishnan and Valli Arunachalam, Edited by Shaikh Moula, 1995, Frank Bros. & Co., India.
2. English for Academic Purposes: A guide & Resource Book for Teachers by Jordan RR, 1997, Cambridge University Press, UK.
3. Enriching your Competence in English by Thorat AR, Walke BS and Gokhale SB, 2000, Orient Longman, India.

#### Specific learning Outcome (SLO):

- Learn the basics of English language.
- Develop skill in writing English
- Develop skill in the phonetics of English language and thus enhance the listening capacity

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- Develop confidence in spoken English that enables participation in debate and group discussion
- Develop ability to listen and understand the audio and video speeches of others.

SEM - I	UCFCoo6/ Fundamentals of Computing (Credits -3)	L	P	T	J
		2	2	0	0
<b>Requisite</b>	<b>Basic knowledge in computer is expected</b>				
<b>Objective</b>	<b>To impart working knowledge in computer</b>				
<b>Modules</b>	<b>Contents</b>	<b>Hr</b>			
Unit-I	<b>Introduction:</b> Computer basics- Types of computers – hardware components – input devices – output devices – storage devices – memory – units and sizes – factors affecting performance – operating systems – applications software – networking – LAN and WAN – Accessories - backup – computer virus – software copyright.	<b>12</b>			
Unit-II	<b>Word Processing:</b> Windows – Office automation – WORD processor – open a new document – toolbars – menus – font dialog box – enter text – scroll – spelling checker – Autocorrect – undo and redo –bullets and numbered lists – indenting – moving and copying – find and replace – autosshapes - saving document – preview and print	<b>12</b>			
Unit-III	<b>Electronic Spreadsheet and Data Presentation:</b> EXCEL spreadsheet – grid of rows and columns - active cell – selecting range – entering data – editing data – row and column labels – adjusting width – creating and copying formulae – relative – logical functions – lookup function – creating chart – bar chart – pie chart - print and save. POWERPOINT presentation – creating slide shows – building outline – switching levels in outline – adding pictures – slide designs – design templates – formatting – color scheme – customized backgrounds – inserting content – hyperlink – revolution in education.	<b>12</b>			
Unit-IV	<b>Database Management System:</b> ACCESS database – concept – template – primary key – records and fields – Student roster database – input mask – adding records – viewing data – updating entries – searching and querying – sorting – Table, forms and reports.	<b>12</b>			
Unit-V	<b>Applications in Healthcare and Medicine:</b> Internet– e-governance – access to information – communication facility – mechanics of E-mail - social transformation– electronic billing – drug information – information flow in lab and radiology - storage of medical records – networking the organization – patient care - intelligent monitoring – scholarly information – health informatics – robotic assisted surgery – Clinical decision support systems –Telemedicine.	<b>12</b>			

**Text Books:**

1. Introduction to Computers by Peter Norton, 7<sup>th</sup> Edn. 2010, Tata McGraw Hill Education Pvt. Ltd., India
2. Microsoft Office 2007 by Gary B. Shelly, Thomas J. Cashman, Misty E. Vermaat, 1<sup>st</sup> Edn. 2010, Delmar Cengage Learning, India.

**Reference Book:**

1. Introduction to Computers by Raj Mohan Joshi, 2006, Isha Books, India.

**Specific learning Outcome (SLO):**

- Learn about various components of computer and their significance
- Learn to create a word file
- Learn to develop data entry using excel and slide preparation using power point
- Able to manage data and use of excel for graphical representation of data
- Understand the importance of computers in medical field



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SEM - II	UCBC013 /Biochemistry (Credits -4)	L	P	T	J
		4	0	0	0
<b>Requisite</b>	<b>Expected to have knowledge in Chemistry and Biology</b>				
<b>Objective</b>	<b>To impart knowledge on the chemistry of various biomolecules</b>				
<b>Modules</b>	<b>Contents</b>	<b>Hr</b>			
Unit-I	<b>Water and Life and Energetics:</b> Water and Life – pH and Buffers. Law of Thermodynamics - Oxidative and reduction reactions, redox potential, free energy and reaction. ATP energetics - Calorie and Joule - concept of BMI - energy requirement of individuals for various activities.	<b>12</b>			
Unit-II	<b>Carbohydrates:</b> Biological significance-Classification, Structure, chemical and physical properties of monosaccharide, disaccharides and polysaccharides. Structure, occurrence and biological importance of structural polysaccharides. Metabolism of carbohydrates- Embden-Meyerhof-Parnas, Entner-Doudoroff, Pentose Phosphate pathways - TCA cycle.	<b>12</b>			
Unit-III	<b>Lipids:</b> Definition, classification and Physical and Chemical properties - Nomenclature of fatty acids – Phospholipids – Sphingolipids – Lipoproteins – Reactions and importance of phospholipids and Eicosanoids, Oxidation of fatty acids ( $\beta$ -Oxidation) - Fatty acid synthesis.	<b>12</b>			
Unit-IV	<b>Amino acids:</b> Structure and classification and properties of amino acids. Proteins – Structure & Classification - Primary, secondary, tertiary and quaternary structures. Enzymes and their classifications - General properties of enzymes (pH, Temperature, substrate concentrations), Michaelis Menton kinetics, $K_m$ & $V_{max}$ , enzyme inhibition, Isozymes, Allosteric enzymes.	<b>12</b>			
Unit-V	<b>Nucleic acids:</b> Importance, general composition (Nucleotides, nucleosides) and properties - denaturation & renaturation. Different types of DNA and RNA - Watson and Crick model of double helical structure - Metabolism of nucleic acids.	<b>12</b>			

### Text Book:

- Principles of Biochemistry by Lehninger AL, 2<sup>nd</sup>Edn. 1993, CBS Publishers, India.

### Reference Books:

- Biochemistry by Voet D and Voet JG, 4<sup>th</sup>Edn. 2010, John Wiley & Sons, USA.
- Biochemistry by Stryer L, 2<sup>nd</sup>Edn. 1998, W.H. Freeman and Company, USA.

### Specific learning Outcome (SLO):

- Get broad knowledge on life and energy
- Learn about carbohydrates, classification and metabolism
- Learn about lipids , classification and metabolism
- Learn about amino acids, enzymes and protein; their structure and function
- Learn about the chemistry of nucleic acids and their metabolism



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SEM - II	UCFG051/Fundamentals of Genetics (Credits -5)	L	P	T	J
		4	2	0	0
<b>Requisite</b>	<b>Expected to have knowledge in basic Cell Biology</b>				
<b>Objective</b>	<b>To impart knowledge in genes, their structure and function</b>				
<b>Modules</b>	<b>Contents</b>				<b>Hr</b>
Unit-I	<b>Mendelian Genetics:</b> History of Genetics and scope of Genetics. Hereditary and Environment; Genotype and Phenotype; Heredity and Variation. Biography of Mendel and his experiments with pea plant. Law of Segregation and Independent Assortment Monohybrid cross, Dihybrid cross back and test cross, Dominance and Recessive, Co-dominance and Incomplete dominance.				<b>15</b>
Unit-II	<b>Chromosomes and Interaction of Genes:</b> Chemical composition, Structural organization of chromatin, Centromeres, Telomeres and secondary constriction. Incomplete inheritance and co-dominance, pleiotropism, modification of F <sub>2</sub> ratios: epistasis, complementary genes, supplementary genes, inhibitory genes, duplicate genes and lethality genes.				<b>15</b>
Unit-III	<b>Multiple Allelism:</b> Introduction, characteristics, examples in Drosophila, rabbit and humans, Blood Group Inheritance in Human - Blood antigens, antigen-antibody reaction, inheritance of A, B, AB, & O blood types. Hemoglobinopathy; Thalasemia and Sickle cell anemia.				<b>15</b>
Unit-IV	<b>Linkage, crossing over and Sex determination:</b> Coupling and repulsion hypothesis Linkage in maize and Drosophila, Linkage and crossing over, Cytological basis of crossing over, Molecular mechanism of crossing over, Chromosomal theory of sex determination, Sex linked genes in humans - Haemophilia, colour blindness, fragile X.				<b>15</b>
Unit-V	<b>Mutations:</b> Chromosomal Mutations: Deletion, Duplication, Inversion, Translocation, Aneuploidy and Polyploidy; Types: spontaneous and induced, Mutagens: Physical and chemical, Mutation detections and Gene mutations. <b>Lab:</b> Basic sterilization techniques required for cell culture Media preparation, Principles of microscopy, Observation of Drosophila, Culture of Human cells, Preparation of Slides, Staining of Slides and Image analysis.				<b>30</b>

#### Text Books:

1. Principles of Genetics by Gardner, E.J Simmons and M.J Snustad D.P, VII<sup>th</sup> Edn, 2008. Wiley Publications, India.
2. Principles of Genetics by Snustad, D.P Simmons M.J. V<sup>th</sup> Edn, 2009. John Wiley and Sons Inc Publications, India.

#### Reference Books:

1. Genetics- A Molecular Approach by Russell P. J. III<sup>rd</sup> Edn 2011, Benjamin Cummings. Publications, USA.
2. Concepts Genetics by Klug, W.S, Michael R Cummings, M.R, Spencer, C.A. X<sup>th</sup> Edn, 2013, Pearson Education, USA.

#### Specific learning Outcome (SLO):

- Learn about classical genetics and the process of inheritance
- Learn the structural organization of chromosomes, genes and gene regulation
- Learn the concept of multiple allelism and its significance in health and disease
- Learn about linkage, crossing over and sex determination citing example from various species
- Learn about mutation and its significance
- Gain practical skills microtechniques, cell culture and image analysis



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SEM - II	UEBS065/Biostatistics (Credits -4)	L	P	T	J
		4	0	0	0
<b>Requisite</b>	<b>Expected to have basic mathematical skills</b>				
<b>Objective</b>	<b>To impart knowledge in the value of statistical analysis and the significance of statistics in study designing</b>				
<b>Modules</b>	<b>Contents</b>				<b>Hr</b>
Unit-I	<b>Statistics Definition and Terms:</b> Importance and usefulness of statistics in behavioral sciences – Scales of measurements – Nominal, Ordinal, Interval and Ratio scales. Data collection – Classification of data – Class intervals – Continuous and discrete representation of data.				<b>12</b>
Unit-II	<b>Descriptive statistics:</b> Measures of Central Tendency – Types: Mean, Median, Mode – Working out these measures with illustrations. Skewness: Quantitative measurement of skewness, Kurtosis: measurement of kurtosis. Measures of variability – Types Range, Standard deviation, Variance – Interpretation.				<b>12</b>
Unit-III	<b>Association of the variables:</b> Chi square goodness of fit, Pearson's Correlation – need for – limitation and interpretation scatter plot method Regression analysis. Fitting of simple linear regression equation.				<b>12</b>
Unit-IV	<b>Hypothesis Testing</b> Null and alternative hypothesis, level of significance Critical region and error probabilities. General properties of normal distribution – factors contributing for non – normal distribution. Significance of differences between means (t test) paired t test and independent t test – interpretation of p-value.				<b>12</b>
Unit-V	<b>Research Design:</b> Sampling methods, simple random sampling, stratified random sampling, systematic random sampling, and cluster random sampling its advantages. Estimation of sample size. Design of survey tables or questionnaires. Rules of experimental design, concept of blind method, randomized control trial method. <b>Practical Lab Sessions on application of statistics in excel:</b> 1. Basic introduction to using the spreadsheet format in Excel. Topics include navigating worksheets and workbooks, accessing files, entering data, arranging the data and saving files. 2. Using formulas in Excel to solve simple problems. 3. Describing data using graphs and tables: frequency tables, pie charts, bar charts, histograms, illustrate with examples. 4. Describing data using numerical measures: mean, median, mode and statistical inference. 5. Compute variance and standard deviation using excel and interpret the data with example problems. 6. Analyze the data for Chi Square goodness of fit. 7. Compute the association between two variables using correlation plot. 8. Describing data using scatter plot method and interpret the results 9. Testing hypotheses about means using excel and interpretation of the results. 10. Design of questionnaires for research and evaluation of reliability of the questionnaires.				<b>12</b>

### Text Books:

1. Methods in Biostatistics by BK Mahajan, 6<sup>th</sup> Edn. 2002, Jaypee Brothers Medical Publishers Pvt. Ltd., India.
2. Introduction to Biostatistics and Research Methods by P.S.S Sundar Rao and J Richard, 4<sup>th</sup> Edn. 2006, Prentice-Hall Pvt. Ltd. India.

### Reference Books:

1. Introductory Statistics by Prem S. Mann, 5<sup>th</sup> Edn. 2004, John Wiley and Sons (Asia) Pvt. Ltd., India.
2. Biostatistics: A methodology for the Health Sciences by Gerald Van Belle and Lloyd Fisher, 2<sup>nd</sup> Edn. 2004, John Wiley and Sons (Asia) Pvt. Ltd., India.

### Specific learning Outcome (SLO):

- Introduction to concept of statistics and its application in health sciences
- To interpret results based on statistical tools and to be able to summarize and describe a data
- Helps to understand and differentiate sample and population
- Introduction to correlation and regression
- To quantify and communicate results effectively and to be able to design health based questionnaire



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SEM - II	UCESD10/Environmental Science and Disaster Management (Credits -4)	L	P	T	J
		4	0	0	0
<b>Requisite</b>	<b>Expected to have knowledge in environment, natural calamities and their management</b>				
<b>Objective</b>	<b>To impart knowledge on the need for environmental protection, natural calamities and the skills to manage such disasters</b>				
<b>Modules</b>	<b>Contents</b>				<b>Hr</b>
Unit-I	<b>Multidisciplinary nature of environmental studies:</b> Introduction, Definition, Scope and Importance. Need for public awareness. <i>Natural Resources:</i> Earth Resources and Man, Renewable and Non-Renewable Resources, Water, Forest, Mineral, Food, Land and Energy Resources – Role of individuals in conservation and sustainable lifestyles. Effects of modern agriculture, Fertilizer / pesticide problems, Water logging and salinity. <i>Ecosystems:</i> Concept, types – forest, grassland, desert and aquatic ecosystem – features, structure and functions - Producers, Consumers and Decomposers - Cycles in the Ecosystem – Energy flow – food chain, webs and ecological pyramids. <i>Biodiversity:</i> Introduction, Definition - Genetic, Species, Ecosystem Diversity - India as a Mega Diversity Nation – Values of biodiversity - Hotspots of Biodiversity - Threats to Biodiversity – habitat loss, Poaching of Wildlife, Man-Wildlife Conflicts - Endangered and Endemic Species of India - Conservation of Biodiversity – <i>in-situ</i> and <i>ex-situ</i> conservation.				12
Unit-II	<b>Fireworks, Pollution and Fire Safety:</b> Pollution - Types and effects and prevention. What are fireworks- Chemical contents- reactions during cracking - Pollution from fireworks - effects on health - prevention and precautions. Social Issues Human, Population and Environment: From Unsustainable To Sustainable Development, Urban Problems Related To Energy, Water Conservation, Rain Water Harvesting, global warming, acid rain, ozone layer depletion, nuclear accidents and nuclear holocaust. Environment Protection Act.				12
Unit-III	<b>Social Issues and the Environmental Health:</b> From Unsustainable to Sustainable Development - Urban Problems Related To Energy, Water Conservation - Rain Water Harvesting, global warming, acid rain, ozone layer depletion, nuclear accidents and nuclear holocaust. Environment Protection Act – Environmental ethics – Public awareness. Air and Water (Prevention and Control), Wildlife protection and Forest conservation Acts - Public awareness. <i>Human Population and the Environment:</i> Population growth – population explosion – family welfare program – Human rights – Value education – Women and Child welfare - Role of Information Technology in environment and human health. <i>Concept of health &amp; disease:</i> Definition, Concept and Philosophy of health and well being - Dimension of health - Spectrum of health, Responsibility of health - Determinates & Indicators of health - Concepts of disease & cessation - Natural history of disease - Iceberg phenomenon, Concepts of control & prevention - Modes of Intervention and Changing pattern of disease. <i>Environment health:</i> Environment sanitation - Definition & components - Water: Safe & wholesome water Requirements – source of water supply (sanitary well). Purification of water (1) Large scale purification, (2) Small scale purification - Water Quality - Special treatment of water. Dynamic of disease transmission & Modes of transmission - Disinfection – Definition & Types of Agents used - Recommended disinfection procedures - Investigation of an epidemic.				12
Unit-IV	<b>Disaster Management:</b> Introduction-concepts & definitions (disaster, hazard, vulnerability, resilience, risks), Classification, causes and impacts (including social, economic, political, environmental, health, psychosocial, etc.) Approaches to Disaster Risk reduction (DRR): Disaster cycle-its analysis, Phases, Culture of safety, prevention, mitigation, preparedness, community based DRR, structural and non-structural measures. Roles and responsibilities of- community, Panchayat Raj, Institutions/Urban Local Bodies (PRIs/ULBs), states, Centre and other stake- holders.				12
Unit-V	<b>Inter-relationship between Disasters and Development:</b> Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land use etc. Climate change Adaptation. Relevance of indigenous knowledge, appropriate technology and local resources. Disaster risk Management in India: Hazard and vulnerability profile of India, Components of disaster relief: Water, Food, Sanitation, Shelter, Health, Waste Management Institutional arrangements (Mitigation, Response and Preparedness, DM Act and Policy, other related policies, plans, programmes and legislation) Field Visit: Visit to local area to document the assets of environment – river/forest/grassland/hill/Mountain – Visit to a local polluted site – urban/rural/ industrial/ agricultural – Study of common plants, insects and birds – Study of simple ecosystems – pond/river/hill/slopes. <i>Disaster Management:</i> Mock drills in hospitals for disaster management. To explore and map Disaster Prone areas, vulnerable sites, vulnerability of people (specific groups) and resources. Prepare plans with local administrations and NGOs.				12

**Text Books:**

1. Environmental Science by SC Santra, 2001, New Central Book Agency (P) Ltd., India; 2. A Text book of Environmental Studies by DK Asthana, 2<sup>nd</sup>Edn. 2012, S. Chand & Co. Ltd., India; 3. Water supply & Sanitary Engineering by SC Rangwala, 27<sup>th</sup>Edn. 2013, Charotar Publishing House, India

**Reference Books:**

1. Environment studies by K Mukkanti, 1st Edn. 2011, S Chand & Co. Ltd., India  
 2. Disease control priorities in developing countries by Dean J Jamison et al., 2<sup>nd</sup>Edn. 2006, World Bank, USA



**Specific learning Outcome (SLO):**

- Learn about the environment and its impact on living organisms
- Learn about biodiversity and various types of pollutions and their deleterious effects on human life
- Learn the significance of environment protection
- Learn about various form disasters due to natural calamities to mankind and the ways and means to manage the same
- Learn to develop environmental policies to protect the environment

SEM - II	UCEN211/ENGLISH II (Credits -4)	L	P	T	J
		4	0	0	0
<b>Requisite</b>	<b>Expected to use correct in English grammar in writing and speaking</b>				
<b>Objective</b>	<b>To impart knowledge in English grammar so as to effectively communicate through writing and speaking</b>				
<b>Modules</b>	<b>Contents</b>				<b>Hr</b>
Unit-I	<b>Communicative Grammar:</b> Time, tense and aspect - Verbs of states and events - Statements, questions and responses - Omission of information - Expressing emotion, hope, pleasure, disappointment, regret, approval, surprise.				<b>12</b>
Unit-II	<b>Communication Skills:</b> Language and communication - differences between speech and writing - distinct features of speech - distinct features of writing - Verbal/nonverbal communication - Presentation skills.				<b>12</b>
Unit-III	<b>Comprehend &amp; Compose:</b> Single word substitutions - Observation, fact finding and drawing conclusion: Analysing data, maps, diagrams, flow charts and drawing conclusions - Factual description.				<b>12</b>
Unit-IV	<b>Technical Writing:</b> Scientific and technical subjects - formal and informal writings - formal writings of reports, handbooks, manuals, letters, memorandum, notices, agenda, minutes.				<b>12</b>
Unit-V	<b>Scientific Writing:</b> Selection of topic - thesis statement - developing the thesis: introductory, developmental, transitional and concluding paragraphs - linguistic unity - coherence and cohesion - descriptive, narrative, expository and argumentative writing.				<b>12</b>

**Text Books:**

1. Writing as Thinking: A Guided Process Approach by M. Frank and Englewood Cliffs, 1990, Prentice Hall, UK.
2. Study Writing; A Course in Written English for Academic and Professional Purposes by L. Hamp-Lyons and B. Heasley, 2006, Cambridge University Press, UK.

**Specific learning Outcome (SLO):**

- Learn English grammar to develop proficiency in the correct usage of English while writing and speaking
- Learn to compose sentences and comprehend what they have learnt
- Learn the art of English writing and different methods of writing
- Develop confidence in language and provide excellent training in writing reports
- Acquire skills in reading fluency, gain knowledge in scientific writing and prepare concise reports



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<b>SEM - II</b>	<b>ULBC019 / Biochemistry (Practical I)</b> <b>(Credits -3)</b>	<b>L</b>	<b>P</b>	<b>T</b>	<b>J</b>
		<b>o</b>	<b>6</b>	<b>o</b>	<b>o</b>
<b>Requisite</b>	<b>Expected to develop practical skill in basic biochemical analyses</b>				
<b>Objective</b>	<b>To provide practical hands on training in various biochemical tests</b>				
<b>Modules</b>	<b>Contents</b>				<b>Hr</b>
1	Qualitative tests for Carbohydrates & Amino acids				<b>90</b>
2	Quantitative analysis of sugars and proteins				
3	Quantitative estimation of cholesterol				
4	Quantification of DNA and RNA				
5	Enzyme kinetic parameters :Km and Vmax				
6	Analysis of oils: Saponification value and iodine number for fats				

**Text Book:**

1. Biotechnology procedures and experiments handbook by S. Harisha. 2007, Infinity science press llcHingham, Massachusetts New Delhi.

**Specific learning Outcome (SLO):**

- Develop practical skill in qualitative and quantitative analyses of biomolecules and identification of biomolecules based on chemical reaction
- Develop practical skill in measuring enzyme kinetics
- Learn to determine saponification value and iodine number in fats



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SEM - III	UCAT007 / Analytical Techniques (Credits -4)	L	P	T	J
		4	0	0	0
<b>Requisite</b>	<b>Expected to have knowledge in biological system, certain chemical and physical principles</b>				
<b>Objective</b>	<b>To impart theoretical knowledge in various analytical techniques involved in biochemical and molecular analyses</b>				
<b>Modules</b>	<b>Contents</b>				<b>Hr</b>
Unit-I	<b>Spectrophotometry:</b> Photometry and spectrophotometry: The Beer-Lambert's Law, percentage transmittance and absorbance, photoelectric colorimeters; spectrophotometers-types, Fluorescence, UV visible				<b>12</b>
Unit-II	<b>Centrifugation:</b> Basic principle and instrumentation. Types and applications. Differential centrifugation-preparation of cellular organelle and other materials: disintegration of cells, density gradient centrifugation; analytical ultracentrifuge-determination of molecular weight.				<b>12</b>
Unit-III	<b>Chromatography and Separation Techniques:</b> Principles, types and applications. Partition chromatography-mobile and stationary phases-paper chromatography-solvent systems-development of $R_f$ value-ascending and descending techniques two dimensional chromatography-thin layer chromatography. Column chromatography preparation of columns-gradient elution-analysis of fraction and elution profiles-ion exchange chromatography-preparation and activation of ion exchange materials- gel filtration.				<b>12</b>
Unit-IV	<b>Electrophoresis:</b> Principles, types and applications; paper and gel electrophoresis-immuno electrophoresis-enzyme linked immuno absorbent assay (ELISA)-isoelectric focusing-two dimensional electrophoresis-capillary electrophoresis. Dialysis-separating membranes-factors affecting dialysis.				<b>12</b>
Unit-V	<b>Radioactive Analysis:</b> Radio isotope techniques-radioactive disintegration-radioactive isotopes used in biology detection of radioactivity-Geiger counters- labeling of biological material with radioactive isotope- scintillation counting-liquid scintillation counters- autoradiography.				<b>12</b>

**Text Book:**

1. Analytical Techniques in the Sciences: Analytical Instrumentation Performance, Characteristics and Quality by Graham Currell, 2000, John Wiley and Sons Ltd. UK.

**Reference Book:**

1. Principle and Techniques of Biochemistry & Molecular Biology by Keith Wilson and John Walker. 7<sup>th</sup>Edn. 2010, Cambridge University Press, USA

**Specific learning Outcome (SLO):**

- Learn spectrometry technique and its applications
- Learn the principle of centrifugation and its application biological analysis
- Learn the principles of separation techniques using chromatography and their types
- Learn the principles of electrophoresis and its applications
- Learn about radioisotopes, counters and their biological applications



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SEM - III	UCMB014/Molecular Biology (Credits -4)	L	P	T	J
		4	0	0	0
<b>Requisite</b>	<b>Expected to have knowledge of biomolecules</b>				
<b>Objective</b>	<b>To impart knowledge on the molecular structure of genes, their functions and maintenance</b>				
<b>Modules</b>	<b>Contents</b>				<b>Hr</b>
Unit-I	<b>Gene Organization:</b> Structural aspects of DNA – the double helical model - conformations of DNA - hyperchromicity – Genome organization – Prokaryotes and Eukaryotes. Organization of genetic material: structure of genes across different organisms, split genes, overlapping genes, pseudo genes, cryptic genes, etc.				<b>12</b>
Unit-II	<b>Replication:</b> Replication in prokaryotes and inhibitors of replication - Semi conservative - Nature of replication - DNA polymerases in prokaryotes- the processes of DNA replication. DNA recombination (molecular mechanisms), Insertion elements and transposons.				<b>12</b>
Unit-III	<b>Transcription:</b> RNA polymerases in prokaryotes – their function- process of transcription in prokaryotes- initiation and elongation and termination. (Rho - dependent and independent), role of sigma factor, Inhibitors of transcription, Regulation of gene expression in bacterial system, positive and negative control - the operon model- detailed study of <i>lac</i> and <i>trp</i> operons.				<b>12</b>
Unit-IV	<b>Translation:</b> Genetic code, Codons, Anticodons, Wobble hypothesis. The stages of protein synthesis - the process of translation in prokaryotes, factors involved in translation - the triplet nature of genetic code- an over view of comparisons with eukaryotic translation.				<b>12</b>
Unit-V	<b>Repair Mechanism:</b> Genetic exchange in bacteria - transformation and transduction (generalized and specialized) and conjugation. DNA repair mechanisms: excision, SOS and UV repair. Gene mutations: types, point mutation, transition, transversion frame shift, insertion and deletion.				<b>12</b>

#### Text Books:

1. Essentials of Molecular Biology by David Freifelder, 2<sup>nd</sup> Edn. 1996, Panima Publishing Corporation, USA.
2. Gene VII by Benjamin Lewin, 7<sup>th</sup> Edn. 2000, Oxford University Press, UK.

#### Reference Books:

1. Molecular Biology of the Gene by Watson, Hopkins, Roserts, Steits and Weiner, 4<sup>th</sup> Edn. 1987, The Benjamin/Cumming Publishing Company, Inc., USA.
2. Molecular Genetics of Bacteria by Larry Snyder and Wendy Champness, 2<sup>nd</sup> Edn. 2003, ASM press, USA.

#### Specific learning Outcome (SLO):

- Learn the molecular organization of genes in prokaryotes and eukaryotes
- Learn the process of gene replication and its significance
- Learn the process of gene transcription and its regulatory mechanisms
- Learn the process of translation and its mechanism and significance
- Learn the process of gene damage and the repair mechanism



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SEM - III	UCDGo54/Developmental Genetics (Credits -4)	L	P	T	J
		4	0	0	0
<b>Requisite</b>	<b>Expected to have knowledge in genetic modulations</b>				
<b>Objective</b>	<b>To introduce students to the genetic mechanisms controlling developmental processes, and to illustrate their importance for identifying and evaluating inherited disorders in humans</b>				
<b>Modules</b>	<b>Contents</b>				<b>Hr</b>
Unit-I	<b>Basic concepts:</b> Development – growth and development, Theories of Development, structure of gametes and gametogenesis, Male and female gametogenesis.				12
Unit-II	<b>Embryogenesis:</b> Stages, process, basic definition, and some symptoms of human fertilization. Patterns, formation and types of cell movements of embryonic cleavage, blastulation and gastrulation.				12
Unit-III	<b>Organogenesis:</b> Germ layers and their derivatives- structure and function of endoderm, mesoderm and ectoderm.				12
Unit-IV	<b>Genetics and Environment:</b> Genetic and environmental Interactions, environmental factors - malformations and disruptions of normal development, teratogens and birth defects.				12
Unit-V	<b>Genetics and Defects:</b> Molecular regulations of human development and defects - Eye development and eye defects; spinal cord and neural tube defects; Brain development and cranial defects; Cardiac development and heart defects; Facial development and facial cleft defects; Muscle development; Kidney development and kidney defects. .				12

<b>Text Book:</b> 1. Development Biology 3 <sup>rd</sup> Edition, Leon W. Browder, Erickson and William R. Jeffery. Saunders College Publishing.
<b>Reference Books:</b> 1. Scott F. Gilbert, Developmental Biology – 8 <sup>th</sup> edition, Sinauer Associates Inc., Publishers, Sunderland, Massachusetts USA (2006). 2. Benjamin Lewin (2010), Genes X, Jones and Bartlett Publishers, England.
<b>Specific learning Outcome (SLO):</b> <ul style="list-style-type: none"> <li>➤ Learn the basic aspects of development from the zygote stage</li> <li>➤ Learn about gametogenesis, fertilization and the various stages of embryonic development</li> <li>➤ Learn about the impact environmental factors on genes and the consequence of developmental defects</li> <li>➤ Learn the relevance of prenatal genetic screening</li> <li>➤ Create awareness on how environment influences embryogenesis</li> </ul>



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SEM -III	UEBB124/Bioethics, Biosafety and IPR (Elective 1) (Credits -4)	L	P	T	J
		4	0	0	0
<b>Requisite</b>	<b>Expected to have basic knowledge in ethical and safety issues</b>				
<b>Objective</b>	<b>To impart knowledge on ethical and safety aspects</b>				
<b>Modules</b>	<b>Contents</b>				<b>Hr</b>
Unit-I	<b>Bioethics:</b> Concepts; Philosophical considerations; Epistemology of Science; Ethical Terms; Principles & Theories; Relevance to Biotechnology; Ethics and the Law Issues: Genetic Engineering, Stem Cells, Cloning, Medical techniques, Transhumanism, Bioweapons; Research concerns - Animal Rights, Ethics of Human Cloning, Reproduction and Stem Cell Research; Emerging issues: Biotechnology's Impact on Society; DNA on the Witness Stand - Use of genetic evidence in civil and criminal court cases; Challenges to Public Policy – To Regulate or Not to Regulate; Improving public understanding of biotechnology products to correct misconceptions.				12
Unit-II	<b>Biosafety:</b> Introduction; Historical Background; Introduction to Biological Safety Cabinets; 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 including ,Cartagena Protocol.				12
Unit-III	<b>Introduction to Intellectual Property:</b> Types of IP: Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications, Protection of New GMOs; International framework for the protection of IP.IP as a factor in R&D; IPs of relevance to Biotechnology and few Case Studies; Introduction to History of GATT, WTO, WIPO and TRIPS, Budapest Treaty; International framework for the protection of IP; IP as a factor in R&D; Patenting by research students, lecturers and scientists-University/organizational rules in India and abroad, credit sharing by workers, financial incentives; Types of patents; Patentability; Section 3 & 4 of Indian Patent Act; Compulsory Licensing;				12
Unit-IV	<b>Patent Search &amp; Patent Infringement Analysis:</b> Patent databases; Searching International Databases; Country-wise patent searches (USPTO, EPO, India etc.); Analysis and report formation Invention in context of "prior art"; Patent infringement- meaning, scope, Introduction to litigation, case studies and examples				12
Unit-V	<b>Patent filing:</b> Filing of a National patent application; Role of a Country Patent Office; Precautions before patenting-disclosure/non-disclosure; PCT and Implications; Procedure for filing a PCT application; Patent application- forms and guidelines, fee structure, time frames; Types of patent applications: provisional and complete specificationsPCT and convention patent applications; International patenting-requirement, procedures and costs				12

#### Text Books:

- Bioethics and Biosafety by MK Sateesh, 1<sup>st</sup>Edn, 2010, IK International Pvt. Ltd., India.
- IPR, Biosafety and Bioethics by DeepaGoel and ShominiParasar, 1<sup>st</sup>Edn. 2013, Pearson Education Publishers, India.

#### Reference Books:

- Bioethics and Biosafety by Geetha Bali and RamamurthiRallapalli, 1<sup>st</sup>Edn. 2007, ,Aph Publishing Corporation, India.
- Intellectual Property Licensing: Forms and Analysis by Richard Raysman, Edward A. Pisacreta and Kenneth A. Adler. 1999-2008, Law Journal Press, USA.

#### Specific learning Outcome (SLO):

- Learn about ethical issues while using biological organisms for experimental studies
- Safety is an important concern when one is handling living organism and in the bioprocessing; learn various guidelines needed for safety in the work place
- Learn about intellectual property rights and the procedures involved in the protection of the same

SEM -III	UEPE017/Principles of Enzymology (Elective 1)	L	P	T	J

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		(Credits -4)	4	0	0	0
<b>Requisite</b>	<b>Expected to have knowledge of Biochemistry</b>					
<b>Objective</b>	<b>To impart knowledge on enzyme kinetics, substrate specificity, enzyme production and purification</b>					
<b>Modules</b>	<b>Contents</b>					<b>Hr</b>
Unit-I	<b>Introduction:</b> Historical perspectives, Classification & Nomenclature- IUB system, rationale, overview and specific examples. Activation energy. Transition state theory, Characteristics of enzymes, ES complex formation- Concept of active centre and binding sites, General properties of enzymes: Effect of temperature, pH and substrate concentration on reaction rate. Enzyme activity, international units, specific activity, turnover number					<b>12</b>
Unit-II	<b>Enzyme Kinetics:</b> Steady state enzyme kinetics. Michaelis - Menten and Lineweaver-Burk derivations and plots -Significance of $V_{max}$ and $K_m$ . Bisubstrate reactions. Advantages and disadvantages of alternate plotting. Enzyme inhibition - types of inhibitors - competitive, noncompetitive and uncompetitive, their mode of action and experimental determination.					<b>12</b>
Unit-III	<b>Enzyme Selectivity:</b> Enzyme specificity, General mechanistic principle, factors associated with catalytic efficiency of enzymes: proximity & orientation, Strain & distortion, acid-base catalysis, covalent catalysis. Techniques for studying mechanism of action, chemical modification of active site groups, specific examples: chymotrypsin, lysozyme, RNase, and DNA polymerase.					<b>12</b>
Unit-IV	<b>Enzyme Uses:</b> Extraction and purification of enzymes, Isoenzymes- with special reference to lactate dehydrogenase. Multi-enzyme complexes; Pyruvate dehydrogenase complex and Fatty acid synthetase complex, Multifunctional enzymes - Zymogen and zymogen activation in digestive system, blood clotting and blood clot dissolution; Ribozymes and their applications					<b>12</b>
Unit-V	<b>Enzyme Technology:</b> Methods for large scale production of enzymes, Clinical and medical application of enzymes, Methods for immobilization of enzymes - Immobilized enzymes and their comparison with soluble enzymes. Application of immobilized enzymes in health and industry.					<b>12</b>

#### Text Books:

1. Understanding enzymes by Palmer T, 4<sup>th</sup> Edn. 1995, Prentice Hall/Ellis Horwood Ltd., UK.
2. Biochemistry by Stryer L., 6<sup>th</sup> Edn. 2013, W. H. Freeman & Company, USA.

#### Reference Books:

1. Lehninger Principles of Biochemistry by Nelson DL and Cox MM, 5<sup>th</sup> Edn. 2008, W.H. Freeman & Company, USA
2. Enzymes, Ribozymes and DNAzymes by P. Palanivelu, 1<sup>st</sup> Edn. 2007, 21<sup>st</sup> Century Publications, India.

#### Specific learning Outcome (SLO):

- Learn about enzyme nomenclature, enzyme-substrate interaction etc.
- Learn about enzyme kinetics, enzyme activation and inhibition
- Learn about the regulators of enzyme activity
- Learn the extraction procedures for enzymes and the analysis of enzyme activity
- Gain knowledge on the Commercial production of enzymes and their clinical and industrial applications



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SEM -III	UEHBG33/Human Biochemical Genetics (Elective 1) (Credits -4)	L	P	T	J
		4	0	0	0
<b>Requisite</b>	<b>Expected to have knowledge of Biochemistry</b>				
<b>Objective</b>	<b>To develop knowledge on the association of biochemical and genetic components in certain pathological process</b>				
<b>Modules</b>	<b>Contents</b>				<b>Hr</b>
Unit-I	<b>Biochemical and Molecular basis of some important human disease:</b> An overview. Inborn errors of aminoacid metabolism, PKU, Alkaptonuria, Homocystinuria, Histidinuria, Albinism.				<b>12</b>
Unit-II	<b>Inborn errors of carbohydrate metabolism:</b> Galactosemia, Diabetes, Hypoglycemia, Lactic acidosis, G-6PD deficiency and glycogen storage disorders.				<b>12</b>
Unit-III	<b>Haemoglobinopathies:</b> Classification, Globin gene mutation, Molecular mechanism of Thalassemias, Sickle cell anemia, other haemoglobin variants.				<b>12</b>
Unit-IV	<b>Lysosomal Storage disorders:</b> Classification of lysosomal storage disorders. Mucopolysaccharidoses and lipidosis - type and molecular variations				<b>12</b>
Unit-V	<b>Biochemical diagnosis:</b> New born screening and population screening for biochemical disorders. Genetic registries and prevention of inherited disorders. Metabolism and metabolic disease resources in the web.				<b>12</b>

**Text Books:**

1. Peter iGenetics: A Molecular Approach by Peter J Russel, 2<sup>nd</sup>Edn. 2006, Pearson Education Inc. Publishers, USA.
2. Genetics: A Conceptual Approach by Benjamin A. Pierce. 2<sup>nd</sup>Edn. 2010, WH Freeman and Company, New York, USA.

**Reference Books:**

1. Emery's Elements of Medical Genetics by Peter Turnpenny, Sion Ellard, 13<sup>th</sup>Edn. 2007, Elsevier Publications, USA.
2. The Metabolic and Molecular Basis of Inherited Diseases by Scriver C.R et al., 8<sup>th</sup>Edn. 2002, McGraw-Hill Professional, USA.

**Specific learning Outcome (SLO):**

- Learn about certain metabolic diseases and their genetic link
- Learning the association between genes and inborn errors of carbohydrate metabolism
- Be able to understand genetic basis of Haemoglobinopathies
- Gain knowledge in the association of genes and lysosomal storage diseases
- Develop knowledge on the biochemical diagnosis for genetic disease



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SEM -III	UECWM26/Chemical Weapons of Mass Destruction and their Disarmament(Elective 1) (Credits -4)	L	P	T	J
		4	0	0	0
<b>Requisite</b>	<b>Expected to have knowledge in basic chemistry</b>				
<b>Objective</b>	<b>To impart their knowledge of chemistry in weapons for peaceful application</b>				
<b>Modules</b>	<b>Contents</b>				<b>Hr</b>
Unit-I	<b>Weapons of Mass Destruction (WMD):</b> Definition of toxic chemicals as per Article II of CWC 1997 - precursors – key component of binary or multi-component chemical systems - chemical weapons containing S, P and F – old and abandoned chemical weapons – Riot control agents – chemical weapons production facility – production capacity.				<b>12</b>
Unit-II	<b>Disarmament:</b> Need for disarmament –Chemical Weapons Conventions – Geneva Protocol 1925 – London Moscow Washington 1972 Convention – OPCW (Organization for the Prohibition of Chemical Weapons) – 1997 Convention on Prohibition of development, production, stockpiling, use of Chemical weapons and their destruction – Three Schedules of Chemicals (Toxic and Precursors) - declarations.				<b>12</b>
Unit-III	<b>Role of OPCW:</b> Capacity Building, Chemical research, legal assistance, Specialized Internship, training in CWC implementation, developing and improving laboratory capacity and safe chemical management. Role of IUPAC.				<b>12</b>
Unit-IV	<b>National Authority Chemical Weapons Convention (NACWC) of India:</b> History – Indian CWC Act 2000 – declaration – destruction – inspection – training programmes - other activities – role of Indian industries.				<b>12</b>
Unit-V	<b>Toxic and Precursor chemicals for Peaceful Purposes:</b> Peaceful applications of toxic and precursor chemicals such as Nmustard, chlorine and phosphorus oxychloride as anticancer agent, disinfectant and catalyst in drug synthesis respectively.				<b>12</b>

**Text Book:**

1. Ralf Trapp, Pure Appl. Chem., Vol. 80, No. 8, pp. 1763–1772, 2008

**References:**

1. Veterans at Risk: The health effects of mustard gas and lewisite, Constance M. Pechura and David P. Rall (Eds), First Edn, 1993, National Academy Press, Washington DC.

**Specific learning Outcome (SLO):**

- Understand the role of chemistry in making weapons of mass destruction
- To get awareness on the global, National and supporting bodies which oversee and support disarmament activities.
- To gain knowledge on modifications of chemicals used in weapon making into useful chemicals.



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SEM - III	ULATo12 /Analytical Techniques (Practical II) (Credits -3)	L	P	T	J
		o	6	o	o
<b>Requisite</b>	<b>Expected to have basic laboratory skill</b>				
<b>Objective</b>	<b>To impart hands on skill in various analytical techniques</b>				
Modules	Contents	Hr			
1	Laboratory safety guidelines and biological waste disposal	<b>90</b>			
2	Precision, accuracy and validity of an experiment. Analysis and presentation of data.				
3	Spectrophotometry a. Identification of compounds by absorption maxima ( $\lambda_{max}$ ) - inorganic b. Identification of compounds by absorption maxima ( $\lambda_{max}$ ) - organic c. Correlation of absorption maxima ( $\lambda_{max}$ ) with color.				
4	Verification of Beer-Lambert's law-using UV-Vis spectrophotometer. a. To plot standard curve of inorganic compounds b. To identify and find the concentration of given substances in a binary mixture				
5	Paper chromatography techniques.				
6	Extraction of lipids and separation using thin layer chromatography.				
7	Separation of nucleic acids by agarose gel electrophoresis (Demonstration)				
8	Column chromatography technique, Separation of proteins by gel filtration. (Demonstration)				

**Text Book:**

1. Fundamentals of Bioanalytical Techniques and Instrumentation by Sabari Ghoshal, 2009, PHI Learning Pvt. Ltd.

**Specific learning Outcome (SLO):**

- Learn spectrometry technique and its applications
- Learn the principle of centrifugation and its application biological analysis
- Learn the principles of separation techniques using chromatography and their types
- Learn the principles of electrophoresis and its applications
- Learn about radioisotopes, counters and their biological applications



# Chettinad

Academy of Research & Education

(Deemed to be University Under Section 3 of the UGC Act 1956)

<b>SEM -III</b>	<b>ULBMo2o/Molecular Biology (Practical III) (Credits 3)</b>	<b>L</b>	<b>P</b>	<b>T</b>	<b>J</b>
		<b>o</b>	<b>6</b>	<b>o</b>	<b>o</b>
<b>Requisite</b>	<b>Expected to have practical skill in molecular biology techniques</b>				
<b>Objective</b>	<b>To inculcate practical skill in certain molecular biological techniques</b>				
<b>Modules</b>	<b>Contents</b>	<b>Hr</b>			
1	Separation of proteins by SDS-polyacrylamide gel electrophoresis	<b>90</b>			
2	DNA isolation (Bacteria), quantification, and characterization				
3	Agarose gel electrophoresis				
4	DNA amplification by PCR				
5	Molecular cloning techniques				
6	Ames test in <i>Salmonella</i> / <i>E.coli</i> to study mutagenicity				
7	Induction of <i>lac</i> operon				

**Text Book:**

1. Essential Molecular Biology: Volume I: 001 (Practical Approach Series), by Terry Brown, 2009, John Wiley and sons.

**Specific learning Outcome (SLO):**

- Develop skill in electrophoretic techniques to separate proteins and nucleic acids
- Develop practical skill in cloning and induction of operon
- Develop skill in PCR techniques



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SEM - IV	UCCG053/Cytogenetics (Credits -4)	L	P	T	J
		4	0	0	0
<b>Requisite</b>	<b>Expected to have knowledge in genetics</b>				
<b>Objective</b>	<b>To impart knowledge and understanding of the clinical applications of cytogenetics.</b>				
<b>Modules</b>					<b>Hr</b>
Unit-I	<b>Chromosome mutations:</b> Variations in chromosome structure: The origin and adaptive significance of duplications, deletions, inversions, and translocations, isochromosomes, ring chromosomes, centric fusions and fissions. Changes in chromosome number - Aneuploidy: Causes and consequences. Polyploidy: Occurrence, types and genetic significance				12
Unit-II	<b>Cellular and molecular cytogenetic technologies:</b> Cell lines, Cell and tissue culture practices, Harvesting of cells for chromosomal analysis, Conventional and specialized staining protocols, FISH and spectral karyotyping, Imaging in cytogenetic practices, Chromosome instability and fragile sites.				12
Unit-III	<b>Genetic basis of syndromes and disorders:</b> Heritable chromosomal abnormalities, Incidence of chromosome aberrations, Disorders of Chromosome breakage syndromes, genetic disorders of eye, genetic disorders in skeleton and skin, congenital heart diseases, Complex polygenic syndromes, learning disorders.				12
Unit-IV	<b>Prenatal diagnosis:</b> Amniocentesis, Chorionic villi biopsy, Cytogenetics of prenatal chromosomal abnormalities with clinical citations, Genetic counselling, Transplantation changes in bone marrow, peripheral stem cells and umbilical cord cells with chromosomal features.				12
Unit-V	<b>Chromosomal diagnostics in hematopoietic disorders:</b> Myeloid disorders, AML, CML and lymphoid leukemia, lymphoblastic lymphoma and their chromosomal changes, Chromosome changes in benign and malignant tumors, Cytogenetics of breast cancer.				12

#### Text Books:

1. Tom Strachan & Andrew P. Read (1999) Human Molecular Genetics. 2<sup>nd</sup> ed. John Wiley & Sons.
2. Elaine Johansen Mange & Arthur P. Mange (1995) Elaine Johansen Mange & Arthur P. Mange 2<sup>nd</sup> Edn, Sinauer Associates, Inc.

#### Reference Books :

1. Peter Sudbery 2002. Human Molecular Genetics (Second Edition), Prentice Hall.
2. M.A. Jobling, M.E. Hurles & C. Tyler-Smith, 2004. Human Evolutionary Genetics-Origins, Peoples & Disease, Garland Science.

#### Specific learning Outcome (SLO):

- Learn the clinical significance of cytogenetic descriptions, and chromosomal diagnosis in various disorders.
- Understand the clinical interpretations of results from molecular and cytogenetic studies
- Learn karyotyping and gain an understanding of chromosomal abnormalities
- Learn sampling procedures of peripheral blood, bone marrow, amniotic fluid, chorionic villus samples, and solid tissues.
- Correlate chromosome findings within leukemia, preleukemic, lymphoma and solid cancers



# Chettinad

Academy of Research & Education

(Deemed to be University Under Section 3 of the UGC Act 1956)

SEM - IV	UCMG056/Medical Genetics (Credits -4)	L	P	T	J
		4	0	0	0
<b>Requisite</b>	<b>Expected to have Basic knowledge genetics</b>				
<b>Objective</b>	<b>To impart knowledge on various genetic disorders associated with molecular pathology and prognosis</b>				
<b>Modules</b>	<b>Contents</b>				<b>Hr</b>
Unit-I	<b>Genetic factors in common diseases:</b> Scope of Medical Genetics. Disease characteristics and Genetic association with Skin-Ichthyosis, baldness, psoriasis, hereditary hemorrhagic telangiectasia, epiloia, multiple neurofibromatosis, nail patella syndrome, Ankylosing spondylitis, Rheumatoid arthritis, Batten disease, Ehlers-Danlos syndrome, Krabbe disease, Pompe disease.				<b>12</b>
Unit-II	<b>Genetics of disease and disorders:</b> Genetics aspects of neurological disorder: Alzheimer's disease, epilepsy and Parkinson's, disease of cardio vascular system: Congenital heart disease, coronary heart diseases and Hypertension. Diabetic Nephropathy. Neuropathy retinopathy and Gestational diabetes mellitus. Disease of Endocrine system: McCune-Albright syndrome, Multiple endocrine neoplasia syndrome, Adrenoleukodystrophy and Sheehan's syndrome.				<b>12</b>
Unit-III	<b>Molecular pathology:</b> Classes of gene mutations in humans, Human mitochondrial diseases, Loss of Function and Gain of functional mutations in humans, Agammaglobinemia, Diseases of collagens. Chorionic somatomammotropin deficiency and Lesch-Nyhan syndrome (HGPRT).				<b>12</b>
Unit-IV	<b>Pharmacogenetics:</b> Definition, Drug Metabolism, Genetic variation revealed solely by the effects of drugs (N- acetyl transferase activity, succinyl choline sensitivity, G-6 PD variants, malignant hypothermia, alcohol metabolism). Hereditary disorders with altered drug response. Porphyria, clinical variation of the hemoglobinopathies.				<b>12</b>
Unit-V	<b>Molecular medicine :</b> Gene therapy - Gene therapy towards molecular genetic disease through therapeutic approaches, Principles and different strategies, The technology of classical gene therapy, Gene therapy for inherited diseases - SCID, Cystic fibrosis, Huntington's disease, Myotonic dystrophy.				<b>12</b>

**Text Books:**

1. Thompson and Thompson, Genetics in Medicine. Robert L.Nussbam, Roderick R. McInnes, Huntington F, Willard. 7th edition WB Saunders Co. (2004).
2. Tom Strachan & Andrew P. Read. 2004. Human Molecular Genetics, 2nd Ed., John Wiley & sons (Asia) PTE Ltd.

**Reference Book:**

1. Harry Harris & Kurt Hirschhorn 1983. Advances in Human Genetics, Plenum Press, NY & London

**Specific learning Outcome (SLO):**

- Learn the organization of the genome and regulation of gene expression as it relates to medical genetic disorders and diagnosis.
- Learn to Identify the clinical presentation and etiology of genetic disorders including: single gene disorders, disorders of chromosome abnormalities, inborn errors of metabolism, multi-factorial genetic disorders and cancer genetics
- Gain knowledge on how changes of DNA and RNA can affect the function of gene
- The genetic basis of pharmacogenesis is made aware of the strategies involved in disease management of genetic disorders.



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Academy of Research & Education

(Deemed to be University Under Section 3 of the UGC Act 1956)

SEM - IV	UCIMD62 /Immunology and Molecular Diagnostics (Credits -4)	L	P	T	J
		4	0	0	0
<b>Requisite</b>	<b>Expected to have knowledge and understanding of Biological System</b>				
<b>Objective</b>	<b>To make the student understand the structure and function of immune system</b>				
Modules	Contents				Hr
Unit-I	<b>Elements of Immunity and antibody structure:</b> Overview of the Immune system- Basic concepts in immunology (History), principles of innate and acquired immunity - Cells and organs of the immune system - Classes of antigens and their characteristics. Classification and characterization of antibody structure, properties, agglutination, complement system, Hypersensitivity, immune tolerance, Immunofluorescence.				<b>12</b>
Unit-II	<b>General properties of virus:</b> Classification of viruses - Structure, properties, pathogenesis, diagnosis and treatment of viroids, Hepatitis viruses, Rabies viruses, Orthomyxo and paramyxo viruses, Pox, Herpes viruses and HIV.				<b>12</b>
Unit-III	<b>Humoral and cell mediated immune response:</b> B-cell maturation. Activation and differentiation, Major Histocompatibility complex (MHC) - antigen processing and presentation T and B cell maturation, activation and differentiation				<b>12</b>
Unit-IV	<b>Transplantation immunology:</b> Basics of graft rejection, Tissue typing, Clinical transplantation, Tumor antigen, Immune response to tumor, Cancer immuno therapy.				<b>12</b>
Unit-V	<b>Microfluidics and nano conjugates in diagnostics:</b> Concepts and advantages of microfluidic devices – Materials and methods for the manufacture of microfluidic component – Fluidic structures – Surface modifications – Lab-on-a-chip for biochemical analysis. Automated DNA sequencing, functional protein identification, paternity testing, Creation of transgenic mice mutants for specific genes-uses in Biomedical research				<b>12</b>

**Text Book:**

1. Textbook of Immunology by Mohanty Sunil Kumar and Leela K Sai, 2nd Edn. 2014, Jaypee Brothers Medical Publishers (P) Ltd., India.

**Reference Book:**

1. Roitt's Essential Immunology by Peter J. Delves, Seamus J. Martin, Dennis R. Burton, Ivan M. Roitt, 12th Edn. 2011, ELBS, Wiley- Blackwell scientific publication, USA

**Specific learning Outcome (SLO):**

- Learn the underlying principles of immunology and its application in solving problems in biological systems
- Understand the structure and function of antibody
- Understand the functions of immune system
- Gain knowledge in hypersensitive reactions
- Have a working knowledge of some immunological techniques and their applications.



# Chettinad

Academy of Research & Education

(Deemed to be University Under Section 3 of the UGC Act 1956)

SEM - IV	UEBGP16/Basic Concepts of Genomics and Proteomics (Elective 2) (Credits -4)	L	P	T	J
		4	0	0	0
<b>Requisite</b>	<b>Expected to have basic knowledge in the fundamentals of Genetics</b>				
<b>Objective</b>	<b>To impart knowledge on the organization of genes and proteins and their role in health and disease</b>				
<b>Modules</b>	<b>Contents</b>				<b>Hr</b>
Unit-I	<b>Gene:</b> Nucleotide, base-pairing, Genetic code, Open reading frame, exon, intron, splicing process, untranslated region, alleles, dominant, recessive, homozygosity, heterozygosity, loss of heterozygosity				<b>12</b>
Unit-II	<b>Chromosome:</b> Definition, visualization – karyotyping, FISH and sequencing, structure – chromatin, nucleosome, histone and nucleoprotein, functional organization, centromere, telomere, microsatellites, inheritance.				<b>12</b>
Unit-III	<b>Protein structure and function:</b> Amino acid, peptide bond, primary structure, alpha-helix, beta-sheet, other secondary structures, noncovalent interactions, tertiary structure, disulphide bridge, quaternary structure, protein cofactors, types of proteins, functional classes, relationship between structure and function.				<b>12</b>
Unit-IV	<b>Polymorphism:</b> Mutation - Definition, SNP, deletion, insertion, class of mutation: inframe, frameshift, synonymous or silent, missense or nonsynonymous, effect on protein structure and activity, protein modification, intergenic polymorphisms, role in disease.				<b>12</b>
Unit-V	<b>Human genome and proteome:</b> DNA sequencing - chemical and enzymatic methods, protein sequencing, Human genome project, organization of human genome, chromosomal anomalies, genetic disorders, protein-DNA and protein-protein interactions.				<b>12</b>

**Text Books:**

1. Introduction to Genomics by Arthur M Lesk, 2<sup>nd</sup>Edn. 2012, Oxford University Press, UK.
2. Handbook of Proteomic Methods by P. Michael Conn, 2010, Humana Press, USA.

**Reference Books:**

1. Genomics by Cantor and Smith, 1999, John Wiley & Sons, USA.
2. Principles of Proteomics by RM. Twyman, 1<sup>st</sup>Edn. 2004, Garland Science/ BIOS Scientific Publishers, USA.

**Specific learning Outcome (SLO):**

- Learn about gene structure and function
- Gain knowledge on the organization chromosomes
- Learn about the molecular organization of proteins and the significant relationship between structure and function
- Learn the impact of chromosomal aberrations and mutations in the etiology of certain diseases
- Develop theoretical knowledge in methods used for gene and protein sequencing, gene-protein and protein-protein interactions



# Chettinad

Academy of Research & Education

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SEM - IV	UTT025 /Transgenic Technology (Elective 2) (Credits -4)	L	P	T	J
		4	0	0	0
<b>Requisite</b>	<b>Expected to have knowledge in gene knock-in and gene knock-out techniques to learn the role of genes in health and diseases</b>				
<b>Objective</b>	<b>To impart knowledge on the process and consequences of gene manipulation techniques</b>				
<b>Modules</b>	<b>Contents</b>				<b>Hr</b>
Unit-I	<b>Introduction to transgenic technology:</b> Introduction to transgenic technology in plants and animals, and its applications to basic research and commercial benefit. Organization of genome, regulation of gene expression and gene silencing in plants and animals.				<b>12</b>
Unit-II	<b>Methodologies of transgenic technology:</b> Tools, techniques and methodologies for developing transgenic plants and animals. Strategies and methodologies of screening, selection, verification and characterization of transformed tissues of plants and animals.				<b>12</b>
Unit-III	<b>Molecular Farming:</b> Production of high value pharmaceutical products in plant and animal systems. Biosafety, Regulation and IPR issues of genetically modified crops and animals. Innovation and Entrepreneurship development from the knowledge of transgenic technology. Transgenic technology for basic and applied research in plant systems: Transgenic technology in plant functional genomics- random insertional mutagenesis of genes, silencing of specific endogenous gene and concept of gene targeting.				<b>12</b>
Unit-IV	<b>Application of transgenic technology in plants:</b> Application of transgenic technology for enhancement of crop yield and nutritional quality of food constituents (carbohydrates, proteins and lipids); and improvement of quantity and quality of plant biomass required for non-food industrial raw materials. Transgenic technology for basic and applied research in animal systems				<b>12</b>
Unit-V	<b>Application of transgenic technology in animals:</b> Transgenic animals for functional genomics through random insertional mutagenesis and gene targeting. Transgenic farm animals, poultry birds and fishes for vaccine development, production of growth hormones and other commercial products; Improving the nutritional quality of milk and meat by transgenic approach. Transgenic mammals for gene therapy. Transgenic animals – retroviral, microinjection, and engineered embryonic stem cell method of transgenesis. Application of transgenic animals – biopharming, disease models, functional knockouts.				<b>12</b>

<p><b>Text Books:</b></p> <ol style="list-style-type: none"> <li>1. Molecular Biotechnology: Principles and Practices by Channarayappa, 1<sup>st</sup>Edn. 2007, University Press, India.</li> <li>2. Molecular Biotechnology by Sandy B. Primrose, 2<sup>nd</sup>Edn. 1991, Blackwell Scientific Publishers, USA.</li> </ol>
<p><b>Reference Book:</b></p> <ol style="list-style-type: none"> <li>1. An Introduction to Molecular Biotechnology: Fundamentals, Methods and Applications by Michael Wink, 2<sup>nd</sup>Edn. 2011, Wiley &amp; Blackwell, USA.</li> </ol>
<p><b>Specific learning Outcome (SLO):</b></p> <ul style="list-style-type: none"> <li>➤ Learners are introduced to transgenic technology applied in living organisms</li> <li>➤ Gain theoretical knowledge in transgenic technology</li> <li>➤ Learn about the applications of transgenic technology in farming and pharmaceuticals</li> <li>➤ Understand how humans are benefited by other organisms</li> <li>➤ Be able to appreciate the application of this technology in healthcare issues</li> </ul>



# Chettinad

Academy of Research & Education

(Deemed to be University Under Section 3 of the UGC Act 1956)

SEM - IV	UENSS18/National Service Scheme (Elective 2) (Credits -4)	L	P	T	J
		4	0	0	0
<b>Requisite</b>	<b>Expected to have a spirit of working as a team</b>				
<b>Objective</b>	<b>To apply their education in finding practical solution to individual and community problems</b>				
<b>Modules</b>	<b>Contents</b>				<b>Hr</b>
Unit-I	<b>Basic Concepts and Programmes:</b> History, philosophy, aims and objectives – emblem, flag, motto, song and badge – organizational structure and responsibilities – regular and day/special camp activities - village adoption.				<b>12</b>
Unit-II	<b>Youth and Leadership Development :</b> Definition of youth – issues, challenges and opportunities for youth – leadership and types – youth leadership and its importance – problem solving and decision-making – youth in peace and nation-building – Youth development programmes.				<b>12</b>
Unit-III	<b>Citizenship, Family and Society:</b> Basic features of constitution of India – fundamental and human rights – consumer awareness – concept of family, community and society – family dynamics and impact – human values – gender justice.				<b>12</b>
Unit-IV	<b>Youth and Health:</b> Health education – need and scope – food and nutrition – water borne diseases and sanitation – national health programme – healthy life styles – HIV, AIDS, Drugs and substance abuse – first aid – yoga – history, philosophy and concept of yoga – yoga as a tool for healthy life style.				<b>12</b>
Unit-V	<b>Youth, Crime and Skill Development:</b> Psychological and sociological factors influencing youth crime – peer mentoring – anti-ragging – cyber crime and prevention – juvenile justice – positive thinking – self-confidence and self-esteem – setting life goals and achieving – stress management – vocational skill development -becoming an entrepreneur.				<b>12</b>

**Text Books:**

1.National Service Scheme Manual (Revised) by Government of India Ministry of Youth Affairs & Sports New Delhi

**Specific learning Outcome (SLO):**

- Making education more relevant to present situation
- Providing opportunities to the students to play their role in planning and executing development projects
- Encouraging students and non-students to work together
- Developing the quality of leadership
- Emphasizing dignity of labour and self-help
- Participation of youth in national development



# Chettinad

Academy of Research & Education

(Deemed to be University Under Section 3 of the UGC Act 1956)

SEM - IV	ULIMD63 / Immunology and Molecular Diagnostics(Practical IV) (Credits -3)	L	P	T	J
		o	6	o	o
<b>Requisite</b>	<b>Expected to have hands on experience in basic biological and analytical techniques</b>				
<b>Objective</b>	<b>To provide hand on experience in immunological techniques</b>				
Modules	Contents				Hr
1	Blood collection methods, grouping & blood cell analysis Separation of serum / plasma Lymphocyte subset identification and enumeration.				90
2	Routes of inoculation - Preparation of Antigen - Protocol of immunization Agglutination tests: Widal test				
3	Complement fixation test Preparation of serum components Immuno diffusion, Immuno electrophoresis & Radial immuno-diffusion test.				
4	Antigen-antibody reaction (precipitation & agglutination reaction tests) Haemoagglutination. Precipitation: Ouchterlony's double immunodiffusion				
5	Isolation and purification of IgG from serum or IgY from chicken egg Blood smear identification of leucocytes by Giemsa stain Antibody titre by ELISA method				

<b>Text Book:</b> 1. Practical Immunology by Frank .C. Hay., Olwyn M.R., Westwood., 4 <sup>th</sup> EDn , 2008, Wiley- Blackwell
<b>Specific learning Outcome (SLO):</b> <ul style="list-style-type: none"> <li>➤ Develop skill in sample collection and processing for immunological analysis</li> <li>➤ Develop practical Knowledge to raise antibody in animals</li> <li>➤ Develop practical skill in immune-diffusion techniques</li> <li>➤ Gain knowledge in isolation and purification of immunoglobulin</li> </ul>



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Academy of Research & Education

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SEM - IV	ULCG055/Cytogenetics (Practical IV) (Credits -3)	L	P	T	J
		o	6	o	o
<b>Requisite</b>	<b>Expected to have hands on experience in basic biological and analytical techniques</b>				
<b>Objective</b>	<b>To provide hands on training in practical aspects of cytogenetics</b>				
Modules	Contents				Hr
1	Principles and applications of basic sterilization techniques				90
2	Culture media preparation technique Culture of Peripheral blood cells				
3	Preparation of metaphase chromosome Slides Staining of metaphase chromosome Slides				
4	Image analysis for Karyotyping : Cytovision Software				
5	Karyograms : normal male, normal female				
6	Identification of Structural abnormalities and numerical abnormalities (demonstration)				

**Text Book:**

1. The Principles of Clinical Cytogenetics, by Steven Gersen, 1<sup>st</sup> Edn, Humana Press, 2010

**Specific learning Outcome (SLO):**

- Students will be able to understand the techniques in clinical cytogenetic as a diagnostic tool
- Hands on experience on karyotyping
- Can gain knowledge and understand the basic structure and function of chromosomes
- Can understand the relation between genetics, evolution and medicine
- Lays foundation to the fundamental concepts of cytogenetics



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<b>SEM - V</b>	<b>UCTCo29/Tissue Culture Technology (Credits -4)</b>	<b>L</b>	<b>P</b>	<b>T</b>	<b>J</b>
		<b>4</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>Requisite</b>	<b>Expected to have knowledge of Biochemistry and Cell Biology</b>				
<b>Objective</b>	<b>To impart technical skill in the culture of cells and tissues</b>				
<b>Modules</b>	<b>Contents</b>				<b>Hr</b>
Unit-I	<b>Introduction to cell culture:</b> Basic rules and regulations of cell culture laboratory- Advantages of Tissue Culture-History and development of cell culture- Infrastructure and layout of cell culture laboratory- Equipment- CO <sub>2</sub> incubator, Biosafety cabinet, Inverted microscope, Centrifuge, Cryopreservant, and other equipments.				12
Unit-II	<b>Sterilization process:</b> Materials used in cell culture-Types and ingredients of different types of media used for animal cell culture- Serum, Trypsin, Antibiotic, Phosphate Buffered saline (PBS), Cryoprotectant used in cell culture.				12
Unit-III	<b>Types of cell culture-</b> Cell adhesion, proliferation, differentiation- Primary cell culture techniques- Secondary cell culture- Cryopreservation- Transfection- Cloning and selection.				12
Unit-IV	<b>Cell culture reactors-</b> Stirrer culture, continuous flow culture, air lift fermentor culture, roller bottle culture, multi surface culture, multi array dishes- organ culture- measurement of cell death.				12
Unit-V	<b>Applications of cell culture:</b> Drug development and medical/pharmaceutical- Genetic Engineering of animal cells and their applications- Limitations of cell culture technique.				12

**Text Books:**

1. J. M. Davis. Basic Cell Culture, 2<sup>nd</sup> Ed n, 2005, Oxford University Press (OUP).
2. Maureen A. Harrison, Ian F. Rae. General Techniques of Cell Culture. Cambridge University Press 1997

**Reference Books:**

1. R. Ian Freshney, Culture of Animal Cell; A manual of Basic Technique 5<sup>th</sup> Edn 2005, John Wiley.
2. N. Jenkins: Animal Cell Biotechnology; Methods & Protocols, 2005, Humana Press

**Specific learning Outcome (SLO):**

- Learn the basic rules and guidelines followed in a cell culture laboratory
- Learn about equipment operation in the lab; sterilization procedures
- Develop skill to maintain different types of culture and cryopreservation of cells
- Apply the technical knowledge for medical and genetic engineering applications



# Chettinad

Academy of Research & Education

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SEM - V	UCGE030/Genetic Engineering (Credits -4)	L	P	T	J
		4	0	0	0
<b>Requisite</b>	<b>Expected to have knowledge of Molecular Biology</b>				
<b>Objective</b>	<b>To impart knowledge of main engines of implementation and transmission of a genetic material at molecular and cellular levels</b>				
<b>Modules</b>					<b>Hr</b>
Unit-I	<b>Milestones in Genetic engineering:</b> Definition of Gene and Recombinant DNA, Steps in Genetic Engineering, principles of gene cloning. Restriction enzymes, Ligation, Alkaline Phosphatase, Double Digest, Modification of Restriction Fragments ends, Other Ways of joining DNA Molecules				<b>12</b>
Unit-II	<b>Vectors and Cloning:</b> Plasmid vectors, Vectors based on the lambda, Bacteriophage, Cosmids, M13 vectors, Expression vectors, Vectors for cloning and expression in Eukaryotic cells, YACs and BACs. DNA amplification, basic features and application PCR and Cell based DNA Cloning – Cloning System for producing single-stranded and mutagenized DNA.				<b>12</b>
Unit-III	<b>rDNA technology and its application:</b> Construction of genomic and cDNA libraries. Identification and characterization of insert DNA fragments. Restriction mapping. Chromosome walking and chromosomal localization of genes. Cloning of microbial genes, Nucleic Acid Hybridization: Principle and application, RFLP, microarrays. Site-directed mutagenesis and molecular chimeras.				<b>12</b>
Unit-IV	<b>Gene therapy:</b> Types of gene therapy, vectors in gene therapy, molecular engineering, human genetic engineering, problems & ethics. Therapeutic products produced by genetic engineering- blood proteins, human hormones, immune modulators and vaccines. Use of genetic engineering in environmental management.				<b>12</b>
Unit-V	<b>Transgenesis:</b> Production of transgenic mice, ES cells for gene targeting in mice, Applications of gene targeting, Transgenic animals, Strategies for gene transfer to plant cells, Use of plant viruses as episomal expression vectors, crop improvement, herbicide resistance, insect resistance, virus resistance, plants as bioreactors.				<b>12</b>

<b>Text Book:</b> 1. Gene Cloning and DNA Analysis by Brown T.A., 4 <sup>th</sup> Edn. 2003, Blackwell Scientific Publications, USA.
<b>Reference Books :</b> 1. Principles of Gene Manipulation: An Introduction to Genetic Engineering by Primrose S.B. and Twymann R.H., 6 <sup>th</sup> Edn. 2004, Blackwell Scientific Publications, USA. 2. Molecular Biotechnology by Glick B.R. and Pasternak J.J., 4 <sup>th</sup> Edn. 2010, ASM Press, USA.
<b>Specific learning Outcome (SLO):</b> <ul style="list-style-type: none"> <li>➤ Develop knowledge in the concept of genetic engineering</li> <li>➤ Be able to clone a gene, express and analyse its product</li> <li>➤ Be able to construct genomic and cDNA libraries</li> <li>➤ Learn about the practical applications of genetic engineering</li> <li>➤ Learn about the legal, safety ethical aspects of genetic engineering</li> </ul>



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Sem V	UEIGC60/Introduction to Genetic counseling (Credits -4)	L	P	T	J
		4	0	0	0
<b>Requisite</b>	<b>Good knowledge in Molecular Biology and Medical Genetics</b>				
<b>Objective</b>	<b>To be aware of the key principles of clinical genetics, Reproductive and molecular biology</b>				
<b>Modules</b>	<b>Contents</b>				<b>Hr</b>
Unit-I	<b>Introduction and process of Genetic Counseling:</b> An overview of the history and development of genetic counseling, Definition of counseling - counseling process- Introduction to counseling skills utilized in genetic counseling via reading, discussion and clinical observation - counselor's skills utilized in prenatal, pediatric, and adult genetic counseling.				<b>12</b>
Unit-II	<b>Psychosocial Aspects of Genetic Counseling:</b> Exploration of the impact of genetic conditions on the individual and family. Risks for psychological stress, Risks for discrimination, psychosocial skills will be strengthened through reading, role play, discussion and interactions with affected individuals and families. Awareness of the impediments to effective genetic counseling.				<b>12</b>
Unit-III	<b>Scope of Genetic Counseling</b> - Methods of genetic counseling, preventive management guidelines - Information gathering and construction of pedigrees and their interpretation, consanguinity marriage, Risk assessment and counseling in common mendelian and multifactorial syndromes, understanding genetic testing and Medical documentation.				<b>12</b>
Unit-IV	<b>The Role of Genetic Counseling in Reproductive Healthcare</b> - Introduction to embryology, Infertility and its clinical management, IVF procedure: Fertilization, Embryo production & Cryopreservation techniques, Intracytoplasmic sperm injection, Sperm abnormality analysis in human.				<b>12</b>
Unit-V	<b>Ethical Challenges and Contemporary Issues in Genetic Counseling:</b> Special considerations in genetic counseling, ethical problems faced by the counselor. Discussion forum targeted at critical evaluation of medical genetics literature - examination of current issues affecting the genetic counseling profession.				<b>12</b>

<b>Text Books</b>
<ol style="list-style-type: none"> <li>1. A Guide to Genetic Counseling, 2<sup>nd</sup>Edn, by Wendy R. Uhlmann, Jane L. Schuette, Beverly Yashar, 2009, Wiley-Blackwell</li> <li>2. Genetic Disease: The Unwanted Inheritance, by John David Rainer, 1989, Haworth Press</li> </ol>
<b>Reference Book:</b>
➤ IVF Techniques for the Beginners, by Kuldeep Jain, Pankaj Talwar, 2013, JP Medical Ltd
<b>Specific learning Outcome (SLO):</b>
<ul style="list-style-type: none"> <li>➤ To understand the importance of genetic counselling</li> <li>➤ To gain knowledge in the genetic disorder and management of disease</li> <li>➤ Student can understand the nuances of counseling</li> <li>➤ To be aware of how to counsel a patient with genetic disorder</li> <li>➤ Good careers as genetic counselors</li> </ul>

SEM - V	UEPE069/Population and Evolutionary Genetics	L	P	T	J
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		(Credits -4)	4	0	0	0
<b>Requisite</b>	<b>Expected to have Basic knowledge in Biology</b>					
<b>Objective</b>	<b>To create awareness on the importance of Population genetics and the evolutionary genetics and their applications in Medicine.</b>					
<b>Modules</b>	<b>Contents</b>					<b>Hr</b>
Unit-I	<b>Population Genetics:</b> Allele frequencies - deriving genotypic & allelic frequencies, introduction to Hardy-Weinberg method & its applications – calculating allelic frequencies, assumptions of Hardy-Weinberg equilibrium, proof of Hardy-Weinberg equilibrium, testing for fit to Hardy-Weinberg equilibrium.					<b>12</b>
Unit-II	<b>Molecular population genetics:</b> Genetic drift, random mutation and gene flow- Y-chromosome polymorphism. Patterns of change in nucleotide and amino acid-sequences -Molecular clock - Neutral theory of molecular evolution-Kinds of molecular data used in phylogenetic analysis.					<b>12</b>
Unit-III	<b>Synthetic theory of Evolution:</b> Lamarckian evolution theory, Darwin's theory of evolution, Neo-Darwinism, modern synthesis theory of evolution, Macroevolution & Microevolution-Principles of Evolutionary Genetics -From Mendel to molecules, Epistasis and the conversion of genetic variances- Evolution of Genetic Diversity - natural variation, sources of genetic variation: chromosomes & crossing over, SNPs, mutation, deletion & rearrangements, recombination, genetic drift & gene flow.					<b>12</b>
Unit-IV	<b>Molecular Evolution:</b> General approaches, principles, detecting selection at molecular level, rates of molecular evolution- Weak selection on non-coding gene features- molecular study of phylogeny- chromosomal evolution-Gene function in molecular evolution.					<b>12</b>
Unit-V	<b>Evolution of Mitochondrial genome:</b> The origin of Eukaryotic cells, Evolution of Eukaryotic Nuclear genome, genome duplication & large-scale chromosomal alterations, Evolution of the Human sex chromosomes- Evolution of Human DNA sequence families & DNA organization, Comparative mammalian genome organization & the evolution of modern humans.					<b>12</b>

<b>Text Book:</b>									
1. Introduction to Quantitative Genetics (4 <sup>th</sup> Edition) by Douglas S. Falconer, Trudy F.C. Mackay, Benjamin Cummings; 4 <sup>th</sup> Edition 1996.									
<b>Reference Books:</b>									
1. Principles of Population Genetics, Fourth Edition Hardcover by Daniel L. Hartl , Andrew G. Clark. Sinauer Associates, Inc.; 4 <sup>th</sup> edition, 2006.									
2. Human Evolutionary Genetics: Origins, Peoples and Disease by Mark Jobling, Matthew Hurles, Garland Science, 2003.									
<b>Specific Learning Outcome (SLO):</b>									
<ul style="list-style-type: none"> <li>➤ Students will be able to articulate how broad, interrelated patterns of human global genetic variation affect how we use DNA variation for identification of individuals.</li> <li>➤ Students will be able to compare and contrast how different DNA technologies can affect identification of individuals based on forensic evidence.</li> <li>➤ Students will be able to reflect before and after the course about how it impacts their future practice in terms of their ability to give expert testimony and do research in population genetics.</li> </ul>									
<b>SEM - V</b>	<b>UECTM39/Clinical Trial and Management (Elective 3)</b>					<b>L</b>	<b>P</b>	<b>T</b>	<b>J</b>
	<b>(Credits -4)</b>					<b>4</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>Requisite</b>	<b>Basic knowledge of Pharmacology and Biopharmaceuticals</b>								

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Objective	To create awareness in clinical trial procedures and rules	
Modules	Contents	Hr
Unit-I	<b>Introduction to clinical research:</b> Terminologies and definition in Clinical Research, Origin and History of Clinical Research, Difference between Clinical Research and Clinical Practice, Types of Clinical Research, Phases of clinical research, Clinical Trials in India –The National Perspective, Post marketing surveillance, Pharmaceutical Industry – Global and Indian Perspective, Clinical Trial market, Career in Clinical Research	12
Unit-II	<b>Pharmacology and drug development:</b> Introduction to Pharmacology, Concept of Essential Drugs, Routes of Drug Administration, Basics of Drug Discovery & Development, Preclinical Testing, Investigational New Drug Application, Clinical trials, New Drug Application and Approval, Pharmacokinetics, Pharmacodynamics in Clinical Research..	12
Unit-III	<b>Ethical Considerations/Guideline/Regulations in Clinical Research:</b> International Conference on Harmonization (ICH), Guidelines for Good Clinical Practice (GCP), The Principles of ICH GCP, Institutional Review Board / Independent Ethics Committee, Investigator, Sponsor, Clinical Trial Protocol and Protocol Amendment(S), Introduction of Clinical Trial Regulation, European Medicine Agency, Food and Drug Administration (US FDA), Drug and cosmetic act	12
Unit-IV	<b>Clinical Trial Management:</b> Project Management, Protocol in Clinical Research, Informed Consent, Case Report Form (CRF), Investigator’s Brochure (IB), Contract Research Organization (CRO), Site management organizations (SMO), Ethical and Regulatory Submissions, Recruitment Techniques, Retention of Clinical Trial Subjects, Monitoring Visits, Investigator Meeting, Documentation in Clinical Trials, Pharmacovigilance, Training in clinical Research, Roles and Responsibilities of Clinical Research Professionals	12

<b>Text Book:</b>
1. Principles and Practice of Clinical Research, edited by John I. Gallin, Frederick P. Ognibene, 3 <sup>rd</sup> Edn. 2012, Academic Press.
<b>Reference Books:</b>
1. Clinical Trials Handbook, edited by Shayne Cox Gad, 1 <sup>st</sup> Edn. 2009, John Wiley Sons Inc, USA.
2. Clinical Studies Management: A Practical Guide to Success, Simon Cook, 1 <sup>st</sup> Edn. 2004, Taylor & Francis, USA.
<b>Specific learning Outcome (SLO):</b>
<ul style="list-style-type: none"> <li>➤ Introduction to clinical research and understanding the difference between clinical research and clinical practice</li> <li>➤ National and International perspective of management research and awareness on the Advantages and limitations of clinical trials</li> <li>➤ Introduction to drug pharmacology and kinetics and knowledge on how to document clinical data</li> <li>➤ Develop awareness on the documentation of clinical data</li> <li>➤ Be able to understand the scope of a clinical work and how to complete successfully</li> </ul>

<b>SEM - V</b>	<b>UEBP032/Biopharmaceuticals (Elective 3)</b>	<b>L</b>	<b>P</b>	<b>T</b>	<b>J</b>
	<b>(Credits -4)</b>	<b>4</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>Requisite</b>	<b>Expected to have knowledge in Biochemistry</b>				
<b>Objective</b>	<b>To impart knowledge on the production and application of pharmaceutical products</b>				



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Modules	Contents	Hr
Unit-I	<b>Introduction to Pharmaceuticals:</b> History & Definition of Drugs, Sources of Drugs - Plant, Animals, Microbes and Minerals, Biopharmaceuticals, Types of Biopharmaceuticals- Biogenerics and Biosimilars; The advent of Biosimilars; Protein-based biopharmaceuticals; Manufacturing processes; Global market; International Non-proprietary Names (INN) nomenclature system biosimilars regulation (EU position, US pathways, Government initiatives).	12
Unit-II	<b>Production of Biopharmaceuticals:</b> Good manufacturing practices, Manufacturing facilities, Sources of Biopharmaceuticals, Production & analysis of Biopharmaceuticals, Recent advances in the manufacture of drugs using r-DNA technology. Production of Therapeutic Proteins, Hormones, Cytokines - Interferon's, Interleukins I & II, Tumor Necrosis Factor (TNF); Nucleic acids.	12
Unit-III	<b>Applications of Biopharmaceuticals:</b> Role of Biopharmaceuticals in treatment of various health disorders, Case studies: Erythropoietin, Insulin, Somatotropin, Interleukin-2, Interferon Granulocytemacrophage-CSF, DNase, Factor VIIa, Factor IX, Factor VIII, Activated protein C, Tissue plasminogen activator, Monoclonal antibodies.	12
Unit-IV	<b>Biosimilars and its Scenario:</b> Approved follow-on proteins/Biosimilars; Characteristics of high selling peptides and proteins,; Target products for FOB (follow-on biologicals)/Biosimilars development peptides; Recombinant nonglycosylated proteins; Recombinant glycosylated proteins; Industries dealing with biogenerics and its market value; World scenario; Indian scenario.	12
Unit-V	<b>Immunogenicity of Biopharmaceuticals:</b> Immunogenicity of biopharmaceuticals: Immunogenicity; Factors contributing to immunogenicity (product-related factors, host- related factors), Consequence of immunogenicity to biopharmaceuticals; Measurement of immunogenicity	12

<b>Text Book:</b> 1. Modern Biopharmaceuticals - Design, Development and Optimization, Jorg Knablein, 1 <sup>st</sup> Edn, August 2005, Wiley-VCH, Weinheim Publishers.
<b>Reference Books:</b> 1. Biopharmaceuticals: Biochemistry and Biotechnology, Gary Walsh, Wiley Publishers, 1998. 2. Biotechnology and Biopharmaceutical Manufacturing, Processing, and Preservation, Drug Manufacturing Technology series, Volume 2, Edited by Kenneth E. Avis, Vincent L. Wu, Interpharm/CRC, 1996.
<b>Specific learning Outcome (SLO):</b> <ul style="list-style-type: none"> <li>➤ Impact and importance of biopharmaceutical industry</li> <li>➤ The available products of biopharmaceutical industries</li> <li>➤ Clinical and medical importance of biopharmaceuticals</li> <li>➤ The commercial products of biopharmaceuticals and their market value</li> <li>➤ Immunogenicity of biopharmaceuticals</li> </ul>

SEM - V	UEPMo40/Personalized Medicine(Elective 3 ) (Credits -4)	L	P	T	J	
		4	0	0	0	
<b>Requisite</b>	<b>Expected to have more knowledge of Biochemistry, Genetics and Cell Biology</b>					
<b>Objective</b>	<b>To have complete genomic of the individual patient for use in disease diagnosis and prognosis</b>					
Modules	Contents					Hr
Unit-I	<b>Basic Aspects:</b> Definition, Medical aspects, Molecular basis, Basic technologies, Role of					12



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	genetics in future approaches, Integration of technology	
Unit-II	<b>Biomarkers:</b> Genetic, Epigenetic, Transcriptomic, Proteomic, Metabolomic, Role of biomarkers, Biomarkers for monitoring response to therapy Marketed biomarkers, Issues and challenges, Future	<b>12</b>
Unit-III	<b>Microarrays:</b> Types, Procedure for setting microarray, drug permeability, drug availability, drug - drug interaction, drug toxicity, drug development, challenges.	<b>12</b>
Unit-IV	<b>Diagnostics:</b> Introduction, sensors: cantilever, active and passive, surface effects on cantilevers, steric effects, biomedical cantilever applications, surface Plasmon nanosensors, microfluidics	<b>12</b>
Unit-V	<b>Nanodiagnostics and clinical applications:</b> Early detection of cancer, brain probes, monitoring cardiovascular disease, detection of infectious agents : Bacteria - Virus -, markets for nanomolecular diagnostics	<b>12</b>

**Text Books:**

1. Textbook of Personalized Medicine, by Kewal K. Jain 2<sup>nd</sup> Edn. 2015, Humana Press.
2. Nanobiotechnology in Molecular Diagnostics: Current Techniques and Applications, by K.K. Jain, 2005, Taylor & Francis

**Reference Books:**

1. Medical Nanotechnology and Nanomedicine, by Harry F. Tibbals, 2010, CRC press.
2. Handbook of Personalized Medicine: Advances in Nanotechnology, Drug Delivery, and Therapy, 1<sup>st</sup> Edn, by Ioannis S. Vizirianakis, CRC Press

SEM - V	ULGE035/Genetic Engineering (Practical VI) (Credits -3)	L	P	T	J
		0	6	0	0
<b>Requisite</b>	<b>Expected to have practical skill in biochemical and cell biological techniques</b>				
<b>Objective</b>	<b>Hands on training on the rDNA technological aspects</b>				
<b>Modules</b>	<b>Contents</b>				<b>Hr</b>
1	DNA isolation and Characterization				<b>90</b>
2	Basic concept of primer designing				
3	Target gene amplification				
4	Ligation of DNA				
5	Cloning of the amplified product				



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6	Bacterial gene expression	
7	Study of DNA Finger Printing (Demonstration)	
8	Southern Blotting technique (Demonstration)	

**Text Book:**

1. Essential Molecular Biology: Volume I: 001 (Practical Approach Series), by Terry Brown, 2009, John Wiley and sons.

**Specific learning Outcome (SLO):**

- Principle concepts of genetic engineering
- Practical Knowledge of PCR technique
- Practical application of rDNA technology
- Gain practical knowledge on the use of bacteria for gene manipulation



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SEM - V	ULTC034/Tissue Culture Technology (Practical VII) (Credits -3)	L	P	T	J
		o	6	o	o
<b>Requisite</b>	<b>Expected to have practical skill in biochemical and cell biological techniques</b>				
<b>Objective</b>	<b>To provide hands on training on basic cell culture and maintenance of mammalian cells <i>in vitro</i></b>				
<b>Modules</b>	<b>Contents</b>				<b>Hr</b>
1	<i>In vitro</i> Culture - Washing & Sterilization, Preparatory steps for tissue culture, handling cell culture equipments				<b>90</b>
2	Preparation of Culture media & Reagents				
3	Culturing and maintenance of cells				
4	Trypan Blue Dye Exclusion Method				
5	MTT Assay				
6	Cryopreservation and Retrieval of Cells				
7	Detection of Apoptosis by DAPI staining				

**Text Book:**

1.Principles and Practice of Animal Tissue Culture, By Gangal, Sudha, 2<sup>nd</sup> Edn, Universities Press (India) Private Ltd., 2010.

**Specific learning Outcome (SLO):**

- Basic knowledge in the principles of tissue culture techniques
- Gain practical knowledge on the basic requirements for cell culture lab
- Learn hands on training in the maintenance of sub cultures
- Biochemistry behind live and dead cells would be understood
- Students can visualize how cells take stain



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SEM - VI	UCB1036/Bioinformatics (Credits -4)	L	P	T	J
		4	0	0	0
<b>Requisite</b>	<b>Expected to have advance knowledge in Biology and good computational skills</b>				
<b>Objective</b>	<b>To implement computation methods for scientific solutions</b>				
<b>Modules</b>	<b>Contents</b>	<b>Hr</b>			
Unit-I	<b>Introduction to Bioinformatics:</b> definition, history; computer - system, topology and peripherals for communication; Internet - basics, connection, web browsing and URL.	<b>12</b>			
Unit-II	<b>Biological Databases:</b> Overview, Applications, Prospects; Modes of database search, data storage (flat file, db-tables); Gene and protein sequence databases; GenBank, EMBL, DDBJ, PDB; access to sequence databases via internet.	<b>12</b>			
Unit-III	<b>Sequence alignment and sequence analysis:</b> Concept of local and global sequence alignment, Pairwise sequence alignment, scoring an alignment, substitutional matrices, Pattern recognition, BLAST; Multiple sequence alignment, homology, analogy (ClustalW, T-Coffee, GeneDoc).	<b>12</b>			
Unit-IV	<b>Protein prediction:</b> Physical properties, secondary structure, alpha & beta structure, motifs, tertiary structures, specialized structure and function. Molecular visualization - protein conformation and visualization tool (RASMOL).	<b>12</b>			
Unit-V	<b>Drug discovery:</b> Role of bioinformatics in drug discovery, target discovery, lead discovery, microarray, docking and prediction of drug quality. Bioinformatics companies.	<b>12</b>			

**Text Books:**

1. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins by Baxevanis AD and Ouellette BFF, 2<sup>nd</sup> Ed. 2001, John Wiley & Sons, Inc., USA.
2. Bioinformatics Sequence and Genome Analysis by Mount DW, 2<sup>nd</sup> Edn. 2004, Cold Spring Harbour Laboratory Press, USA.

**Reference Books:**

1. Developing Bioinformatics Computer Skills by Gibas C and Jambeck P, 1<sup>st</sup> Edn. 2001, O'Reilly & Associates Inc. USA. 1999.
2. Introduction to bioinformatics by Attwood, T.K. & D.J. Parry-Smith, 1<sup>st</sup> Edn. 1999, Pearson Education India, Asia.

**Specific learning Outcome (SLO):**

- Basic introduction on how computational field can be explored bioinformation systems
- Basic understanding of statistical knowledge
- Understand the ethical issues of storing biological information
- To understand and identify proteins
- To appreciate accuracy and efficacy
- Gain skills in data storage and information



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SEM - VI	UCSCB37/Stem Cell Biology (Credits -4)	L	P	T	J
		4	0	0	0
<b>Requisite</b>	<b>To make the student to understand the basic concepts of Stem cell biology</b>				
<b>Objective</b>	<b>The course objectives are to impart knowledge about types of stem cells and their application</b>				
<b>Modules</b>	<b>Contents</b>				<b>Hr</b>
Unit-I	<b>Introduction to Stem Cells</b> - Basics and Properties - self renewal and pluripotency of stem cells- stem cells and niches, induced pluripotency of stem cells (iPS).				<b>12</b>
Unit-II	<b>Types of Stem cells:</b> Hematopoietic Stem Cells, Mesenchymal Stem Cells, Embryonic Stem Cells, Fetal Stem Cells- Germline stem cells and germline derived pluripotent cell-Embryonic Stem Cells Blastoyst and inner cell mass cells; Stem cell differentiation; Stem cells cryopreservation.				<b>12</b>
Unit-III	<b>Isolation and characterization:</b> Isolation, culturing and characterization of Hematopoietic, Mesenchymal and Embryonic stem cells from human and rodents-Tools used for stem cell characterization- Fluorescence activated cell sorter (FACS) and Immunohistochemistry.				<b>12</b>
Unit-IV	<b>Human Embryonic Stem Cells and society</b> -Human stem cells research-Ethical considerations; Stem cell religion consideration-Stem cell based therapies: Pre clinical regulatory consideration and Patient advocacy				<b>12</b>
Unit-V	<b>Applications of stem cells:</b> Neurodegenerative diseases; Parkinson's , Alzheimer and Spinal Cord Injuries . Cardiomyopathy; Kidney failure; Liver Failure; Cancer and Hemophilia.				<b>12</b>

#### Text Books:

1. Robert Lanza et al. Principles of Tissue Engineering, 3<sup>rd</sup> Edn. Academic Press; 3 edition (August 21, 2007)
2. Stein et al. Human Stem Cell Technology and Biology: A Research Guide and Laboratory Manual. Wiley-Blackwell; 1<sup>st</sup> Edn ,, 2011

#### Reference Book:

1. R. Lanza, J. Gearhart et al (Eds), Essential of Stem Cell Biology. (2009), Elsevier Academic press.

#### Specific learning Outcome (SLO):

- Students will be able to understand the techniques in isolation, culturing and characterization of various stem cells.
- The importance of regenerative medicine will be understood
- The relevance of developmental biology would be clearly understood
- The ethical concerns of stem cell technology would be made aware
- Applications of these methods will be made aware



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SEM - VI	UCRCG57/Reproductive and Cancer Genetics (Credits -4)	L	P	T	J
		4	0	0	0
<b>Requisite</b>	<b>Expected to have basic knowledge of genetic aspects and developmental biology</b>				
<b>Objective</b>	<b>To familiarize molecular and cellular basis of cancer and the role of genetics in reproduction</b>				
<b>Modules</b>	<b>Contents</b>	<b>Hr</b>			
Unit-I	<b>Chromosomal basis of sex determination:</b> Evolution of sex chromosomes, Sex chromosome type, simple and multiple sex chromosomes, mechanism and systems of sex determination in <i>C. elegans</i> , <i>Drosophila</i> and Humans. Chromosome imprinting phenomena. Cell fate specification and organogenesis – condition and autonomous specification. Cytoplasmic determinants development of tetrapod limb – sex determination and differentiation – <i>Drosophila</i> and human.	<b>12</b>			
Unit-II	<b>Prenatal and Reproductive Genetics:</b> Preimplantation genetic diagnosis, Prenatal Screening and Diagnosis, Amniocentesis, Chorionic villi biopsy, Cytogenetics of prenatal chromosomal abnormalities with clinical citations, Genetic counseling, Transplantation changes in bone marrow, peripheral stem cells and umbilical cord cells with chromosomal features.	<b>12</b>			
Unit-III	<b>Developmental and Reproductive Genetics:</b> Models for human developmental stages Hormone assay for thyroid (TSH, T <sub>3</sub> , and T <sub>4</sub> ) and sexual disorders (testosterone, dihydrotestosterone, estradiol, FSH, LH by RIA), semen analysis, Y-chromosome microdeletion.	<b>12</b>			
Unit-IV	<b>Cancer Cell and Its Properties:</b> Clonal nature of cancer, proposed theories of carcinogenesis, Causes of cancer, Radiation carcinogenesis – radiation and human cancer temporal stages of radiation action. Genetic effects of ionizing radiation, Virus and oncogene activation by radiation. Interaction of radiation and chemical carcinogenesis.	<b>12</b>			
Unit-V	<b>Cancer as a genetic disease:</b> An overview of cancer and control of cell number, cell proliferation machinery, Machinery for Programmed Cell Death, the genetics of aberrant cell control, cancer research in genomic analysis. Oncogene in human cancer and their genetic relevance: Tumor suppressor genes, Role of protooncogenes during development, Metastasis, Genetic basis of carcinogenesis.	<b>12</b>			

### Text Books:

1. Hamerton, J. L., 1984. Human Cytogenetics. Vols. I & II. Academic Press, N.Y. White, M.J.D. Modes of Speciation, W.H. Freeman & Co.
2. Gardner, Simmons, & Snustad, 1997. Principles of Genetics 8<sup>th</sup> Edn., John Wiley and Sons. Lewin, B., 1996. Genes VI, John Wiley and Sons.

### Reference Books:

1. Mark H. F. L., 2000. Medical Cytogenetics, Marcel Dekker Inc, N.Y. Sambamurthy, A.V.S., 1999. Genetics, Narosa Publishing House, New Delhi.
2. Sumner, A.T. 2003. Chromosomes : Organization and Function, Black well Publishing, USA

### Specific learning Outcome (SLO):

- Students will be able to understand the genetics aspects of sex determination, molecular basis of cancer development
- Importance of prenatal diagnosis would be understood
- The reproductive developmental states and the genetic variation would be clearly understood
- The behavioral changes of cancer cell would be made aware



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- Lays foundation to the research based on genetic variation and disease management

SEM - VI	ULBlo41/Bioinformatics (Practical VIII) (Credits -3)	L	P	T	J
		o	6	o	o
<b>Requisite</b>	<b>Computational skills</b>				
<b>Objective</b>	<b>Training in the field of bioinformatics</b>				
<b>Modules</b>	<b>Contents</b>				<b>Hr</b>
1	Primary databases				90
2	Secondary databases				
3	Sequence analysis				
4	Tools such as BLAST, FASTA, Clustalw				
5	Multiple Sequence alignment				
6	Structure database				
7	Molecular Visualization Tools-Rasmol & Swiss PDB Viewer				

**Text Book:**

1. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, by Andreas D. Baxevanis , B.F. Francis Ouellette, 2009

**Specific learning Outcome (SLO):**

- Knowledge on data gathering, analysis and interpretation
- Understand how tools can be used for data storage
- Ethics involved in using tools
- To apply computational knowledge in statistics
- To select appropriate tool based on requirement



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<b>SEM - VI</b>	<b>UEPJo68/Project/Dissertation (Credits -8)</b>	<b>L</b>	<b>P</b>	<b>T</b>	<b>J</b>
		<b>0</b>	<b>12</b>	<b>0</b>	<b>0</b>
<b>Requisite</b>	<b>Respective experimental skills</b>				
<b>Objective</b>	<b>To enrich the undergraduate students with a research early experience</b>				
	<b>Contents</b>				<b>Hr</b>
	<ul style="list-style-type: none"> <li>➤ Documentation for hands on project of about 30 pages would be submitted</li> <li>➤ Project undertaken would be batch wise and each batch contains not more than four students</li> <li>➤ Dissertation would be submitted</li> <li>➤ The project will be internally evaluated by the department</li> </ul>				<b>180</b>

**Specific learning Outcome (SLO):**

- The experience would allow them to better understand published works, learn to balance collaborative and individual work and discover a passion for research – leading to graduate studies
- Develops new avenues for future career
- Collaborate with graduate and doctorate research scholars
- Build strong academic bonds
- Students would be well trained for beginners industrial or academic career
- Understanding the practical skills in the field of medical genetics