M.Sc. Bioinformatics
(Five Year integrated)
Programme

Syllabus and Regulations

Learning Outcome based Curriculum Framework (LOCF)
under Choice Based Credit System (CBCS)

(2022 - 2023 Batch onwards)

DEPARTMENT OF BIOINFORMATICS
SCHOOL OF LIFE SCIENCES
BHARATHIDASAN UNIVERSITY
TIRUCHIRAPPALLI - 620 024

M. Sc. BIOINFORMATICS (5-YEAR INTEGRATED) PROGRAMME

Learning Outcome based Curriculum Framework (LOCF) under Choice Based Credit System (CBCS) (2022-2023 onwards)

FIRST YEAR

Part	Course Code	Name of the Course	Credits	Teach-ing Hours	Maximum Marks		
					CIA	ESE	Total
	SEMESTER – I						
I	21P1TAM1	Language Course – I (Tamil/Hindi/French)	3	6	25	75	100
II	ELC01	English Language Course – I	3	5	25	75	100
III	22BI1CC01	Introduction to Bioinformatics	4	4	25	75	100
	22BI1CC02	Cell Biology	4	4	25	75	100
	22BI1LC01	Practical–I: Introduction to Bioinformatics Lab	2	3	40	60	100
	22BI1AICC01	Mathematics – I	3	4	25	75	100
IV	22BI1VE01	Value Education	2	3	25	75	100
		Seminar, Library, Leveraging E-Resources	--	1	--	--	--
		Total	21	30	190	510	700

Part	Course Code	Name of the Course	Credits	Teach-ing Hours	Maximum Marks		
					CIA	ESE	Total
	SEMESTER – II						
I	21P1TAM2	Language Course – II(Tamil/Hindi/French)	3	6	25	75	100
II	ELC02	English Language Course – II	3	5	25	75	100
III	22BI2CC03	Computer Programming in C	4	4	25	75	100
	22BI2CC04	Biophysics	4	4	25	75	100
	22BI2LC02	Practical – II : Computer Programming in C Lab	2	3	40	60	100
	22BI2AICC02	Mathematics – II	3	4	25	75	100
IV	22BI2ES01	Environmental Studies	2	3	25	75	100
		Seminar, Library, Leveraging E-Resources	--	1	--	--	--
		Total	21 (42)	30	190	510	700 (1400)

SECOND YEAR

Part	Course Code	Name of the Course	Credits	Teach-ing Hours	Maximum Marks		
					CIA	ESE	Total
	SEMESTER – III						
I	21P1TAM3	Language Course – III(Tamil/Hindi/French)	3	6	25	75	100
II	ELCO3	English Language Course – III	3	5	25	75	100
III	22BI3CC05	Bioinformatics Databases & Resources	4	4	25	75	100
	22BI3CC06	Object Oriented Programming in C++	4	4	25	75	100
	22BI3LC03	Practical III : Bioinformatics Databases & Resources and OOP in C++ Lab	2	3	40	60	100
	22BI3AIICC03	Biochemistry	3	3	25	75	100
IV	22 BI3NMEC01	Programming for Life Sciences	2	3	25	75	100
		Seminar, Library, Leveraging E-Resources	--	2	--	--	--
		Total	21 (63)	30	190	510	700 (2100)

Part	Course Code	Name of the Course	Credits	Teach-ing Hours	Maximum Marks		
					CIA	ESE	Total
	SEMESTER – IV						
I	21P1TAM4	Language Course–IV (Tamil/Hindi/French)	3	6	25	75	100
II	ELC04	English Language Course – IV	3	5	25	75	100
III	22BI4CC07	Molecular Biology	4	4	25	75	100
	22BI4LC04	Practical IV : Molecular Biology Lab	2	3	40	60	100
	22BI4AII CC04	Analytical Biochemistry	3	3	25	75	100
	22BI4AIILC01	Allied Practical – I : Analytical Biochemistry Lab	2	3	40	60	100
IV	22BI4NMEC02	Basics of Bioinformatics	2	3	25	75	100
V	22BI4EA01	Extension Activities	2	--	100	--	100
		Seminar, Library, Leveraging E-Resources	--	3	--	--	--
		Total	21 (84)	30	305	495	800 (2900)

THIRD YEAR

Part	Course Code	Name of the Course	Credits	Teach-ing Hours	Maximum Marks		
					CIA	ESE	Total
	SEMESTER – V						
III	22BI5CC08	Computational Biology	4	4	25	75	100
	22BI5CC09	Bioinformatics Programming in PERL	4	4	25	75	100
	22BI5CC10	Structural Bioinformatics	4	4	25	75	100
	22BI5CC11	Biostatistics using R	5	5	25	75	100
	22BI5LC05	Practical V: Computational Biology and PERL Lab	3	4	40	60	100
	22BI5SEC01	Skill Based Elective Course 1. Protein Engineering 2. Pharmacology	5	5	25	75	100
IV	22BI5SK01	Soft Skills	2	2	100	--	100
V	22BI5GS01	Gender Studies	2	2	100	--	100
		Seminar, Library, Leveraging E-Resources	--	--	--	--	--
		Total	29 (113)	30	365	435	800 (3700)

Part	Course Code	Name of the Course	Credits	Teach-ing Hours	Maximum Marks		
					CIA	ESE	Total
	SEMESTER – VI						
III	22BI6CC12	Genomics	4	4	25	75	100
	22BI6CC13	Microbiology	4	4	25	75	100
	22BI6CC14	Numerical Methods	4	4	25	75	100
	22BI6CC15	Molecular Modeling and Drug Design	4	4	25	75	100
	22BI6LC6	Practical VI : Genomics and Molecular Modeling and Drug Design Lab	2	4	40	60	100
	22BI6SEC02	Skill Based Elective Course 1. Cancer Biology 2. Molecular Pathogenesis	5	5	25	75	100
	22BI6CP01	Project	4	5	40	60	100
		Seminar, Library, Leveraging E-Resources	--	--	--	--	--
		Total	27 (140)	30	205	495	700 (4400)

Total Credits for B.Sc. Programme = 140

FOURTH YEAR

Course Code	Name of the Course	Credits	Teaching Hours	Maximum Marks		
				CIA	ESE	Total
SEMESTER – VII						
22BI7CC16	Proteomics	5	5	25	75	100
22BI7CC17	Bioinformatics Programming in Python	5	5	25	75	100
22BI7CO01	Core Choices Course (At least Two Choices) 1.Genetic Engineering 2.Enzyme Engineering	5	5	25	75	100
22BI7EC01	Elective Course (At least Two Choices) 1. Cheminformatics 2. Medicinal Chemistry	4	5	25	75	100
22BI7LC07	Practical – VII: Genetic Engineering Lab	3	5	40	60	100
22BI7LC08	Practical – VIII: Proteomics and Python Lab	3	5	40	60	100
	Seminar, Library, Leveraging E-Resources	--	--	--	--	--
	Total	25 (165)	30	180	420	600 (5000)

Course Code	Name of the Course	Credits	Teaching Hours	Maximum Marks		
				CIA	ESE	Total
SEMESTER – VIII						
22BI8CC18	Immunology and Immunoinformatics	5	5	25	75	100
22BI8CC19	Mathematical and Statistical Techniques	5	5	25	75	100
22BI8CO02	Core Choices Course (At least Two Choices) 1. Database Management Systems 2. Machine Learning in Bioinformatics	5	5	25	75	100
22BI8EC02	Elective Course (At least Two Choices) 1. Medical Informatics 2. Metabolic Engineering	4	5	25	75	100
22BI8LC09	Practical – IX: Immunology and Immunoinformatics Lab	3	5	40	60	100
22BI8NMEC03	Non-Major Elective Course Medical Coding	2	3	25	75	100
	Seminar, Library, Leveraging E-Resources	--	2	--	--	--
	Total	24 (189)	30	165	435	600 (5600)

FIFTH YEAR

Course Code	Name of the Course	Credits	Teaching Hours	Maximum Marks		
				CIA	ESE	Total
SEMESTER – IX						
22BI9CC20	Systems Biology	4	4	25	75	100
22BI9CC21	Synthetic Biology	4	4	25	75	100
22BI9EIBC01	Applied Bioinformatics and IPR	4	4	25	75	100
22BI9CO03	Core Choices Course (At least Two Choices) 1. Pharmacoinformatics 2. Agriculture Bioinformatics	5	5	25	75	100
22BI9EC03	Elective Course (At least Two Choices) 1. NGS Techniques and Data Analysis 2. Drug and Pharmaceutical Technology	4	5	25	75	100
22BI9LC10	Practical – X: Systems and Synthetic Biology Lab	3	5	40	60	100
22BI9NMEC04	Non-Major Elective Course Bioethics, Biosafety and IPR	2	3	25	75	100
	Seminar, Library, Leveraging E-Resources	--	--	--	--	--
	Total	26 (215)	30	190	510	700 (6300)

Course Code	Name of the Course	Credits	Teaching Hours	Maximum Marks		
				CIA	ESE	Total
SEMESTER – X						
22 BI10CP02	Project	15	30	50	150	200
	Seminar, Library, Leveraging E-Resources	--	--	--	--	--
	Total	15 (230)	30	50	150	200 (6500)

Total Credits for M.Sc. Programme = 90

Total Credits for B.Sc. + M.Sc. Programme = (140 + 90) = 230

Summary of Course Structure for
MSc Bioinformatics (Five Year Integrated) Programme
UG and PG Level

S.No.	Part	Type of the Course	Number of Courses	Total Credits
UG Level				
1	I	Languages	4	12
2	II	General English	4	12
3	III	A. Allied Courses I & II	5	14
		B. Core Courses	15	61
		C. Laboratory Courses	6	13
		D. Skill Based Elective Courses	2	10
		E. Project	1	4
4	IV	A. Value Education	1	2
		B. Environmental Studies	1	2
		C. Non-Major Elective Courses	2	4
		D. Soft Skills	1	2
5	V	A. Extension Activities	1	2
		B. Gender Studies	1	2
		Total	**44**	**140**
PG Level				
6	III	A. Core Courses	6	28
		B. Core Choices Courses	3	15
		C. Elective Courses	3	12
		D. Laboratory Courses	4	12
		E. Entrepreneurship/Industry Based Course	1	4
		F. Project	1	15
		G. Non-Major Elective Courses	2	4
		Total	**20**	**90**
		Overall Total	**64**	**230**

Summary of Course Structure for
MSc Bioinformatics (Five Year Integrated) Programme
UG and PG Level Combined

S.No.	Part	Type of the Course	Number of Courses	Total Credits
1	I	Languages	4	12
2	II	General English	4	12
3	III	A. Allied Courses I & II	5	14
		B. Core Courses	21	89
		C. Core Choices Courses	3	15
		D. Entrepreneurship/Industry Based Course	1	4
		E. Laboratory Courses	10	25
		F. Elective Courses	3	12
		G. Skill Based Elective Courses	2	10
		H. Non-Major Elective Courses	4	8
		I. Project	2	19
4	IV	A. Value Education	1	2
		B. Environmental Studies	1	2
		C. Soft Skills	1	2
5	V	A. Extension Activities	1	2
		B. Gender Studies	1	2
		Total	**64**	**230**

PROGRAMME OUTCOMES

- PG Graduands are Professionally Competent with characteristic Knowledge-bank, Skill-set, Mind-set and Pragmatic Wisdom in their chosen fields.
- PG Graduands demonstrate the desired sense of being Seasoned and exhibit unequivocal Spiritedness with excellent qualities of productive contribution to society and nation in the arena Science and Technology.
- PG Graduands are mentored such that they exert Leadership Latitude in their chosen fields with commitment to novelty and distinction.
- PG Graduands are directed in understanding of ethical principles and responsibilities, moral and social values in day-to-day life thereby attaining Cultural and Civilized personality.
- PG Graduands are able to Collate information from different kinds of sources and gain a coherent understanding of the subject.

PROGRAMME SPECIFIC OUTCOMES

- Development of various biological databases of specific interest
- Development of structure based drug designing using homology based modelling and virtual screening
- Obtain the stability analysis of the three dimensional structures using Molecular Dynamic Simulations
- Development of ligand based drug designing using pharmacophore approach
- Describe the whole genome analysis and variant calls for genetic disorders
- Application of Bioinformatics to Agriculture, Medicine and Synthetic Biology
- Explain the bio ethics, bio safety and IPR.
- Describe the biological networks using systems biology approach.

DEPARTMENT OF BIOINFORMATICS
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M.Sc. BIOINFORMATICS (Five Year Integrated) DEGREE PROGRAMME

(2022-2023 Batch onwards)

REGULATIONS 2022

1. Name of the Programme

M.Sc. Bioinformatics (Five Year Integrated)

2. About the Programme

The Department of Bioinformatics, Bharathidasan University offers the M.Sc. Bioinformatics (Five Year Integrated) Programme to the candidates who have passed +2 examination or examination equivalent there of as input so as to offer the programme at an advance level and to avoid repetition of courses between undergraduate and post-graduate levels of study. The course is aimed at preparing post-graduate with expertise in all aspects of Bioinformatics, with special reference to the modern trends in the subject including tools and techniques, with motivation for research, teaching and / or industrial applications.

3. Eligibility for Admission

A candidate who has passed the Higher Secondary Examination (10+2 pattern) conducted by the Board of Secondary Education of Tamil Nadu or CBSE or an examination equivalent thereof and who have studied i) Mathematics, Physics, Chemistry and Biology / Computer Science (or) ii) Physics, Chemistry, Botany and Zoology shall be eligible for admission as candidate for the M.Sc. (Five Year Integrated) Bioinformatics Programme.

4. Number of Seats

The number of seats shall be 40, but may change from time to time. This includes five seats for students coming from other States.

5. Admission Procedure

Selection will be made based on an Entrance Test (50 marks) and the average of the marks scored in i) Mathematics, Physics, Chemistry and Biology / Computer Science (50 marks) (or) ii) Physics, Chemistry, Botany and Zoology (50 marks). The entrance test will be based on the basic knowledge of English, General Aptitude, Mathematics, Physics, Chemistry and Biology and Computer Science. The entrance test will be objective type. On the basis of the performance in the entrance test, and the marks secured in XII, the candidates will be short listed.

After preparing the merit list, selection will be made applying the communal reservation rules of the Government of Tamil Nadu.

6. Duration of the Programme

The programme is for 5 years with 10 semesters of which, five odd semesters and five even semesters. The odd semester shall be from June/July to October/November and the even semesters from November/December to April/May. Odd semester shall be from June/July to October/November and even semester shall be from November/December to April/May. There shall be not less than 90 working days which shall comprise 450 teaching clock hours for each semester (exclusive of the days for the conduct of University end-semester examinations). The programme is offered as per the UGC guidelines through the Learning Outcome based Curriculum Framework (LOCF) under Choice Based Credit System (CBCS). The revised syllabus is designed as the complete integrated programme and hence there is no provision for lateral entry i.e., candidates who have completed any B.Sc. degree may not be allowed to join in the 4th year of the M.Sc. programme. During the five years programme, the students may be allowed to leave the programme after successful completion of the third year and it will be considered case by case.

7. Course of Study

The course of study comprises theory, tutorial, practical (lab), seminar and

major project in the core subjects etc., according to the syllabus and text books prescribed from time to time. The term “course” is applied to indicate a logical part of the subject matter of the programme and is invariably equivalent to the subject matter of a “paper” in the conventional sense. The X semester shall be exclusively allotted for major project. In addition, there will be field trips / industry visit / summer training in Industry.

8. Fees Structure

The prescribed fees structure for the programme is given in **Annexure I** and may subject to change from time to time.

9. Board of Studies

The Head of the Department shall be the Chairman of the Board of Studies for the programme. All the faculty members of the department shall be members of the Board. In addition to that Board will have three subject experts from outside Bharathidasan University, an expert from Industry and one alumnus.

10. Programme Structure

The programme is of higher and advanced level and makes the candidates motivated for quality research and teaching.

There shall be a total of 64 courses for the entire five year period of study, and a project work covering 6 months during the final year.

The Learning Outcome based Curriculum Framework (LOCF) under Choice Based Credit System (CBCS), as vogue at the University from time to time will be practiced. The number of credits for each course is indicated in Course Structure as given in **Annexure II**.

11. Examinations

The academic year shall be divided into odd and even semesters and for each semester there shall be 90 working days. Examination for the odd semester shall be conducted in November / December and for even semester in April / May.

Candidates who have shortage of attendance exceeding 50% in any semester(s) have to redo the semester(s), only after completion of their five years programme.

There shall be Continuous Internal Assessment (CIA) for each paper (theory as well as practical separately, wherever applicable), the maximum marks for which shall be 25. In awarding marks for the CIA, Assignments, Seminars, Tests and Model Exams, shall be taken into consideration. The passing minimum shall be 40% of the marks (i.e., 10 marks out of 25 in theory and 16 marks out of 40 in practical) allotted for the CIA.

At the end of each semester there shall be an End Semester Examination (ESE). The maximum marks for each theory paper shall be 75 and for practical, wherever applicable, shall be 60. The passing minimum shall be 40% of the marks (i.e., 30 marks out of 75 in theory and 24 marks out of 60 in practical) allotted for the End Semester Examination. However, the aggregate passing minimum (i.e., CIA and ESE put together) shall be 50% of the marks.

11.1 Attendance and Condonation

Students must have 75% of attendance in each semester to appear for the examination. Students who have attendance between 65% and 74% shall apply for condonation in the prescribed form with the prescribed fee. Students who have attendance between 50% and 64% shall apply for condonation in prescribed form with the prescribed fee along with the Medical Certificate. Students who have attendance below 50% are not eligible to appear for the examination. They shall re-do the semester(s) after completion of the Programme (i.e. 5 years).

11.1 Duration of Examination

The duration of examination for each theory course will be 3 Hours. The duration for practical examination may be decided by the Board of Studies, but not less than 3 Hours.

11.2 CIA and ESE Marks

Theory		**Practical**	
CIA – 25	ESE – 75	CIA – 40	ESE – 60

11.3 CIA Marks Components

Theory		Practical	
Assignment	5	Continuous Performance	20
Seminar	5	Model Practical	10
Best 1 test out of 2 (each 2 Hours duration)	15	Record	5
+ Model Exam (3 Hours duration)		Viva	5
	25		40

11.4 End Semester Examination (ESE)

Question Paper Pattern

Part A (10 x 2 = 20 Marks)

A total of ten questions; Two questions must be taken from each unit; No choice

Part B (5 x 5 = 25 Marks)

A total of five questions; Either - OR pattern; One question must be taken from each unit.

Part C (3 x 10 = 30 Marks)

A total of five questions; One question from each unit; Answer any three questions

11.5 Evaluation

Single valuation - Both the question paper setting and the evaluation of each paper must be done by the external examiner only.

11.6 Passing Minimum

CIA - 40%
ESE - 40%
Aggregate - 50%

A candidate shall be declared to have passed in each course if he/she secures not less than 40% marks in the University Examinations and 40% marks

in the CIA and not less than 50% in the aggregate, including CIA and University Examinations marks.

Candidates who have secured the pass marks in the End Semester Examination (ESE) and in the CIA, but failed to secure the aggregate minimum pass mark (ESE + CIA) are allowed to secure aggregate minimum pass mark by appearing for University Examination only. Candidates who have failed in the Internal Assessment are permitted to appear for their Internal Assessment marks in the subsequent semesters (2 chances will be given) by writing the

CIA tests and assignments.

A candidate shall be declared to have passed in the Project work if he/she gets not less than 40% in each of the Project Report and Viva-voce but not less than 50% in the aggregate of both the marks for Project Report and Viva-voce.

A candidate who gets less than 40% in the Project must resubmit the Project Report. Such candidates need to defend the resubmitted Project at the Viva-voce within a month. A maximum of 2 chances will be given to the candidate.

11.7 For Arrear Candidates

A candidate who does not pass the subject(s) may be permitted to appear in such failed subject(s) in the subsequent examination to be held in October / November or April / May. However, candidates who have arrear in practical / lab shall be permitted to take their arrear practical / lab examinations only along with regular practical examination(s) in the respective semesters.

11.8 Exam Fee

Examination fee is as per the university norms.

11.9 Commutation of marks into grades

Commutation of marks into grades as per the university norms and is given in Sec. 15.

11.10 Ranking

- A candidate, who passes all courses in the prescribed of duration of the

course in the first appearance in all the papers and also scores the highest total marks, is alone eligible for ranking.

- Reappeared candidates will not be considered for ranking.
- University norms will be followed in ranking the candidates

12. Conferment of the Degree

A candidate shall be declared eligible for conferment of the degree only after he / she has passed all the courses prescribed there for, including practical / labs and project/ dissertation.

13. Commencement of this Regulation

These regulations shall take effect from the academic year 2022 – 2023, i.e., for students who are to be admitted to the first year of the programme during the academic year 2022 – 2023 and thereafter.

14. Revision of Regulation and Curriculum

The University may, from time to time, revise, amend or change the Regulations and the Curriculum, if found necessary.

15. Grading System

15.1 Grading

Once the marks of the CIA and the end-semester examination for each of the courses are available, they will be added. The marks thus obtained, will then be graded as per the scheme provided in **Table 1**.

From the second semester onwards the total performance within a semester and the continuous performance starting from the first semester are indicated by Semester **Grade Point Average (GPA)** and **Cumulative Grade Point Average (CGPA)**, respectively. These two are calculated by the following formulae:

$$\text{GPA} = \frac{\sum_{i=1}^{n} C_i G_i}{\sum_{i=1}^{n} C_i}, \qquad \text{WAM (Weighted Average Marks)} = \frac{\sum_{i=1}^{n} C_i M_i}{\sum_{i=1}^{n} C_i}$$

where C_i is the Credit earned for the Course I, G_i is the Grade Point obtained by the student for the Course I, M is the Marks obtained for the course i and n is the number of Courses **passed** in that semester.

CGPA = Average GPA of all the Courses starting from the first semester to the current semester.

15.2 Classification of Final Results

(i) The classification of final results shall be based on the CGPA, as indicated in **Table 2**.

(ii) For the purpose of Classification of Final Results, the candidates who earn the CGPA 9.00 and above shall be declared to have qualified for the Degree as "Outstanding". Similarly, the candidates who earn the CGPA between 8.00 and 8.99, 7.00 and 7.99, 6.00 and 6.99, and 5.00 and 5.99 shall be declared to have qualified for their Degree in the respective programmes as "Excellent", "Very Good", "Good", and "Above Average" respectively.

(iii) Absence from an examination shall not be taken as an attempt.

Table 1: Grading of the Courses

Marks Range	Grade Point	Corresponding Grade
90 and above	10	O
80 and above but below 90	9	A+
70 and above but below 80	8	A
60 and above but below 70	7	B+
50 and above but below 60	6	B
Below 50	N.A.	R.A.

Table 2: Final Result

CGPA	Corresponding Grade	Classification of Final Results
9.0 and above	O	Outstanding
8.00 to 8.99	A+	Excellent
7.00 to 7.99	A	Very Good

6.00 to 6.99	B+	Good
5.00 to 5.99	B	Above Average
Below 5.0	R.A.	Re-Appearance

Credit based weighted Mark System is to be adopted for individual semesters and cumulative semesters in the column “Marks Secured” (for 100).

16. Equivalence

Bioinformatics is an emerging area in life sciences. It is an interdisciplinary subject and it requires expertise and knowledge from all branches of Life Sciences and Science as a whole. Hence, this M.Sc. Bioinformatics (Five Year Integrated) Programme is recognised as the PG degree of a recognised university and there is no equivalence for it with any other existing conventional M.Sc. degree programmes in Life Sciences.

17. Research and Job Opportunities

After successful completion of this M.Sc. Bioinformatics (Five Year Integrated) Programme, there are lot of research and job opportunities available in Universities, Institutes and Industries. Bioinformatics degree holders can find job opportunities in all sectors of Biotechnology, Agricultural, Biomedical, Pharmaceutical and Information Technology (IT) departments of research institutions and industries.

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FIRST YEAR

SEMESTER - I

Part	Course Code	Name of the Course	Credits	Teach-ing Hours	Maximum Marks		
					CIA	ESE	Total
	SEMESTER – I						
I	21P1TAM1	Language Course – I (Tamil/Hindi/French)	3	6	25	75	100
II	ELC01	English Language Course – I	3	5	25	75	100
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	22BI1CC02	Cell Biology	4	4	25	75	100
	22BI1LC01	Practical–I: Introduction to Bioinformatics Lab	2	3	40	60	100
	22BI1AICC01	Mathematics – I	3	4	25	75	100
IV	22BI1VE01	Value Education	2	3	25	75	100
		Seminar, Library, Leveraging E-Resources	--	1	--	--	--
		Total	21	30	190	510	700

பகுதி 1 தமிழ்

ஐந்தாண்டு ஒருங்கிணைந்த பட்டப்படிப்பு
முதல் பருவம்
மொழிப்பாடம்
தாள் 1. இக்கால இலக்கியம்
(21P1TAM1)

நோக்கம்

- இக்காலத் தமிழ்க்கவிதை சிறுகதை முதலானவற்றை அறிமுகப்படுத்துதல்.
- புதுக்கவிதை, ஹைகூ கவிதை முதலான புதிய இலக்கிய வடிவங்களை அறிமுகப்படுத்துதல்.
- கவிதையின் அமைப்பு, உத்திகள், கவிதைப் படைப்பாளர்களுக்குரிய தனித்தன்மைகள் ஆகியவற்றை விளக்குதல்.
- கவிதையில் காலந்தோறும் நேர்ந்த அக, புற மாற்றங்களும் வளர்ச்சிகளும் பற்றிக் கூறுதல்.
- மரபுக்கவிதை, புதுக்கவிதை எனும் பாகுபாட்டை விளக்குதல்.
- கவிதைப் படைப்பாளர்களின் படைப்பாற்றலையும் படைப்பாளர் ஒவ்வொருவருக்கும் உரிய தனித்தன்மைகளையும் மொழிதல்.
- சிறுகதையின் அமைப்பு, உத்திகள், சிறுகதைப் படைப்பாளர்களுக்குரிய தனித்தன்மைகள் ஆகியவற்றை விளக்குதல்.
- தமிழ் உரைநடையின் வரலாறு, வளர்ச்சி, வகைமை, நடைச் சித்திரங்கள் போன்றவற்றை இயம்புதல்.
- நாட்டுப்புறப்பாடல்களில் வெளிப்படும் கிராமியப் பண்பாடு, மொழிநடை, கற்பனை, இசை போன்ற பல கூறுகளை விளம்புதல்.
- தமிழ் இலக்கியத்தின் மீதான ஈர்ப்பை மிகுவித்தல். சங்க காலம் தொடங்கி இக்காலம் வரை தோன்றி வளர்ந்துள்ள இலக்கிய, இலக்கணங்களை இயம்புதல்.
- தமிழ் இலக்கியப் பொருண்மை காலந்தோறும் மாறி வந்த நிலைகளையும் காலந்தோறும் தோன்றிய இலக்கியங்களையும் நவில்தல்.

பாடத்திட்ட அமைப்பு

- மரபுக்கவிதை, புதுக்கவிதை, ஐக்கூ கவிதைகள், நாட்டுப்புறப் பாடல்கள், சிறுகதை, உரைநடை, தமிழ் இலக்கிய வரலாறு எனும் அடிப்படையில் பகுத்து அலகுகள் அமைக்கப்பட்டுள்ளன.

அலகு 1. தமிழ்க் கவிதை வளர்ச்சி - அறிமுகம் : கவிதை எனும் இலக்கிய வகையின் பொதுவான இயல்புகளும் அமைப்புகளும் - தமிழ்க் கவிதையில் காலந்தோறும் நேர்ந்த அக, புற மாற்றங்களும் வளர்ச்சிகளும் - உள்ளடக்கம், வடிவமைப்பு, வெளியீட்டு முறைகள் - வெளியீட்டு முறை மாற்றங்கள் - இன்றைய கவிதை - மரபுக் கவிதை, புதுக்கவிதை எனும் பாகுபாடு - 'மரபு' என்பதன் விளக்கம் - இக்காலத் தமிழில் 'மரபுக் கவிதை' என்பதன் விளக்கம் - மரபுக் கவிஞர்கள் : பாரதியார், பாரதிதாசன், கவிமணி, சுரதா முதலானோர்.

1. பாரதியார் - செந்தமிழ்நாடு, புதுமைப்பெண்
2. பாரதிதாசன் - அழகு, தமிழனுக்கு வீழ்ச்சியில்லை
3. கவிமணி - சுகாதாரக்கும்மி, தொழிலாளியின் முறையீடு
4. சுரதா - கலப்பை, போலி உடும்பு

குறியிலக்குகள் (Objectives)

1. பாரதியார் தாய்நாட்டின் மீது கொண்டிருந்தப் பற்றை உணர்வர்.
2. தமிழ்நாட்டின் சிறப்பு, வளங்கள், தமிழ் நீதி நூல்கள், தமிழ் மன்னர்கள் பற்றிய வரலாற்றுச் செய்திகள் ஆகியவற்றை அறிந்துகொள்வர்.
3. பாரதி படைத்த புதுமைப் பெண் பற்றி அறிவர்.
4. அழகு எனும் கவிதை வழி வாழ்க்கையில் நாம் காணுகின்ற ஒவ்வொன்றிலும் அழகு உள்ளது என்பதை உணர்வர்.
5. தமிழன் ஒவ்வொருவரும் தம் மொழிக்காகவும் நாட்டுக்காகவும் மக்களுக்காகவும் பாடுபட வேண்டுமென்பதை உணர்ந்து கொள்வர்.
6. கவிமணி கவிதை வழி உள்ளத்திற்கும் உடலுக்கும் உள்ள தொடர்பு, சுத்தத்தின் சிறப்பு பற்றி விளங்கிக் கொள்வர்.
7. உழைக்கும் தொழிலாளர்களின் உணர்வைப் புரிந்து கொள்வர்.
8. கருத்தை உவமை நலத்துடன் கவிதையில் எடுத்துரைக்கும் உத்தியைக் கற்பர்.
9. உழவர்களின் அவலநிலையை அறிவர்; பொதுவுடைமைக் கருத்துகளை விளங்கிக் கொள்வர்.
10. போலி உடும்புக் கவிதை வழி பகுத்தறிவுச் சிந்தனையை வளர்த்துக் கொள்வர்.

அலகு **2. மரபுக் கவிஞர்கள் :** நாமக்கல் கவிஞர், கவி. காமு.ஷெரீப், கண்ணதாசன், வாணிதாசன் - பாடுபொருள் - கவிதை வெளிபாட்டுப் பாங்கு - படைப்பாற்றல் - கருத்தாக்கம் - தனித்தன்மைகள்.

1. நாமக்கல் கவிஞர் - தமிழ் வாழ்க, தருணம் இதுவே
2. கவி காமு ஷெரீப் - நிலவே சொல், அறிய முயல்
3. கண்ணதாசன் - நட்பு
4. வாணிதாசன் - வாழ்க இளம்பரிதி

குறியிலக்குகள் (Objectives)

1. தமிழின் சிறப்பும் உயர்வும் குறித்து அறிவர்.
2. காந்தியச் சிந்தனைகள் படைப்புகளில் வெளிப்படும் திறத்தினை விளங்கிக் கொள்வர்.
3. கவிதையில் வெளிப்படும் கற்பனை திறத்தினைக் கற்று உணர்வர்.
4. இறைச் சிந்தனைகள் பற்றி அறிவர்.
5. கூடா நட்பு என்றும் துன்பம் தரும் என்பதை விளங்கிக் கொள்வர்.
6. பரிதியின் அழகை, ஆக்கத்தை, அழிவை அறிந்து கொள்வர்.

அலகு **3. நாட்டுப்புறப்பாடல்கள் :** விளக்கம் - வகைப்பாடு - காதல் பாடல்கள் - தாலாட்டு - விளையாட்டு - ஒப்பாரிப் பாடல்கள் - நாட்டப்புறக்கதைப் பாடல்கள் - விளக்கம் - வகைகள் - சமூகக் கதைப்பாடல்கள் - வரலாற்றுக் கதைப்பாடல்கள் - புராணக் கதைப்பாடல்கள் - **புதுக்கவிதை :** புதுக்கவிதை - விளக்கம் - புதுக்கவிதையின் தோற்றமும் வளர்ச்சியும் - புதுக்கவிதை வகைமை - புதுக்கவிஞர்கள் - ந. பிச்சமூர்த்தி, , மீரா, சிற்பி, அப்துல் ரகுமான், அரங்க மல்லிகா, அறிவுமதி, ஆண்டாள் பிரியதர்ஷினி, ஈரோடு தமிழன்பன், தாமரை, மு.மேத்தா, வைரமுத்து முதலியோர் - புதுக்கவிதையின் இன்றைய வளர்ச்சி நிலை - **ஐக்கூ, சென்டிரியூ, கஜல், லிமைரைக்கூ, போன்சாய் - கவிதைகள் :** அறிமுகம் - வடிவமைப்பு - தனித்தன்மை - தமிழ்க்கவிதை இலக்கியத்தில் ஹைக்கூ - ஹைக்கூ கவிஞர்கள் - ஹைக்கூவும் சென்ரியூவும் - சென்ரியு கவிதைகள் - லிமரைக்கூ, போன்சாய்க் கவிஞர்கள் - தமிழில் புதிய வடிவக்கவிதைகள்.

1. நாட்டுப்புறப்பாடல்கள் - தாலாட்டுப் பாடல், தொழில் பாடல்

2. புதுக்கவிதைகள்

2.1. அப்துல் ரகுமான் - வெற்றி
2.2. அறிவுமதி - நட்புக் காலம்
2.3. ஈரோடு தமிழன்பன் - மறைக்க இடம் தேடும் மனம்
2.4. சிற்பி - ஓடு ஓடு சங்கிலி
2.5. தாமரை - தீர்ப்பு
2.6. மீரா - தலைகுனிவு
2.7. மேத்தா மு - வெளிச்சம் வெளியே இல்லை
2.8. வைரமுத்து - ருசி

3. ஐக்கூ கவிதைகள்

3.1. அமுதபாரதி
3.2. அரிமதி தென்னகன்
3.3. அன்பாதவன்
3.4. செந்தமிழன்
3.5. புதுவை இளவேனில்

குறியிலக்குகள் (Objectives)

1. நாட்டுப்புறப்பாடல்களில் வெளிப்படும் கிராமியப் பண்பாடு, மொழிநடை, கற்பனை, இசை போன்ற பல கூறுகளை அறிவர்.
2. புதுக்கவிதைகளில் இடம்பெறும் படிமம், குறியீடு, தொன்மம் முதலான உத்திகளைக் கற்றுணர்வர்.
3. புதுக்கவிதைகள் வெளிப்படுத்தும் சமூக விமர்சனம், வாழ்வியல் கருத்துகள், தனிமனித உணர்வுகள், பெண்ணியச் சிந்தனைகள் போன்றவற்றை விளங்கிக் கொள்வர்.
4. ஐக்கூ கவிதையின் வடிவம், கருத்து வெளிப்படும் முறைமையைக் கற்றுணர்வர்.
5. தமிழ்க் கவிதை இலக்கியத்தில் ஐக்கூ பெருமிடத்தை ஆராய்ந்தறிவர்.

அலகு 4. தமிழ்ச் சிறுகதை அறிமுகம் : விளக்கம் - சிறுகதையின் அமைப்பு - உள்ளடக்க வகைமை - வடிவமைப்பு - உத்திகள் - பாத்திரப்படைப்பு - உரையாடல் - நடை - தமிழில் சிறுகதையின் தோற்றமும் வளர்ச்சியும் - காலந்தோறும் தமிழ்ச் சிறுகதை பெற்றுவரும் புதுத் தோற்றங்கள் - வெளியுலகப் பாதிப்புகள் - சிறுகதைச் சாதனையாளர்கள் - தமிழ்ச் சிறுகதை முன்னோடிகள் - படைப்புகளின் உருவ, உள்ளடக்க வேறுபாடுகள் - வெளியீட்டு முறைகள் - தனித்தன்மைகள் - **உரைநடை :** வரலாறு - வளர்ச்சி - பல்வேறு வகையான உரைநடைகள் - **தனித்தன்மைகள் - சிறப்பியல்புகள்.**

1. சிறுகதை - கைவண்ணம்... (தேர்ந்தெடுக்கப்பட்ட சிறுகதைகள்)
தொகுப்பாசிரியர் முனைவர் தங்க. செந்தில்குமார்
அய்யா நிலையம், கதவு எண், 1603
ஆரோக்கிய நகர், ஐந்தாம் தெரு, ஈபி. காலனி
நாஞ்சிக்கோட்டைச் சாலை
தஞ்சாவூர் - 613 006

2. உரைநடை - அறியப்படாத தமிழகம்
பேராசிரியர் தொ. பரமசிவன்
காலச்சுவடு பதிப்பகம்
669 கே. பி. சாலை
நாகர்கோவில் - 629001.

குறியிலக்குகள் (Objectives)

1. சிறுகதை வரையறை, தோற்றமும் வளர்ச்சியும் பற்றி அறிவர்.
2. சிறுகதை கட்டமைப்பில் கருவின் (வாநஅந) முக்கியத்துவத்தை உணர்வர்.
3. சிறுகதை உத்திகளைக் கற்றுணர்வதுடன் சிறுகதைப் படைப்புகளின் உருவ, உள்ளடக்க வேறுபாடுகளை இனங்காண்பர்.
4. சிறுகதை எழுத்தாளர்களையும் அவர்கள் கதைக் கூறும் போக்கினையும் விளங்கிக்கொள்வர்.
5. சிறுகதை நாவல் இலக்கியத்திலிருந்து வேறுபடும் முறைமையை அறிவர்.
6. உரைநடை இலக்கியத்தின் தனித்தன்மையைக் கற்றுணர்வர்.
7. தமிழ் பண்பாட்டின் உருவாக்கம் பற்றிய புரிதலைப் பெறுவர்.

அலகு **5. இலக்கிய வரலாறு அறிமுகம்** - இலக்கியம் - தோற்றப் பின்புலம் - போக்கும் வளர்ச்சியும் - தமிழ் இலக்கிய வரலாற்றுப் பகுப்புகள் - இலக்கிய - உள்ளடக்கமும் வடிவமும் - சங்க இலக்கியம் - சங்க மருவிய கால இலக்கியம் - பக்திக்கால இலக்கியம் - காப்பியகால இலக்கியம் - சிற்றிலக்கியம் - சித்தர் இலக்கியம் - பத்தொன்பதாம் நூற்றாண்டு இலக்கியம் - இருபதாம் நூற்றாண்டு இலக்கியம்.

1. இலக்கிய வரலாறு - 1. மரபுக் கவிதை
   2. புதுக்கவிதை
   3. உரைநடை
   4. சிறுகதை

மனப்பாடச் செய்யுள்

1. பாரதியார் கவிதைகள் - 1. புதிய ஆத்திசூடி பரம்பொருள் வாழ்த்து
   2. தமிழ்
   3. கேட்பன
   4. பாரத ஜனங்களின் தற்காலநிலை
   5. வேண்டும்

2. பாரதிதாசன் கவிதைகள் - 1. தமிழ் வளர்ச்சி
   2. இன்பத் தமிழ்
   3. தென்றல்
   4. செந்தாமரை
   5. வள்ளுவர் வழங்கிய முத்துக்கள்

குறியிலக்குகள் (Objectives)

1. மரபுக் கவிதை இலக்கணம் பற்றி அறிவர்.
2. மரபுக் கவிஞர்களையும் அவர்களின் படைப்புகளையும் அறிந்து கொள்வர்.
3. புதுக்கவிதை தோற்றம் வளர்ச்சிக் குறித்து அறிவர்.
4. உரைநடை தோற்றம் வளர்ச்சிக் குறித்து கற்றுணர்வர்.
5. சிறுகதை தோற்றமும் வளர்ச்சியும் பற்றி அறிவர்.

பயிற்றுமுறை

- தமிழ்க் கவிதையில் காலந்தோறும் நேர்ந்த அக, புற மாற்றங்கள், வளர்ச்சிகள், உள்ளடக்கம், வடிவமைப்பு, வெளியீட்டு முறைகள், வெளியீட்டு முறைகளில் மாற்றங்கள் ஆகியவற்றை விளக்க வேண்டும்.
- மரபுக் கவிதைக்குப் பாரதி காட்டிய புதுநெறிகள், இக்கால இலக்கியம் சமூக ஆன்மீகச் சிந்தனைகளில் பாரதி ஏற்படுத்திய தாக்கம், கவிதை ஆக்கப் புதுமைகள், தனித்தன்மைகள் ஆகியவை குறித்து விளக்கி உரைத்தல் வேண்டும்.

- கவிதைப் படைப்பாளர்களின் காலம், படைப்பாக்கத் திறன் , தனித்தன்மைகள், படைப்புகளின் சிறப்பியல்புகள் போன்றவற்றை எடுத்துரைத்தல் வேண்டும்.
- மரபுக் கவிதைக்கும் புதுக் கவிதைக்கும் உள்ள வேறுபாடுகளை விளக்குவதுடன் கவிதையின் அமைப்பு, வகைமைகள், உத்திகள் முதலியவற்றை விளக்கிப் படைப்பாக்கத்திறனைத் தூண்டுதல் வேண்டும்.
- ஐக்கூ போன்ற புதிய வடிவக் கவிதைப் படைப்பாளர்களை அறிமுகம் செய்தல், அக்கவிதைகளின் அமைப்பு, உள்ளடக்கம், வகைமைகள், உத்திகள் ஆகியவற்றிடையேயுள்ள ஒற்றுமை வேற்றுமைகளை விளக்கி உரைத்தல் வேண்டும்.
- நாட்டுப்புற ஆய்வின் தேவை, வளர்ச்சி, தற்போதைய நிலை ஆகியன பற்றி எடுத்தியம்புதல்.
- சிறுகதைப் படைப்பாளர்களை அறிமுகம் செய்தல், அவர்களின் சிறுகதையின் அமைப்பு, உள்ளடக்க வகைமை, உத்திகள், நடை ஆகியவை குறித்து விளக்க வேண்டும்.
- காலந்தோறும் தமிழ்ச் சிறுகதை பெற்று வரும் புதுத்தோற்றங்களை இயம்ப வேண்டும்.
- படைப்புகளின் உருவ உள்ளடக்க வேறுபாடுகளை இனங்கண்டு விளக்க வேண்டும்.
- படைப்பாளர்களின் படைப்பாற்றல்கள், தனித்தன்மைகள் ஆகியவற்றுடன் சிறுகதை, அதன் சிறப்பியல்புகளையும் எடுத்துரைத்தல் வேண்டும்.
- பல்வேறு அறிவுத் துறைகளில் நூல் பெருக்கத்திற்கு உரைநடை காரணமாக விளங்கியதை எடுத்து இயம்ப வேண்டும். சங்க காலம் தொடங்கி இக்காலம் வரை தோன்றி வளர்ந்துள்ள இலக்கிய, இலக்கணங்களை இயம்புதல் வேண்டும்.
- தமிழ் இலக்கியப் பொருண்மை காலந்தோறும் மாறி வந்த நிலைகளையும் காலந்தோறும் தோன்றிய இலக்கியங்களையும் நவில்தல் வேண்டும்.

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இணைய முகவரிகள்

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Part II English- Syllabus (from 2021-2022)

Department of English
Bharathidasan University
English Language Course - Semester I

ENGLISH FOR EFFECTIVE COMMUNICATION - I

COURSE CODE: ELC01 CREDITS : 3

Objectives

- To expose learners to various styles of prose writing and different ways of narrations
- To equip learners with the basics of English grammar
- To help learners develop their writing skills

Module 1 (Prose)
Martin Luther King - "I Have a Dream"
R.L. Stevenson - "Walking Tours"
Philip Larkin's - "The Pleasure Principle"
Practicum: Exercises in summarizing and essay writing.

Module 2 (Short Story)
R. K. Narayan - "A Snake in the Grass"
Ruskin Bond - "The Cherry Tree"
Oscar Wilde - "A Model Millionaire"
Leo Tolstoy - "Where Love is, God is"
Practicum: Creative thinking and writing, narrating stories**.**

Module 3
Parts of Speech
Forms of 'Be': Negative and Positive; Question tags
Tense – Past, Present and Future – Perfect, Continuous, Perfect Continuous – Verbs: Transitive and Intransitive; Active and Passive, Modals and Phrasal verbs
Practicum: Identifying and analyzing the grammar of grammatical words.

Module 4
Sentences and Clauses: Adverbial and Conditional Clauses; Reported Speech
Using Conjunction and Connectives, Writing letters, Paragraphs and Essays
Practicum: Identifying and framing phrases, clauses and sentences.

Module 5: Current Contours (For Continuous Internal Assessment only)
Communication in the digital era –writing for the New Media-language of Social Media.

Textbook:
Krishnaswamy, N. *Modern English: A Book of Grammar Usage and Composition.* Macmillan India Ltd, 2009. Print. (Module III & IV)

References:
Honey Dew: An Anthology of Prose, Poetry and One-act Plays. 2014 ed. Hyderabad: Orient BlackSwan, 2014. Print.

Joshi, L.M, ed. *Masters of English Prose: From Bacon to Beerbohm.* New Delhi: Orient BlackSwan,2014. Print.

Course Outcomes:

After completion of the course the students will be able to realise the following outcomes:

- Acquire the four language skills LSRW
- Use learned skills efficiently in everyday communication
- Apply effectively the nuances of speaking skills in dialogues, discussions and public speeches
- Recognize the nuances of reading skills to promote better comprehension
- Incorporate the writing skills in all forms of written communication
- Enhance the language skills for effective and efficient day-to-day communication

INTRODUCTION TO BIOINFORMATICS

COURSE CODE: 22BI1CC01 CREDITS : 4

COURSE OBJECTIVES

- To learn about the bioinformatics databases, databanks, data format and data retrieval from the online sources.
- To make students understand the essential features of the interdisciplinary field of science for better understanding biological data.
- To provide the student with a strong foundation for performing further research in bioinformatics.

UNIT I INTRODUCTION

Introduction – Definition of Bioinformatics - Genome sequencing projects – First Genome Sequence *H. Influenzae*– Biological Sequence versus Structure Deficit–Importance of Bioinformatics - Pattern recognition and Prediction - Protein folding problem–Sequence Analysis - Homology and Analogy, National Center for Biotechnology Information (NCBI) – Entrez, PubMed– European Molecular Biology network – Bioinformatics Programmes in India.

UNIT II PROTEIN INFORMATION RESOURCES

Proteins – Amino acids – Peptide bond - Amino acid properties – Levels of protein structure – Secondary Structure elements – α-helix, β-sheet and β-turns – Types of Proteins – Structural Classification – Biological databases – Primary sequence database, secondary databases – Protein Sequence Databases – PIR, Swissprot, UniProt – Protein Structure Databases – PDB, PDBe, MMDB –Structure Classification Databases – SCOP, CATH (Basic Concepts only)

UNIT III GENOME INFORMATION RESOURCES

Genome – gene / DNA and RNA structure - Watson and Crick model – A, B and Z forms of DNA – RNA secondary structure – DNA Sequence Databases – GenBank, EMBL, DDBJ–Specialized genomic resources – Importance of DNA sequence analysis – Gene structure and DNA sequences – Features of DNA sequence analysis – Approaches to gene hunting – Expression profile of a cell – cDNA libraries (Basic Concepts only).

UNIT IV SEQUENCE ALIGNMENT METHODS

Sequence Alignment - Programs for Aligning sequences – Pairwise Alignment – Identity and Similarity Dotplot – Global alignment – Local alignment –Dynamic programming (basic concept only) –Database searching – BLAST.

Multiple alignment – definition – computational complexity – Methods – Manual, Simultaneous, Progressive – MSA Databases – PRINTS, BLOCKS – Searching MSA Databases with multiple alignments.

UNIT V PHYLOGENETIC METHODS AND BIOINFORMATICS APPLICATIONS

Concept of evolutionary trees – Dendrograms – Methods for construction, Maximum Parsimony – Distance methods – NJ, UPGMA, –Character based method – Maximum Parsimony – Model based – Maximum likelihood method (qualitative concepts only) – Phylogenetic Tools – ClustalW, PHYLIP, PAUP, MEGA4 (Introduction only).

Bioinformatics Applications – Agricultural – Transgenic Plants and Animals, Pharmaceutical – Drug design and Medical – SNP, Genetic Disorders, Gene therapy.

UNIT VI Current Contours: (For Continuous Internal Assessment only)

Advanced Genome Analysis Techniques - Comparative Genome Analysis - Open Problems about Evolution and Phylogeny - Open Problems about Protein Structure and Function

MATERIALS FOR STUDY AND REFERENCE

1. David W Mount, Bioinformatics: Sequence and Genome analysis, 2nd Edition, CBS Publishers, New Delhi, 2004.
2. T.K.Attwood, D J Parry Smith, Samiron Phukan, Introduction to Bioinformatics, Pearson Education, UK, 2007.
3. M.Michael Gromiha, Protein Bioinformatics - From Sequence to Function, Elsevier India Pvt. Ltd, New Delhi, 2010.

WEB RESOURCE LINKS

- www.Bioinformatics.org
- www.bioinfo.mbb.yale.edu/mbb452a/intro/
- www.biology.ucsd.edu/others/dsmith/Bioinformatics.html
- https://www.ebi.ac.uk/pdbe/

COURSE OUTCOMES

After completion of this course student would be able to

- Understand the features of DNA sequence analysis
- Analyze the pair wise sequence alignment methods.
- Use and explain the application of bioinformatics.
- Follow the details on Watson and Crick model.
- Decipher the importance of bioinformatics.
- Master the aspects of protein-protein interaction, BLAST and PSI-BLAST.
- Describe the features of the databases of local and multiple alignments.
- Interpret the characteristics of phylogenetic methods and bioinformatics applications.

CELL BIOLOGY

COURSE CODE: 22BI1CC02 CREDITS : 4

COURSE OBJECTIVES

- To understand the basic concept of cell organelles structure and function
- To understand cell growth
- To Know about metabolism and diseases

UNIT -I BASIC CONCEPTS OF CELLS

Cells as a basic unit – Discovery of the cells – Principles of Microscopy – Classification of cell types–Development of cell theory – Organization of prokaryotic and eukaryotic cells – Ultrastructure of Cells (Images only) – Comparison of microbial, plant and animal cells

UNIT -II CELL TRANSPORT AND COMPOSITION

Biochemical composition of cells and their biological significance – Structure and physico-chemical properties of Carbohydrates, Lipids, Proteins, Nucleic acids, Vitamins and Electrolytes – Cell transport phenomenon – Membrane architecture – Active and Passive transport, Diffusion and Osmosis

UNIT -III STRUCTURE OF CELL ORGANELLES

Sub-cellular organization – Structure and Function of Cell wall - Cell membranes – Cytosol, Nucleus, Mitochondria, Golgi apparatus, Endoplasmic Reticulum, Ribosome, Chloroplast, Vacuoles, Peroxisomes, Lysosomes, Microfilaments and Microtubules

UNIT -IV CELL DIVISION AND CELL CYCLE

Cell Division – Mitosis and meiosis and their regulation - Steps in cell cycle and Components of the Cell-Cycle Control System – Cell senescence and Cell death

UNIT -V SPECIALIZED CELLS

Specialized cells – Nerve cells, Muscle cells, Sperm and Ovum cells - Structure of neuron - Structure of synapse and Nerve impulse –Molecular Organization of Contractile System – Mechanisms of Muscle Contraction

UNIT -VI CURRENT CONTOURS: (For Continuous Internal Assessment only)

Spermatogenesis, oogenesis and fertilization- cleavage – development – organogenesis- making synthetic cells, cell biology of bacteria, prions, *RNA gene regulation*, kinases, large-scale analysis and/or bioinformatics, and innovative studies/techniques in cell biology.

MATERIALS FOR STUDY AND REFERENCES

1. De Roberties, E.D.P and De Roberties, E.M.F., Cell and Molecular Biology, 8th Edn., Lippincott Williams and Wilkins Publisher, India, 2005.
2. Cooper G.M and Hausman R.E. The Cell –A Molecular Approach, 4thEdn., Sinauer Associates Inc. USA, 2007.
3. Lodish H, Berk A, Zipursky S.L, Matsudair P, Baltimore D and Darnell J., Molecular Cell Biology, 4th Edn., W.H.Freeman and Company, USA, 2000.
4. Chatterjea M N and Shinde R, Text Book of Medical Biochemistry, 8th Edn., Jaypee Brothers Medical Publishers Pvt. Ltd., New Delhi, 2012.
5. Verma PS and Agarwal VK, Cell Biology, Genetics, Molecular Biology, Evolution and Ecology, S. Chand & Co. New Delhi, 2005.

6. Stansfield WD, Colome JS and Cano RJ, Schaum's Easy Outlines Molecular and Cell Biology, McGraw-Hill, New York, 2003.
7. Stephen R. Bolsover et al., Cell Biology - A Short Course, John Wiley & Sons, New Jersey, 2004.

WEB RESOURCE LINKS

- www.cellbio.com
- www.molbiolcell.org
- www.nature.com/molcellbio/index.html
- www.biology-questions-and-answers.com/cell-biology-review.html
- www.johnkyrk.com

COURSE OUTCOMES

After completion of this course student would be able to

- Understand the facts about the history of Cell.
- Know the aspects of protein and the levels of protein structure.
- Attain the skills to analyze the details on the ultra structure of nucleus.
- Expert on the details about (a) Sperm cell (b) Nerve cell.
- Master the description about Meiosis.
- Understand the facts about the stages of cell cycle.
- Analyze the aspects about Fluid Mosaic model.
- Understand the features of the major classes of lipids.

PRACTICAL – I: INTRODUCTION TO BIOINFORMATICS LAB

COURSE CODE: 22BI1LC01 CREDITS : 2

COURSE OBJECTIVES

- To learn about the bioinformatics databases, databanks and data format data retrieval from the online sources.
- To make students understand the essential features of the interdisciplinary field of science for better understanding biological data.

1. Literature Database Search – PubMed, BioMed Central, Public Library of Sciences (PloS)
2. Introduction to NCBI and EBI
3. Protein Sequence Database - PIR and Swissprot / UniProt
4. Nucleotide Sequence Database – GenBank, EMBL, DDBJ
5. Protein Structure Database – PDB
6. Protein 3D molecule viewer – VMD
7. Pairwise sequence alignment - Dotplot
8. Pairwise sequence alignment - lalign
9. Multiple sequence alignment – Clustalw
10. Database search – BLAST

COURSE OUTCOMES

After completion of this course student would be able to

- Search the literature data of the given protein using PubMed.
- Search the nucleotide sequence data of the given species using NCBI / EMBL / DDBJ.
- Search the protein sequence of the species using PIR and Swissprot / UniProt.
- Find the structure of protein using PDB.
- View the 3D structure of a protein using RASMOL software.
- Perform the pair wise alignment of the given proteins using Dotplot / EMBOSS water /EMBOSS Needle.
- Carry out the multiple sequence alignment of the proteins with Clustal OMEGA.
- Search the database of proteins / nucleic acids using BLAST program.

Allied: MATHEMATICS I

COURSE CODE: 22BI1AICC01 CREDITS : 2

COURSE OBJECTIVES

- To provide the knowledge of matrix, square matrix, linear equations, and know their properties.
- To know the properties of vector and area of triangle and parallelogram
- To solve problems involving forces, velocities and accelerations

UNIT I MATRICES AND DETERMINANTS

Matrix: Algebra of Matrix – Determinants and its properties – Co-factor of Determinants – Adjoint - Inverse – Solution of system of linear equations by matrix inversion method - Rank of a Matrix – Consistency of a system of linear equations: Cramer's rule method and rank method of Non-Homogeneous equations and Homogeneous linear system.

UNIT II VECTOR ALGEBRA

Definition – algebraic properties – scalar multiplication – properties – position vector – resolution of a vector in two and three dimensions – direction cosines and direction ratios – Scalar Product – Angle between two vectors – Properties of scalar product – applications of Dot products – Vector product – properties of vector product – Applications of cross product – Product of three vectors – Lines – Equation of a straight line – Angle between two lines – Applications – Bond length – Bond angle calculations – Electro statics work.

UNIT III ANALYTICAL GEOMETRY

Locus – straight lines – perpendicular distance from a point – family of straight lines – angle between two straight lines – pair of straight lines – Circle – tangent equation – length of the tangent from a fixed point to circle - condition for tangent- family of circles – Applications.

UNIT IV DIFFERENTIAL CALCULUS

Functions – Graph of Functions – Types of Functions – algebra of functions – Limit of a function – fundamental results - Important limits – Continuity of a function – Concept of Differentiation. Derivatives – Differentiation techniques – Product rule, quotient rule, chain rule, method of substitution, Derivative as a rate measure – rate of change – velocity – acceleration – related rates – Derivative as a measure of slope – tangent – normal and angle between curves – Stationary points – increasing, decreasing, maxima, minima, concavity convexity, points of inflexion.

UNIT – V INTEGRAL CALCULUS

Concept and Definition of Integral – Integration of Linear Functions – Properties of Integrals – Methods of Integration – Decomposition method – Substitution method – Integration by parts – Definite Integrals and its Properties – Applications of Integrals.

UNIT -VI CURRENT CONTOURS: (For Continuous Internal Assessment only)

Calculus and Analysis - Geometry and Topology – Combinatorics – Logic - Number Theory - Dynamical Systems and Differential Equations - Mathematical Physics

UNIT -VI CURRENT CONTOURS: (For Continuous Internal Assessment only)
Calculus and Analysis - Geometry and Topology – Combinatorics – Logic - Number Theory -Dynamical Systems and Differential Equations - Mathematical Physics.

MATERIALS FOR STUDY AND REFERENCES

1. Lawrence R.Harvill and Louis P. Pipes, Applied Mathematics for Engineers and Physicists, 3rd Edn., Dover Publications, New York, 2014.

2.Alan Hinchliffe, Molecular Modelling for Beginners, Second Edition, A John Wiley and Sons Ltd. Publications, 2008.
3. Erwin Kreysig, Engineering Mathematics, 9thEdn., John Wiley, USA, 2006.
4. Manicavachagam Pillay and Natarajan A, Text Book of Analytical Geometry, S.Viswanathan Publ. Pvt. Ltd., Chennai, 1983.
5. Narayanan S and Manicavachagam Pillay TK, Calculus, Vol.I, S.Viswanathan Publ. Pvt. Ltd., Chennai, 1982.

WEB RESOURCE LINKS

- https://www.purplemath.com/
- http://www.seemath.com/
- https://www.nctm.org/mathforum/

COURSE OUTCOMES

After completion of this course student would be able to

- Understand to solve the systems of linear equations. Compute determinants and write their properties.
- Understand to write the difference between Scalar and Vector Quantities, types of vectors.
- Recognize to write the different geometrical concepts of vector and to solve problems involving forces, velocities and accelerations.
- Perceive to find the center and radius of a circle given the equation in standard or general form.
- Recognize the limit of a function using the Limit Laws. Use the formal definition of limit to establish the limit of linear and quadratic functions.
- Envisage the slope of the tangent line to a function at a point.
- Recognize to determine the equation of a line from given information, the slope, x intercept and y intercept of an equation.
- Unravel the relationship between the derivative of a function as a function and the notion of the derivative as the slope of the tangent line to a function at a point.
- Note a concept and definition of integral and how to integrate the linear functions using decomposition method and substitution method.

COURSE CODE: 22BI1VE01 CREDITS : 2

VALUE EDUCATION

COURSE OBJECTIVES

- To understand the philosophy of life and values through Thirukural
- To analyse the components of values education to attain the sense of citizenship
- To understand different types of values towards National Integration and internationalunderstanding
- To learn yoga as value education to promote mental and emotional health
- To understand human rights, women rights and other rights to promote peace and harmony

UNIT I :PHILOSOPHY OF LIFE AND SOCIAL VALUES

Human Life on Earth (Kural 629) -Purpose of Life (Kural 46) -Meaning and Philosophy of Life (Kural 131, 226) -Family (Kural 45), Peace in Family (Kural 1025) Society (Kural 446), The Law of Life (Kural 952), Brotherhood (Kural 807) Five responsibilities / duties of Man (a) to himself (b) to his family (c) to his environment (d) to his society, (e) to the Universe in his lives (Kural 43, 981).

UNIT-II : HUMAN VALUES AND CITIZENSHIP

Aim of education and value education: Evolution of value oriented education, Concept of Human values: types of Values- Character Formation – Components of Value education- A P J Kalam's ten points for enlightened citizenship- The role of media in value building

UNIT-III : VALUE EDUCATION TOWARDS NATIONAL AND GLOBAL DEVELOPMENT

Constitutional or national values: Democracy, socialism, secularism, equality, Justice, liberty, freedom and fraternity - Social Values: Pity and probity, self-control, universal brotherhood - Professional Values - Knowledge thirst, sincerity in profession, regularity, punctuality and faith - Religious Values: Tolerance, wisdom, character - Aesthetic Values- Love and appreciation of literature and fine arts and respect for the same- National Integration and International Understanding

UNIT IV : YOGA AND HEALTH

Definition, Meaning, Scope of Yoga - Aims and objectives of Yoga - Yoga Education with modern context - Different traditions and schools of Yoga - Yoga practices: Asanas, Pranayama and Meditation.

UNIT V : HUMAN RIGHTS

Concept of Human Rights: Indian and international perspectives- Evolution of Human Rights- definitions under Indian and International documents -Broad classification of Human Rights and Relevant Constitutional Provisions: Right to Life, liberty ad Dignity- Right to equality- Right against exploitation- Cultural and Educational Right- Economic Rights- Political Rights- Social Rights - Human Rights of Women and Children – Peace and harmony.

BOOKS FOR REFERENCES:

1. Thirukkural with English Translation of Rev. Dr. G.U. Pope, Uma Publication, 156, Serfoji Nagar, Medical College Road, Thanjavur 613 004
2. திருக்குறள் - ஜி.யு.போப் - ஆங்கில மொழியாக்கத்துடன் - உமா நூல் வெளியீட்டகம், தஞ்சாவூர்
3. Leah Levin, Human Rights, NBT, 1998
4. V.R. Krishna Iyer, Dialetics and Dynamics of Human Rights in India, Tagore Law Lectures.

5. Yogic Thearpy - Swami Kuvalayananda and Dr.S.L.Vinekar, Government of India, Ministry of Health, New Delhi.
6. SOUND HEALTH THROUGH YOGA - Dr.K.Chandrasekaran, Prem Kalyan Publications, Sedapatti, 1999.
7. Grose. D. N – "A text book of Value Education' New Delhi (2005)
8. Gawande. EN – "Value Oriented Education" – Vision for better living. New Delhi (2002) Saruptsons
9. Brain Trust Aliyar- "Value Education for Health, Happiness and Harmony" Erode (2004) Vethathiri publications

COURSE OUTCOMES: After completion of the course, the student will be able to:

- Apply the values in thirukural to be peaceful, dutiful and responsible in family and society
- Develop character formation and sense of citizenship
- Be secular, self-control, sincere, respectful and moral.
- Master yoga, asana and meditation to promote mental health
- Be attitudinal to follow the constitutional rights

FIRST YEAR

SEMESTER - II

Part	Course Code	Name of the Course	Credits	Teach-ing Hours	Maximum Marks		
					CIA	ESE	Total
	SEMESTER – II						
I	21P1TAM2	Language Course – II (Tamil/Hindi/French)	3	6	25	75	100
II	ELC02	English Language Course – II	3	5	25	75	100
III	22BI2CC03	Computer Programming in C	4	4	25	75	100
	22BI2CC04	Biophysics	4	4	25	75	100
	22BI2LC02	Practical – II : Computer Programming in C Lab	2	3	40	60	100
	22BI2AICC02	Mathematics – II	3	4	25	75	100
IV	22BI2ES01	Environmental Studies	2	3	25	75	100
		Seminar, Library, Leveraging E-Resources	--	1	--	--	--
		Total	21 (42)	30	190	510	700 (1400)

பகுதி 1 தமிழ்
ஐந்தாண்டு ஒருங்கிணைந்த பட்டப் படிப்பு
இரண்டாம்பருவம்
மொழிப்பாடம்
தாள் : 2. இடைக்கால இலக்கியமும் புதினமும்
(21P1TAM2)

நோக்கம்

- சமய இலக்கியத் தோற்றத்திற்கான வரலாற்றுப் பின்புலத்தை அறிவித்தல்.
- தமிழ் சைவ, வைணவ இலக்கியங்களை அறிமுகப்படுத்தல்.
- சைவம், வைணவம், இஸ்லாம், கிறித்துவ சமயத்தினரின் பணிகளை வரலாற்று அடிப்படையில் இயம்புதல்.
- தமிழ்ச் சிற்றிலக்கியங்களின் இலக்கியச் சிறப்பைக் கற்பித்தல்.
- தமிழ்ச் சிற்றிலக்கியத்தின் வகை தொகை, வடிவமைப்பு, அக, புறச் செய்திகள் முதலியவற்றைக் கற்பித்தல்.
- தமிழ் மொழியின் செம்மொழிப்பண்புகளை அறியச் செய்தல்.
- மொழிபெயர்ப்பியலின் இன்றியமையாமையை உணரச் செய்தல்.

பாடத்திட்ட அமைப்பு

- பன்னிரு திருமுறைகள், நாலாயிர திவ்வியப் பிரபந்தம், சிற்றிலக்கியங்கள், புதினம், தமிழச் செம்மொழி வரலாறு, மொழிபொர்ப்பியல் எனும் அடிப்படையில் அமைக்கப்பட்டுள்ளன.

அலகு 1. பக்தி இலக்கியத்தில் வரலாறு - பழந்தமிழ் இலக்கியத்தில் சைவ சமயக் குறியீடுகள் - சைவ இலக்கியங்கள் - தோற்றமும் வளர்ச்சியும் - பக்தி இயக்கம் - தோத்திர சாத்திர வகைகள் - புதிய யாப்பும் இசையும் - திருமுறைப் பகுப்பு - சைவ சமயக் குரவர் - திருஞானசம்பந்தர் - வாழ்க்கை வரலாறு - கிரியை நெறி - பாடப்பட்ட தல வரலாறு - நாயக நாயகி பாவம் - திருக்கடைக் காப்பு முறை - வாதங்கள் - அற்புதங்கள் - பாடற் சிறப்புகள் - திருநாவுக்கரசு - வாழ்க்கை வரலாறு - சரியை நெறி - பாடப்பட்ட தல வரலாறு - அகத்துறை மரபு - தாண்டகம் - அற்புதங்கள் - சாத்திரச் சாடல் - சிறப்பியல்புகள் - சுந்தரர் - வாழ்க்கை வரலாறு - யோக நெறி - பாடப்பட்ட தன் வரலாறு - அற்புதங்கள் - திருமுறைப் பகுப்பு - முதல் எட்டுத் திருமுறைகள் - ஒன்பதாம் திருமுறை - பத்தாம் திருமறை (திருமந்திரம்) - பதினோராம் திருமுறை - சிறப்பியல்புகள்.

பன்னிரு திருமுறைகள்

1. திருநாவுக்கரசர் தேவாரம் - திருப்பூந்துருத்தி திருஅங்கமாலை
2. சுந்தரர் தேவாரம் - திருவையாற்றுப் பதிகம்
3. மாணிக்கவாசகர் திருவாசகம் - சிவபுராணம்
4. திருமூலர் திருமந்திரம் - இளமை நிலையாமை

குறியிலக்குகள் (Objectives)

1. பழந்தமிழ் இலக்கியங்களில் சைவ சமயக் குறியீடுகளையும் சைவ இலக்கியங்களின் தோற்றப் பின்புல வரலாற்றையும் பக்தி இயக்கங்களையும் கற்றறிவர்.
2. சைவ இலக்கியத்தின் தோத்திர, சாத்திர வகைகளையும் புதிய யாப்பு இசை அமைப்பினையும் கற்றுணர்வர்.
3. சமயப் பாடல்களில் வெளிப்படும் புராண, வரலாற்றுச் செய்திகளை அறிந்து கொள்வர்.
4. ஐந்தெழுத்து மந்திரம், திருநீற்றின் சிறப்பு, கோள்களின் நன்மை தீமை முதலானவற்றை விளங்கிக் கொள்வர்.
5. சரியை, கிரியை, யோகம், ஞானம் எனும் இறைநெறிக் கோட்பாட்டையும் நாயக, நாயகி பாவனையில் அமைந்த அகத்துறைப் பாடல்களையும் கற்றறிவர்.

அலகு 2. வைணவ இலக்கியங்கள் - பழந்தமிழகத்தில் திருமால் வழிபாடு - ஆழ்வார்கள் கால நிலை - வைணவ எழுச்சி - திவ்யப் பிரபந்தம் - முதல் ஆழ்வார்கள் - பிற ஆழ்வார்கள்.

நாலாயிரத் திவ்வியப் பிரபந்தம் : 1. பெரியாழ்வார் திருமொழி - நற்றாய் புலம்பல்

2. தொண்டரடிப்பொடியாழ்வார் திருமாலை

3. திருப்பாணாழ்வார் - அமலன் ஆதிபிரான்

4.மதுரகவியாழ்வார் - கண்ணிநுண்சிறுத்தாம்பு

குறியிலக்குகள் (Objectives)

1. ஆழ்வார்கள் பக்தித் திறத்தினையும் பல்வகை யாப்பிசை அமைப்பினையும் அறிந்து கொள்வர்.
2. வைணவ நெறிகள், வைணவ சமய மறுமலர்ச்சிக்குக் காரணமாக இருந்த ஆழ்வார்கள் பற்றித் தெரிந்து கொள்வர்.
3. அகத்துறையில் அமைந்த பாசுரங்கள் வழி பக்தியின் மேன்மைகளைக் கற்றுணர்வர்.
4. சிற்றிலக்கிய வளர்ச்சிக்கு ஆழ்வார்கள் பாசுரங்கள் முன்னோடியாய் விளங்கியதைக் கற்றறிவர்.
5. ஆழ்வார்களின் பாசுரங்கள், தமிழ் வேதம் என்றும் வேதத்திற்கு இணையானவை என்றும் போற்றப்படுவதை அறிவர்.

அலகு 3. சிற்றிலக்கியங்களின் தோற்றமும் வளர்ச்சியும் - சிற்றிலக்கியம் - விளக்கம் - தோற்றமும் வரலாறும் - **பிள்ளைத்தமிழ் :** இலக்கணம் - முதல் பிள்ளைத்தமிழ் நூல் - வகைகளும் பருவங்களும் - இலக்கியத்தின் தன்மை - சிறப்பியல்புகள் - **கலம்பகம் :** இலக்கணம் - பெயர்க்காரணம் - முதல் கலம்பக நூல் - இலக்கியத்தின் தன்மை - சிறப்பியல்புகள் - **தூது :** இலக்கணம் - முதல் நூல் - தூதுப் பொருள்கள் - இலக்கிய வடிவமைப்பு - இலக்கியத்தின் தன்மை - சிறப்பியல்புகள் - **குறவஞ்சி :** இலக்கணம் - முதல்நூல் - இலக்கிய அமைப்பு - யாப்பு அமைப்பு - நாடகப்பாங்கு - சிறப்பியல்புகள் - **பரணி :** இலக்கணம் - பெயர்க்காரணம் - முதல் பரணி நூல் - இலக்கியத்தின் தன்மை -

சிறப்பியல்புகள் - **தனிப்பாடல்கள் :** அறிமுகம் - தோற்றம் - வளர்ச்சி - யாப்பும் வடிவமைப்பும் - இலக்கியத் தன்மை - இலக்கியச் சுவை - பாடுபொருள்.

அ) முத்துக்குமாரசுவாமி பிள்ளைத்தமிழ் : 2 பாடல்கள்

1. செங்கீரைப் பருவம் - பாடல் 8 - 'விரல்சுவை உண்டு'

2. அம்புலிப் பருவம் - பாடல் 6 - 'ஒழியாத புவனத்து'

ஆ) நந்திக்கலம்பகம் : 5 பாடல்கள்

1. வாடை நோக

2. உரை வரம்பு

3. மயில்கண்டால்

4. சூழிவன்

5. கோலக் கொடி

இ) தமிழ்விடுதூது : 17 முதல் 46 வரை - 30 கண்ணிகள்

ஈ) குற்றாலக் குறவஞ்சி : குறத்தி மலைவளம் கூறல் - 3 பாடல்கள்

1. வானரங்கள்

2. முழங்கு

3. ஆடும் இரவு

உ) கலிங்கத்துப் பரணி - களம் பாடியது - 4 பாடல்கள்

1. ஆடல்

2. நெருங்கு

3. வாய்மடித்து

ஊ) தனிப்பாடல்கள் : 5 பாடல்கள்

1. காளமேகப் புலவர் - 3 பாடல்கள்

    1. கத்துகடல்

    2. பூநக்கி

    3. பண்பு

2. ஔவையார் - 1 பாடல்

    1. மதியாதார் முற்றம்

3. பலபட்டடைச் சொக்கநாதப் புலவர் - 1 பாடல்

1. படிக்காசுப் புலவர் பாடல் சிறப்பு

குறியிலக்குகள் (Objectives)

1. பிள்ளைத் தமிழ் இலக்கிய வகைமை, இலக்கண அமைப்பு, முதல்நூல் சிறப்பு, தனிச்சிறப்பியல்புகள் போன்றவற்றை அறிந்து கொள்வர்.
2. தூது இலக்கியத்தின் இலக்கணம், முதல்நூல் சிறப்பு, தூதுப் பொருள்கள், இலக்கிய அமைப்பு, பாட்டுடைத் தலைவனின் சிறப்புகள் முதலியவற்றைக் கற்றறிவர்.
3. அந்தாதி, கலம்பக இலக்கியங்களின் இலக்கணம் பாட்டுடைத் தலைவன், கலம்பகத்தின் பலவகை உறுப்புகள், அகப்பொருள், புறப்பொருள் கூறுகள் போன்றவற்றைக் கற்றுணர்வர்.
4. குறவஞ்சி இலக்கிய அமைப்பினையும் பாவினங்களின் பயில்வுகளையும் இயற்கை வருணனைகளையும் நாடக இலக்கியக் கூறுகளையும் குறவஞ்சி இலக்கியப் பொருளமைப்புகளையும் கற்றறிவர்.
5. பரணி இலக்கியத்தின் மூலம் அதன் இலக்கணம், வடிவமைப்பு, இலக்கியச் சுவை முதலியவற்றை அறிவர்.
6. தனிப்பாடல்களின் யாப்பு அமைப்பு, தோற்றம், வளர்ச்சி நிலைகளைக் கற்றறிவர்.
7. தனிப்பாடல்களின் பாடுபொருள், இலக்கியச்சுவைகளை விளங்கிக் கொள்வர்.

அலகு 4. தமிழ்ப் புதினம் அறிமுகம் : புதினம் - புதினத்தின் அமைப்பு - பல்வேறு உள்ளடக்கங்கள் - வகைமைகள் - கதைக்கூற்று உத்திகள் - கதைகூறு உத்திகள் - பாத்திரப்படைப்பு - நடை - தமிழில் புதினத்தின் தோற்றமும் வளர்ச்சியும் - தமிழ்ப் புதினத்தில் குறிப்பிடத்தக்க சாதனைகள் - தமிழ்ப் புதின முன்னோடிகள் - பொன்னீலன் - படைப்புகளில் எதிரொலிக்கும் சமூக வாழ்வு - தனிப்பார்வைகள் - புதினங்களின் பல்வேறு சிறப்பியல்புகள்.

புதினம்

1. புதிய மொட்டுகள் - பொன்னீலன்

குறியிலக்குகள் (Objectives)

1. புதினத்தின் அமைப்பு, வகைமைகள், பல்வேறு உள்ளடக்கங்கள், உத்திகள், பாத்திரப்படைப்பு, நடை ஆகியவற்றைக் கற்றுணர்வர்.
2. புதினப் படைப்பாளர்களின் படைப்பாற்றல், தனித்தன்மை, வெளிப்பாட்டு முறைகள் குறித்து அறிந்து கொள்வர்.
3. தமிழ்ப் புதினங்களின் போக்குகள் குறித்து அறிவர்.
4. தமிழ்ப் புதினங்கள்வழி வட்டார வழக்குச் சொற்களையும் மண்சார்ந்த சமூக வாழ்வு முறைகளையும் அறிந்து கொள்வர்.

அலகு 5. தமிழ்ச் செம்மொழி வரலாறு : மொழி விளக்கம் - மொழிக் குடும்பங்கள் - உலகச் செம்மொழிகள் - இந்தியச் செம்மொழிகள் - செம்மொழித் தகுதிகள் - வரையறைகள் - வாழும் தமிழ்ச் செம்மொழி - தமிழின் தொன்மை - தமிழின் சிறப்புகள் - தமிழ்ச்

செம்மொழி நூல்கள் - பரிதிமாற் கலைஞர் அவர்கள் முதல் பல்வேறு அறிஞர்கள் அமைப்புகள் - நிறுவனங்கள் - இயக்கங்கள் ஆகியவற்றின் தொடர் முயற்சிகள் - அறப்போராட்டங்கள் - தமிழ்ச் செம்மொழி அறிந்தேற்பு - **மொழிபெயர்ப்பியல் :** விளக்கம் - மொழிபெயர்ப்பின் தன்மைகள் - மொழிபெயர்ப்பின் நோக்கம் - நிறுவன நோக்கம் - தனிமனித நோக்கம் - பயன்.

குறியிலக்குகள் (Objectives)

1. தமிழ் மொழி செம்மொழி என்பதையும் அதன் பண்புகளையும் அறிவர்.
2. இந்திய மொழிக் குடும்பங்களைப் பற்றி அறிந்து கொள்வர்.
3. உலகச் சொம்மொழிகளையும் செம்மொழித் தகுதிகளையும் கற்றறிவர்.
4. தமிழின் தொன்மை, தமிழச் செம்மொழி நூல்களை அறிந்து கொள்வர்.
5. மொழிப்பெயர்ப்பியலின் விளக்கம், தன்மை, நோக்கங்களைக் கற்றறிவதுடன் மொழிப்பெயர்த் திறனையும் பெறுவர்.

பயிற்றுமுறை

- சைவ சமயக் குரவர்களின் இறைநெறிக் கோட்பாட்டையும் அவர்கள் தமிழகத்தில் சைவ சமயத்தை வளர்த்த முறைகளையும் இயம்புதல் வேண்டும்.
- பக்திப் பாடல்களில் இடம்பெற்றுள்ள நாட்டுப்புறக் கூறுகளை விளம்புதல் வேண்டும்.
- பக்தி இலக்கியங்களில் காணலாகும் புதிய யாப்பும் இசையும் பற்றி எடுத்துரைத்தல் வேண்டும்.
- பழந்தமிழ் இலக்கியங்களில் இடம்பெற்றுள்ள சைவ, வைணவக் குறியீடுகளை இனங்காணுதல் வேண்டும்.
- சிற்றிலக்கிய வளர்ச்சிக்குப் பக்தி இலக்கியங்கள் முன்னோடியாய் விளங்கியதை இயம்புதல் வேண்டும். சிற்றிலக்கிய வகை, தொகைகளை விளம்புதல் வேண்டும்.
- சிற்றிலக்கியங்கள் தொல்காப்பிய இலக்கியக் கொள்கைகளுடன் பொருந்தும் பாங்கினை விளக்குதல் வேண்டும்.
- சிற்றிலக்கியங்கள் தோன்றிய சூழலையும் சிற்றிலக்கிய வளர்ச்சிக்குத் திருமுறை, பாசுர இலக்கியங்களின் பங்களிப்பையும் இயம்புதல் வேண்டும்.
- சிற்றிலக்கியங்களில் பொதிந்துள்ள வரலாற்றுச் செய்திகள், சமுதாய நெறிகள், வாழ்வின் மாண்புகள், மன்னர்களின் ஆட்சிச் சிறப்புகள் போன்றவற்றை விளக்குதல் வேண்டும்.
- சிற்றிலக்கிய வகையுள் பெயர் உருமாற்றங்களையும் சிற்றிலக்கியப் பொருட்கூறு விரவி வருதலையும் எடுத்துரைத்தல் வேண்டும்.
- சிற்றிலக்கியங்களில் காணலாகும் அகப்பொருள் இலக்கணத் தழுவல், பாடலமைப்பு, இலக்கியச் சுவை முதலியவற்றை மொழிதல் வேண்டும்.
- சிற்றிலக்கியங்களில் உள்ள அகப்பொருள், புறப்பொருள் கூறுகளையும் பல்வகைப் பாவினங்களையும் முதல் நூல் சிறப்பியல்புகளையும் விளக்குதல் வேண்டும்.

- புதினப் படைப்பாளர்களை அறிமுகம் செய்தல், புதிய மொட்டுகள் புதினத்தின் அமைப்பு, உள்ளடக்கம், உத்திகள், பாத்திரப்படைப்பு, நடை ஆகியவற்றை விளக்கி உரைத்தல் வேண்டும்.
- தமிழ் மொழி, செம்மொழி என்பதையும் அதன் பண்புகளையும் மொழிதல் வேண்டும்.
- இந்திய மொழிக் குடும்கங்களையும் உலகச் சொம்மொழிகளையும் இயம்புதல் வேண்டும்.
- செம்மொழித் தகுதிகளையும் தமிழின் தொன்மை, தமிழச் செம்மொழி நூல்களையுமம் நவிதல் வேண்டும்.
- மொழிப்பெயர்ப்பியலின் விளக்கம், தன்மை, நோக்கங்களைக் கற்பிப்பதுடன் மொழிப்பெயர்ப்புப் பயிற்சியையும் அளித்தல் வேண்டும்.

பாடநூல்கள்

1. திருநாவுக்கரசர். 1992. **தேவாரம்,** திருப்பனந்தாள் : காசிமடம் வெளியீடு.
2. சுந்தரர். 2011. **தேவராம்,** கோயம்புத்தூர் : விஜயா பதிப்பகம்.
3. மாணிக்கவாசகர். 2010. **திருவாசகம் (மூலமும் உரையும்),** சென்னை : திருமகள் நிலையம்.
4. திருமூலர், **திருமந்திரம்.**
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6. செயங்கொண்டார். 2014. **கலிங்கத்துப்பரணி,** சென்னை : பாரிநிலையம்.
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9. பொன்னீலன், **புதிய மொட்டுகள்,** சென்னை : நியூ செஞ்சுரி புக் ஹவுஸ்.

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3. இரகவையங்கார் மு. **ஆழ்வார்கள் காலநிலை,** சிதம்பரம் : மணிவாசகர் பதிப்பகம்.
4. கந்தசாமி சோ.ந. **திருமுறை இலக்கியம்**, சென்னை : உலகத் தமிழாராய்ச்சி நிறுவனம்.
5. முத்துச் சண்முகன், நிர்மலா மோகன். 1979. **சிற்றிலக்கியங்களின் தோற்றமும் வகையும்,** மதுரை : முத்துப் பதிப்பகம்.
6. செல்வராசு ந. 1995. **இருபதாம் நூற்றாண்டுச் சிற்றிலக்கியங்கள்,** சென்னை : மணிவாசகர் பதிப்பகம்.
7. சந்திர சேகர் இரா. 2012. **தமிழ்ச் சிற்றிலக்கியங்கள்,** சென்னை : நாம் தமிழர் பதிப்பகம்.
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9. உலகச்செவ்வியல் மொழிகளின் வரிசையில் தமிழ் - வா.செ. குழந்தைசாமி.
10. செம்மொழிகள் வரிசையில் தமிழ் - ஜி.ஜான் சாமுவேல்

11. செம்மொழி - உள்ளும் புறமும், மாணவ முஸ்தபா "அறிவியல் தமிழ் அறக்கட்டளை"
12. சாலினி இளந்திரையன், தமிழ் செம்மொழி ஆவணம், மணிவாசகர் பதிப்பகம், சென்னை.
13. தமிழ்ச் செம்மொழி வரலாறு, முனைவர் மு. சாதிக்பாட்சா, ராஜா பப்ளிகேஷன்ஸ், திருச்சிராப்பள்ளி - 23.
14. ஆனந்தன் சு. 2015. **தமிழ் இலக்கிய வரலாறு,** திருச்சி : கண்மணி பதிப்பகம்.
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18. வெள்ளைவாரணர் க. 1979,1980. **பன்னிரு திருமுறை வரலாறு (தொகுதி 1,2),** சிதம்பரம் : அண்ணாமலைப் பல்கலைக்கழகம்.
19. இராசமாணிக்கம் மா. **இருபதாம் நூற்றாண்டுத் தமிழிலக்கியம்,** தஞ்சை : இராசி பதிப்பகம்.
20. சிவபாத சுந்தரம் சிட்டி, **தமிழ் நாவல் ஒரு நூற்றாண்டு வரலாறும் வளர்ச்சியும்.**
21. கார்த்திகேசு சிவத்தம்பி. 2013. **நாவலும் வாழ்க்கையும்,** சென்னை : என்.சி.பி.எச்.
22. சிட்டி சிவபாத சுந்தரம். **தமிழ் நாவலின் தோற்றமும் வளர்ச்சியும்**
23. மாதையன் பெ. **செவ்வியல் இலக்கியம்: காலமும் கருத்தும்.**
24. முருகேசபாண்டியன் ந. **மொழிபெயர்ப்பியல்,** திருச்சி : உயிர் எழுத்து பதிப்பகம்.
25. சேதுமணியன், 1990. **மொழிபெயர்ப்பியல் கோட்பாடுகளும் உத்திகளும்,** மதுரை : செண்பகம் வெளியீடு.
26. சிவசண்முகம் சி. தயளான் வே. 1982. **மொழிபெயர்ப்பியல்,** சிவகங்கை : அன்னம்.
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இணையதள முகவரிகள் :

1. www.tamilheritage.org
2. www.thehistoryofsrivaishnavam.weebly.com
3. www.sivasiva.dk
4. www.shivam.org
5. www.thevaram.org
6. www.tamilvu.org
7. www.sirukathaikal.com
8. www.noolulagam.com
9. www.katuraitamilblogspot.com

Part II English- Syllabus (from 2021-2022)

Department of English
Bharathidasan University
English Language Course - Semester II

ENGLISH FOR EFFECTIVE COMMUNICATION - II

COURSE CODE: ELC02 CREDITS : 3

Objectives:

- To enable learners to understand different styles of prose writing and narratives
- To equip learners with grammar towards effective communication
- To make learners develop their analytical reading skills

Module 1(Prose)

Swami Vivekananda - "To Madras Disciples"
George Orwell - "Politics and the English Language"
G.K. Chesterton - "On Running after One's Hat"
Practicum: Exercises in summarizing and essay writing.

Module 2 (Short Story)

K A Abbas - "The Sparrow"
O' Henry - "The Ransom of Red Chief"
Rabindranath Tagore - "Kabuliwala"
Practicum: Creative thinking and writing, narrating stories**.**

Module 3

Articles and Determiners, Pronouns and its various types, Prepositions, Adjectives and Adverbs, Word Order, Conjunction and Clauses
Practicum: Identifying and analyzing the grammar of grammatical words.

Module 4

Tense - Present, Past, Present Perfect
Question tags using Modals and "wh" words
Passive, Verb forms, Future, Modals, Imperatives, There and It, Auxiliary Verbs, Questions, Reported Speech
Practicum: Practice in usage of various tenses.

Module 5: Current Contours (For Continuous Internal Assessment only)

English for 21st century Professions-recent development in the job market-discourse for the New Media and Social Media-Language demands of the 21st century.

Textbook:

Murphy, Raymond. *Essential English Grammar: A Self-Study Reference and Practice Book for*

South Asian Students of English with Answers. Cambridge: Cambridge UP, 2002. Print. (Module III & IV)

Reference:

Honey Dew: An Anthology of Prose, Poetry and One-act Plays. 2014 ed. Hyderabad: Orient BlackSwan, 2014. Print.

Joshi, L.M, ed. *Masters of English Prose: From Bacon to Beerbohm.* New Delhi: Orient BlackSwan, 2014. Print.

The Best Words. Hyderabad: Orient BlackSwan, 2015. 94-101. Print.

Course Outcome:

After completion of the course the students will be able to realise the following outcomes:

- Acquire the four language skills LSRW
- Use learned skills efficiently in everyday communication
- Apply effectively the nuances of speaking skills in dialogues, discussions and public speeches
- Recognize the nuances of reading skills to promote better comprehension
- Incorporate the writing skills in all forms of written communication
- Enhance the language skills for effective and efficient day-to-day communication

COMPUTER PROGRAMMING IN C

COURSE CODE: 22BI2CC03 CREDITS: 4

COURSE OBJECTIVES

- To learn character set, data types, statements, functions, structure, input or output operations, pointers, files etc.,
- To provide available in c language in order to write c programs.

UNIT -I FUNDAMENTALS AND INPUT /OUTPUT STATEMENTS

History & Features of C – Character Set – Identifiers and Keywords – Data Types – Constants and Variables – Declaration of Variables and Constants – Symbolic Constants – Operators – arithmetic, unary, relational, logical, assignment and conditional operators – Hierarchy of operators – Input and output statements - character, string and formatted input and output

UNIT -II ARRAYS AND STRINGS

Arrays – one, two and multi-dimensional arrays – character arrays and strings comparison of strings – mathematical and string library functions – Control Statements – branching statements– *if* and *switch* statements – simple programs

UNIT -III CONTROL STATEMENTS

Control Statements – looping statements – *while*, *do-while* and *for* statements – *goto* statement – simple programs – sum of n natural numbers, sum of individual digits, ascending order, addition of matrices, alphabetical order, molecular weight and A+T & G+C content of DNA sequence

UNIT -IV FUNCTIONS

User Defined Functions in C – Defining and Accessing Functions – Passing Arguments – Function prototypes – scope and visibility of variables – simple programs – nPr, nCr, n!, swap two values.

UNIT- V STRUCTURES AND FILES

User defined data types in C – Structures – Declaring structures and Accessing members – Array of structures – Unions – Defining and Opening a File – Closing a File – Input/Output Operations on Files – simple programs

UNIT -VI Current Contours: (For Continuous Internal Assessment only)

Designing Data Types, Optimization Techniques, Machine Learning - Dynamic linking-most notably dlm_open and friends-Signals, forking and inter-process communication-Threading, and related advanced concepts such as thread local storage

MATERIALS FOR STUDY AND REFERENCE

1. S. Parthasarathy, Essentials of Programming in C for Life Sciences, Second Edition, Ane Books India, New Delhi, 2011.

2. E.Balagurusamy, *Programming in ANSI C*, Fourth Edition, Tata McGraw-Hill Publishing Company Limited, 2002.
3. Byron S. Gottfried, *Schaum's Outline of Programming with C*, McGraw-Hill Publications. 1996.

WEB RESOURCE LINKS

- http://www.dmoz.org/Computers/Security/Malicious_Software/Viruses/
- http://www.office.microsoft.com
- http://openoffice.org
- http://www.exforsys.com/tutorials/c-language
- http://www.grassrootsdesign.com/
- https://www.tutorialspoint.com/index.htm

COURSE OUTCOMES

After completion of this course student would be able to

- Understand the basic description, character set and variables of C language.
- Relate the basic operators and input/output statements in C.
- Describe the array and list out its types and library strings.
- Explain the concepts of branching control statements.
- Outline the basics of looping control statements.
- Define the accession and passing arguments in functions in C.
- Describe and access the structure in C and Union concepts.
- Learn the basics of file handling in C language.

BIOPHYSICS

COURSE CODE: 22BI2CC04 CREDITS: 4

COURSE OBJECTIVES

- To make the students to learn the laws of thermodynamics principles and techniques involved in qualitative and quantitative methods.
- Understand the physical principles that govern the function of important biological phenomena such as cellular networks, molecular motors and gene regulation.

UNIT- I LAWS OF PHYSICS AND CHEMISTRY
Introduction – Quantum Mechanics – The Electronic Structure of Atoms – Molecular Orbitals and Covalent Bonds – Molecular Interactions – Stereochemistry and Chirality – Thermodynamics – Entropy – Enthalpy – The free energy of a System – Chemical potential – Oxidation-reduction potential

UNIT -II PHYSICO-CHEMICAL TECHNIQUES TO STUDY BIOMOLECULES
Introduction – Hydration of Macromolecules – Role of Friction – Diffusion – Sedimentation – The Ultracentrifuge – Viscosity

UNIT -III SPECTROSCOPY
Introduction – Ultraviolet/Visible Spectroscopy – Fluorescence Spectroscopy – Infrared Spectroscopy

UNIT- IV X-RAY CRYSTALLOGRAPHY
Introduction – Crystals and Symmetries – Crystal Systems – Point Groups and Space Groups – Growth of Crystals of Biological Molecules –X-ray Diffraction – X-ray Data Collection – Structure Solution – Refinement of the Structure

UNIT -V NMR SPECTROSCOPY
Introduction – Basic Principles of NMR – NMR Theory and Experiment – Classical Description of NMR – NMR Parameters – The Nuclear Overhauser Effect – NMR Applications in Chemistry– NMR Applications in Biochemistry and Biophysics – NMR in Medicine

UNIT -VI Current Contours: (For Continuous Internal Assessment only)
Self-organized systems and pattern formation-Protein folding- Cellular networks-Molecular motors-Polymers and membranes- Gene regulation

MATERIALS FOR STUDY AND REFERENCE

1. Vasantha Pattabhi and N Gautham, Biophysics, Kluwer Academic Publishers, New York 2002.
2. N. Gautham, Bioinformatics: Databases And Algorithms, Narosa Publishers, Chennai, 2005.
3. David H Freifelder, Physical Biochemistry, W H Freeman, USA, 1982.

WEB RESOURCE LINKS

- www.flinders.edu.au/medicine/sites/support-services/risk-assessment-&-safe-operating-procedures.cfm.
- www.chm.davidson.edu/vce/spectrophotometry/Spectrophotometry.html
- www.ehs.ucsc.edu/lab_research_safety/pubs/bio/UCSC%20Autoclave%20procedures%2004_2005.pdf.
- www.lbl.gov/ehs/biosafety/manual/html/4.0.shtml

COURSE OUTCOMES

After completion of this course student would be able to

- Describe the molecular interactions and electronic structure of atoms.
- Explain the chemical potential and oxidation and reduction potential.
- Understand the physico chemical techniques to study biomolecules.
- Explain the process of diffusion, sedimentation, ultracentrifuge and viscosity.
- Describe the principle and instrumentation of UV/Visible spectroscopy.
- Compare the Fluorescence Spectroscopy with Infrared Spectroscopy.
- Analyze the details about X-ray crystallography

  Describe the principle, description and applications of NMR.

PRACTICAL - II: COMPUTER PROGRAMMING IN C LAB

COURSE CODE: 22BI2LC02 CREDITS: 2

COURSE OBJECTIVES

- To learn character set, data types, statements and
- To learn the functions structure, input or output operations, pointers, files etc., available in C language in order to write c programs.

Write C programs for the following

1. a) Compute the relative centrifugal force using r_{max} (in cm) and rpm value
   b) Compute the rpm value using r_{max} (in cm) and RCF value
   c) Calculate sedimentation time (in hrs. & mins.)using clearing factor and sedimentation coefficient
2. a) Find the biggest of three given numbers using if-else statement
   b) Compute all possible roots of quadratic equation using if-else statement
3. a) Find the molecular weight of a given dephosphorylated oligonucleotide sequence
   b) Find the molecular weight of a given DNA sequence, after checking for phosphorylation
4. a) Find the sum of n natural numbers using while and for statements
   b) Compute the sum of n odd numbers using while statement
   c) Find the factorial of a given integer number using for statement
5. a) Compute the nature of the solution based on the pH value using switch –case statement
   b) Compute all possible roots of quadratic equation using switch – case statement
6. a) Reverse the given integer number and store it in a variable using do-while statement
   b) Compute the sum of individual digits up to a single digit of a given number
7. a) Compute the average of n given values
   b) Arrange the n given numbers in ascending order
8. a) Reverse a given string (without using the built in string function)
   b) Checking for palindrome of a given string (without using the built in string function)
   c) Arrange the given names in alphabetical order
9. a) Calculate nCr of given n and r value, using function
   b) Swap two values using function
   c) Swap two given numbers without using additional variable using function
10. Compute the addition of two matrices (use different functions for each operation)
11. To declare a structure for student details and also to read and display the details of two students.
12. a) Copy contents from one file to another
    b) Computing base composition of a given nucleotide sequence. Read the sequence from a data file.

Note: Test all your C programs on different platforms (windows, linux/unix).

COURSE OUTCOMES

After completion of this course student would be able to

- Write a simple program using Turbo C compiler and gcc compiler.
- Create Compile and Execute of a C program.
- Write C program to find the all possible roots of a quadratic equation using if-else and switch-case statement.
- write a C program to find the sum of n natural numbers using while, do-while and for statements
- Write a C program to reverse a given string and check for palindrome.
- Write a C program to compute the addition of two matrices using functions.
- Find the factorial of a given integer number using for statement.
- Swap two values using function.

Allied : MATHEMATICS II

COURSE CODE: 22BI2AICC02 CREDITS : 3

COURSE OBJECTIVES

- To learn about eigen values and eigen vectors and its properties.
- To introduce the basic concept of differential equation and classification
- To learn find the solution for first and second order equations.

UNIT-I EIGEN VALUES AND EIGEN VECTORS

Characteristic equation – Eigen values and Eigen vectors – Properties of Eigenvalues – Problem Solving using Cayley-Hamilton theorem –Similarity transformation – Orthogonal diagonalization.

UNIT- II SEQUENCE AND SERIES

Definitions – Sequences and Series – Special types – Arithmetical Progression – Geometric Progression – Harmonic Progression – Means of Progression – Binomial Theorem for Rational Number other than Positive Integer – Binomial Series – Approximation – Summation of Binomial Series – Exponential Series – Logarithmic series.

Trigonometry: Trigonometric Ratios and Identities – Compound Angles – Trigonometrical Equations – Properties of Triangles – Solutions of Simple Problems.

UNIT -III VECTOR CALCULUS

Differentiation of Vectors - Gradient, Divergence and Curl of Functions –**S**olenoidal and irrotational fields - Unit tangent vetor - Unit normal vector - Angle between two surfaces – Scalar potential – Double and Triple integrals- Line, Surface and Volume Integrals – Applictions – Electro static potential.

UNIT IV INTRODUCTION TO DIFFERENTIAL EQUATIONS

Ordinary Differential Equations: Definition of order, degree and solutions – Method of separation of variables – homogeneous equations – exactness and integrating factors - linear equations and Bernoulli equations - Applications - Solving rate equation of first order.

UNIT V HOMOGENEOUS AND NON-HOMOGENEOUS DIFFERENTIAL EQUATIONS

Solutions of homogenous and non-homogenous equations – methods of finding particular integrals – operator method – method of variation of parameters – Solutions of simple simultaneous ODE's.

UNIT -VI CURRENT CONTOURS: (For Continuous Internal Assessment only)

Calculus and Analysis - Geometry and Topology – Combinatorics – Logic - Number Theory- Dynamical Systems and Differential Equations - Mathematical Physics.

REFERENCE BOOKS

1. Mathematical Modelling and it's Applications in Biology, Ecology and Population Study,2016.

2. D. S. Jones, M. J. Plank, and B.D. Sleeman. Differential Equations and Mathematical Biology Second Edition, CHAPMAN & HALL/CRC Mathematical and Computational Biology Series, 2009.

3. Alan Hinchliffe, Molecular Modelling for Beginners, Second Edition, A John Wiley and Sons Ltd. Publications, 2008**.**

4. Veerarajan T, Engineering Mathematics, Tata McGraw-Hill Publ. Co. Ltd., New Delhi,2008

5.Erwin Kreysig, Engineering Mathematics, 9th Edition, John Wiley, USA,2006.

6. Narayanan S and Manicavachagam Pillay TK, Trigonometry, S.Viswanathan Publ. Pvt. Ltd. and Vijay Nicole Imprints Pvt. Ltd. Chennai,2004.

7. J.D. Murray Mathematical Biology Third Edition, Springer , 2001.

8. Narayanan S Manicavachagam Pillay TK and Ramanaiah G, AAdvanced Mathematics for Engineering Students, Vols I &II, S.Viswanathan Publ. Pvt. Ltd., Chennai,1985.

9. Narayanan S and Manicavachagam Pillay TK, Calculus, Vol.II, S.Viswanathan Publ. Pvt. Ltd., Chennai,1982.

WEB RESOURCE LINKS

- https://www.purplemath.com/
- http://www.seemath.com/
- https://www.nctm.org/mathforum/

COURSE OUTCOMES

After completion of this course student would be able to

- Understand the Eigen values and Eigenvectors of square matrices and find the inverse of a square matrix using Cayley - Hamilton theorem.
- Evaluate the double and triple integrals in Euclidean and cylindrical coordinate systems.
- Form a sequence and obtain the series corresponding to a sequence, find the sum of n terms of an arithmetic progression.
- Get knowledge on the concept of differential equation, classifies the differential equations with respect to their order and linearity.
- Understand the method to solve first-order ordinary differential equations and exact differential equations.
- Perceive the way of conversion of separable and homogeneous equations to exac differential equations by integrating factors.
- Solve Bernoulli and Euler differential equations and to find solution of higher-order linear differential equations.
- Solve the homogeneous linear differential equations and non-homogeneous linear differential equations with constant coefficients.

- Find the solution of higher-order linear differential equations with variable coefficients using method of variation of parameter.
- Find the solutions of simple simultaneous ODE‟s

ENVIRONMENTAL STUDIES

COURSE CODE: 22BI2ES01 CREDITS : 2

COURSE OBJECTIVES:

- To appreciatethe scope of Environmental Studies, Community ecology and the interdisciplinary nature of environmental issues
- To have a basic knowledge of Natural resources its classification, concepts, and natural resources of India.
- The course designed to gain knowledge on values of biodiversity and conservation on global, national, and local scales
- To study about sources and effects of environmental pollution like air, water, soil, thermal, marine, nuclear and noise
- To understand the concerns related to Sustainable Development on environment and health
- To introduce the students in the field of Law and Policies and Acts both at the national and international level relating to environment.

UNIT-1: The Multidisciplinary nature of environmental studies
Definition, scope and importance.(2 lectures)
Need for public awareness

UNIT-2: Natural Resources: Renewable and non-renewable resources:
Natural resources and associated problems.

a) Forest resources: use and over-exploitation, deforestation, case studies. Timberextraction, mining, dams and their effects on forests and tribal people.
b) Water resources: Use and over-utilization of surface and ground water, floods,drought, conflicts over water, dams benefits and problems.
c) Mineral resources: Use and exploitation, environmental effects of extracting andusing mineral resources, case studies.
d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, waterlogging, salinity, case studies.
e) Energy resources: Growing energy needs, renewable and non renewable energysources, use of alternate energy sources. Case studies.
f) Land resources: Land as a resources, land degradation, man induced Landslides,soil erosion and desertification.
g) Role of an individual in conservation of natural resources.
h) Equitable use of resources for sustainable lifestyles.

(8 lectures)

Unit: 3 **Ecosystems**

- Concept of an ecosystem.
- Structure and function of an ecosystem.
- Producers, consumers and decomposers
- Energy flow in the ecosystem
- Ecological succession.
- Food chains, food webs and ecological pyramids
- Introduction, types, characteristic features, structure and function of thefollowing ecosystem:-
  a. Forest ecosystem
  b. Grassland ecosystem
  c. Desert ecosystem
  d. Aquatic ecosystems, (ponds, streams, lakes, rivers, oceans, estuaries)

(6 lectures)

Unit: 4 **Biodiversity and its conservation**

- Introduction – Definition : Genetic, species and ecosystem diversity
- Biogeographical classification of India
- Value of biodiversity : consumptive use, productive use, social, ethical,aesthetic and option values
- Biodiversity at global, National and local levels
- India as a mega-diversity nation
- Hot-spots of biodiversity
- Threats to biodiversity : habitat loss, poaching of wildlife, man-wildlifeconflicts.
- Endangered and endemic species of India
- Conservation of biodiversity: In-situ and Ex-situ conservation ofbiodiversity.
- Biological Diversity Act 2002/ BD Rules, 2004

(8 lectures)

Unit: 5 **Environmental Pollution**

Definition Causes, effects and control measures of :

a. Air Pollution
b. Water Pollution
c. Soil Pollution
d. Marine Pollution
e. Noise pollution
f. Thermal Pollution
g. Nuclear hazards

- Solid waste Management: Causes, effects and control measures of urbanand industrial wastes.
- Role of an individual in prevention of pollution

- Pollution case studies
- Disaster management: floods, earthquake, cyclone and landslides.
- Ill-Effects of Fireworks: Firework and Celebrations, Health Hazards, Types of Fire, Firework and Safety

(8 lectures)

Unit: 6 Social Issues and the Environment

- From Unsustainable to Sustainable development.
- Urban problems related to energy.
- Water conservation, rain water harvesting, watershed management.
- Resettlement and rehabilitation of people; its problems and concerns.Case studies
- Environmental ethics: Issues and possible solutions.
- Climate change, global warming, acid rain, ozone layer depletion,nuclear accidents and holocaust. Case studies.
- Wasteland reclamation.
- Consumerism and waste products.
- Environment Protection Act.
- Air (Prevention and Control of Pollution) Act.
- Water (Prevention and Control of Pollution) Act.
- Wildlife Protection Act.
- Forest Conservation Act.
- Issues involved in enforcement of environmental legislation
- Public awareness.

(7 lectures)

Unit: 7 Human Population and the Environment

- Population growth, variation among nations.
- Population explosion – Family Welfare Programmes
- Environment and human health
- Human Rights - Value Education
- HIV/ AIDS - Women and Child Welfare
- Role of Information Technology in Environment and human health
- Case studies.

Unit: 8 Field Work

Visit to a local area to document environmental assets-river / forest/ grassland/ hill / mountain

REFERENCE:

1. Agarwal, K.C. 2001 Environmental Biology, Nidi Public Ltd Bikaner.
2. Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt ltd, Ahamedabad –380013, India, E-mail: mapin@icenet.net(R)
3. Brunner R.C. 1989, Hazardous Waste Incineration, McGraw Hill Inc 480 p
4. Clark R.S. Marine Pollution, Clanderson Press Oxford (TB)
5. Cunningham, W.P.Cooper, T.H.Gorhani E & Hepworth, M.T. 2001.
6. De A.K. Environmental Chemistry, Wiley Eastern Ltd
7. Down to Earth, Centre for Science and Environment (R)
8. Gleick, H.P. 1993. Water in crisis, Pacific Institute for Studies in Dev., Environment &Security. Stockholm Env. Institute Oxford University, Press 473p.
9. Hawkins, R.E. Encyclopedia of India Natural History, Bombay Natural History Society,Bombay (R)
10. Heywood, V.H & Watson, R.T. 1995. Global Biodiversity Assessment. CambridgeUniversity Press 1140 p.
11. Jadhav, H & Bhosale, V.M. 1995. Environmental Protection and Laws Himalaya Pub.House, Delhi 284 p.
12. Mckinney, M.L. & Schoch R.M. 1996. Environmental Science systems & Solutions,Web enhanced edition 639 p.
13. Mhaskar A.K. Matter Hazardous, Techno-Science Publications (TB)
14. Miller T.G. Jr. Environmental Science, Wadsworth Publishing Co. (TB)
15. Odum, E.P. 1971 Fundamentals of Ecology. W.B. Saunders Co. USA. 574 p
16. Rao MN & Datta, A.K. 1987 Waste Water treatment, Oxford & IBH Publication Co. PvtLtd 345 p.
17. Sharma B.K. 2001 Environmental chemistry Goel Publ House, Meerut.
18. Survey of the Environment, The Hindu (M).
19. Townsend C. Harper, J and Michael Begon, Essentials of Ecology, Blackwell science(TB)
20. Trivedi R.K. Handbook of Environmental Laws, Rules, Guidelines, Compliances andStandards, Vol. I and II, Enviro Media (R).
21. Trivedi R.K. and P.K. Goel, Introduction to air pollution, Techno-Science Publications(TB).
22. Wagner K.D. 1998 Environmental Management. W.B. Saunders Co. Philadelphia USA499 p

    (M) Magazine (R) Reference (TB) Textbook

23. http://nbaindia.org/uploaded/Biodiversityindia/Legal/33%20Biological%20Diversit%20Rules,%202004.pdf.

COURSE OUTCOMES:

- Understand the environmental importance including interactions across local to globalscales.
- The learners to update and analyze environmental relationships and interactions of environmental components
- The student to gain knowledge on importance of natural resources in a systematic way.
- The course content is introduce the concept of renewable and non-renewable energyresources and its scenario in India and at global level
- The students will know the relationship between biodiversity and ecosystem functions,direct and indirect values of biodiversity resources and their bioprospecting opportunities.
- The learners can gain awareness related on environmental pollution, causes and pollutioncontrol with case studies.
- Student to obtain the environmental ethics and gain knowledge about the sustainable development.
- Learners should realize the environmental legislation and policies of national and international regime and know the regulations applicable to industries and other organizations with significant Environmental aspects

SECOND YEAR

SEMESTER - III

Part	Course Code	Name of the Course	Credits	Teach-ing Hours	Maximum Marks		
					CIA	ESE	Total
	SEMESTER – III						
I	21P1TAM3	Language Course – III(Tamil/Hindi/French)	3	6	25	75	100
II	ELCO3	English Language Course – III	3	5	25	75	100
III	22BI3CC05	Bioinformatics Databases & Resources	4	4	25	75	100
	22BI3CC06	Object Oriented Programming in C++	4	4	25	75	100
	22BI3LC03	Practical III : Bioinformatics Databases & Resources and OOP in C++ Lab	2	3	40	60	100
	22BI3AIICC03	Biochemistry	3	3	25	75	100
IV	22 BI3NMEC01	Programming for Life Sciences	2	3	25	75	100
		Seminar, Library, Leveraging E-Resources	--	2	--	--	--
		Total	21 (63)	30	190	510	700 (2100)

Language Course – III (Tamil)

COURSE CODE: 21P1TAM3 CREDITS:3

பகுதி 1 தமிழ்
ஐந்தாண்டு ஒருங்கிணைந்த பட்டப்படிப்பு
மூன்றாம் பருவம், மொழிப்பாடம்
தாள் 3. காப்பியமும் நாடகமும்

நோக்கம்

- தமிழ்க் காப்பியங்களை அறிமுகப்படுத்துதல்.
- காப்பியங்கள் கூறும் வாழ்வியல் அறங்களை உணர்த்துதல்.
- காப்பிய இலக்கியங்களின் இலக்கியச் சுவையைப் பயிற்றுவித்தல்.
- நாடக இலக்கியத்தின் தத்துவத்தைக் கற்பித்தல்
- காலந்தோறும் நாடக இலக்கியம் தந்த சமூகப் பங்களிப்பை உணர்த்துதல்

பாடத்திட்ட அமைப்பு

- சமணம், பௌத்தம், சைவம், வைணவம், கிறித்துவம், இசுலாம் ஆகிய சமயங்களின் முதன்மையான காப்பியங்களையும் சாபம் விமோசனம் என்ற நாடகத்தினையும் அவற்றிற்குரிய இலக்கிய வரலாற்றுப் பகுதிகளையும் அடிப்படையாகக் கொண்டு அலகுகள் திட்டமிடப்பட்டுள்ளன.

அலகு 1. ஐம்பெருங்காப்பியங்களில் முழுமையாக்க் கிடைத்த காப்பியங்கள் : ஐம்பெருங்காப்பியங்கள் - அறிமுகம் - சிலப்பதிகாரம் - கதைச்சுருக்கம் - அடைக்கலக்காதை - மணிமேகலை - கதைச்சுருக்கம் - சிறைக்கோட்டம் அறக்கோட்டமாக்கிய காதை - சீவகசிந்தாமணி - கதைச்சுருக்கம் - விமலையார் இலம்பகம்.

1. சிலப்பதிகாரம் - அடைக்கலக் காதை
2. மணிமேகலை - சிறைக்கோட்டம் அறக்கோட்டமாக்கிய காதை
3. சீவக சிந்தாமணி - விமலையார் இலம்பகம்

குறியிலக்குகள்(Objectives)

1. ஐம்பெருங்காப்பியங்களைப் பற்றிய அறிமுகத்தைப் பெறுவர்.
2. ஐம்பெருங்காப்பியங்களில் முழுமையாகக் கிடைத்த இலக்கியங்கள் பற்றிய தெளிவினைப் பெறுவர்.
3. சிலப்பதிகார நூல் அமைப்பையும் கதைச்சுருக்கத்தையும் தெரிந்தறிவர்.
4. மணிமேகலைக் காப்பியம் வெளிப்படுத்தும் பௌத்தச் சிந்தனைகளை அறிவர்.
5. சீவகசிந்தாமணியின் காப்பிய வளத்தைக் கற்றறிவர்.

அலகு 2. வைணவக் காப்பியங்கள் : இதிகாசங்கள் - இராமாயணக்கதைகள் - கம்பராமாயணம் கதைச்சிறப்பு - குகனும் இராமனும் - மகாபாரதக் கதைகள் - தமிழ்பாரத நூல்கள் - வில்லிபாரதம் - நூல் அமைப்பு - சிறப்பு.

1. **கம்பராமாயணம்** - குகப் படலம்
2. **வில்லிபாரதம்** - உலூகன் தூதுச் சருக்கம்

குறியிலக்குகள் (Objectives)

1. வைணவ சமயச் சிறப்பையும் இதிகாசங்களையும் கற்றறிவர்.
2. தமிழில் இராமாயணக் கதை தோன்றி வளர்ந்த முறையைத் தெரிந்து கொள்வர்.
3. கம்பராமாயணச் சிறப்பையும் இலக்கிய வளத்தையும் அறிவர்.
4. தமிழில் மகாபாரதக் கதையை அடிப்படையாகக் கொண்டு தோன்றிய காப்பியங்களைக் கற்றறிவர்.

5. *வில்லிபாரத நூலின் சிறப்புகளைக் கற்பர்.*

அலகு 3. *சமயக் காப்பியங்கள் : சைவ சமய நாயன்மார்கள் - வரலாறு - பெரிய புராணம் - திருத்தொண்டர் சிறப்பு - கிறித்துவ சமயம் - தேம்பாவணி - இசுலாமிய சமயம் - நபிகளின் சிறப்பு - சீறாப்புராணம்*

1.*பெரியபுராணம் - திருநாளைப் போவார் நாயனார் புராணம்*
2.*சீறாப்புராணம் - ஈத்தங்குலை வரவழைத்த படலம்*
3.*தேம்பாவணி - நீர் வரம் அடைந்த படலம்*

குறியிலக்குகள் (Objectives)

1. *சைவ சமயத் திருத்தொண்டர்களின் சிறப்பைத் தெரிந்து கொள்வர் .*
2. *பெரியபுராணம் தோன்றிய வரலாற்றையும் இந்நூல் அமைப்பையும் அறிவர்.*
3. *இசுலாமிய சமயம் தமிழகத்தில் பரவிய முறையையும் சீறாப்புராணச் சிறப்பையும் கற்பர்.*
4. *கிறித்துவ சமயத்தைத் தமிழகத்தில் பரப்பிய ஐரோப்பியர்களின் தமிழ்துதொண்டையும் வீரமாமுனிவரின் வரலாற்றையும் கற்றறிவர்.*
5. *தேம்பாவணி நூல் அமைப்பையும் சிறப்பையும் கற்றுணர்வர்.*

அலகு 4. நாடகம் : *நாடக இலக்கிய அறிமுகம் - நாடக இலக்கியத் தோற்றம் - வளர்ச்சி - நாடக இலக்கியச் சிறப்பு - சாபம் விமோசனம் நாடகம்.*

1. *நாடகம் : சாபம் விமோசனம்*

குறியிலக்குகள் (Objectives)

1. *நாடக இலக்கியத்தைப் பற்றிய அறிமுகத்தைப் பெறுவர்.*
2. *நாடக இலக்கியச் சிறப்பையும் அது தோன்றி வளர்ந்த முறையையும் கற்றறிவர்.*
3. *சாபம் விமோசனம் என்ற நாடகத்தைக் கற்றுணர்வர்.*

அலகு 5. *இலக்கிய வரலாறு : காப்பிய இலக்கியங்களின் தோற்றம் சிலப்பதிகாரம் - மணிமேகலை - காப்பிய இலக்கியங்களின் வளர்ச்சி - சீவக சிந்தாமணி - கம்பராமாயணம் - பெரியபுராணம் - சீறாப்புராணம் - தேம்பாவணி - பக்தி இலக்கியத் தோற்றம் - தேவாரம் - திருவாசகம் - பக்தி இலக்கிய வளர்ச்சி நாலாயிரத் திவ்வியப் பிரபந்தம் - சிற்றிலக்கியங்கள் - நாடக இலக்கியம்.*

குறியிலக்குகள் (Objectives)

1. *காப்பிய இலக்கியங்களின் தோற்றம், வளர்ச்சி பற்றிய அறிமுகத்தைப் பெறுவர்.*
2. *பக்தி இயக்கம் தோன்றி வளர்ந்த முறையையும் தேவாரம் திருவாசகம் முதலிய சைவ இலக்கியப் பன்னிரு திருமுறைகளையும் அறிவர்.*
3. *பக்தி இயக்கத்தில் வைணவத்தின் பங்கையும் நாலாயிரத் திவ்வியப் பிரபந்தத்தின் சிறப்பையும் தெரிந்து கொள்வர்.*
4. *சிற்றிலக்கியங்கள் காலந்தோறும் தோன்றி வளர்ந்த முறையைக் கற்றறிவர்.*
5. *நாடக இலக்கியங்கள் வளர்ந்த வரலாற்றைக் கற்றுணர்வர்.*

பயிற்றுமுறை

- *காலந்தோறும் தமிழில் தோன்றிய காப்பியங்களைப் பயிற்றுவித்தல்.*
- *தமிழில் இராமாயண, மகாபாரதக் கதைகள் தோன்றி வளர்ந்த முறையையும் தமிழ்க்காப்பிய மரபையும் எடுத்துரைத்தல்.*
- *பக்தி இயக்கம் தமிழ்ச் சமூகத்தில் செலுத்திய தாக்கத்தினை விளக்குதல்.*

- சிற்றிலக்கியங்கள் தமிழில் தோன்றிய காலச்சூழலையும் அதன் வரலாற்றையும் தெளிவுபடுத்துதல்.
- நாடகம் தமிழ்ச் சமூக வரலாற்றோடு இணைந்து வளர்ந்தமையைக் கற்பித்தல்.

பாடநூல்கள்

1. சாமிநாதையர் உ.வே. (உ.ஆ.), **சிலப்பதிகாரம்,** சென்னை : உ.வே.சா. பதிப்பகம்.
2. சாமிநாதையர் உ.வே. (உ.ஆ.), **மணிமேகலை,** சென்னை : உ.வே.சா. பதிப்பகம்.
3. **சீவகசிந்தாமணி**
4. **பெரியபுராணம்**
5. **கம்பராமாயணம், 2010.** சிதம்பரம் : அண்ணாமலைப் பல்கலைக்கழகம்.
6. **வில்லிபாரதம்**
7. **சீறாப்புராணம்**
8. மரிய அந்தோணி வி. (உ.ஆ.) **தேம்பாவணி,** பாளையங்கோட்டை : வீரமாமுனிவர் ஆய்வுக் கழகம்.
9. இராமசுவாமி மு., செண்பகம் இராமசுவாமி. சாபம் **?....**விமோசனம், சென்னை : பாவை பிரிண்டர்ஸ் (பி) லிட்.
10. ஆனந்தன் சு. 2015. **தமிழ் இலக்கிய வரலாறு,** திருச்சிராப்பள்ளி : கண்மணி பதிப்பகம்.

பார்வை நூல்கள்

1. சுப்பிரமணியஆச்சாரியர் வெ.சு. 2011. **சிலப்பதிகார ஆராய்ச்சி,** சென்னை : சேகர் பதிப்பகம்.
2. சீனிச்சாமி துரை. 1994**. தமிழில் காப்பியக் கொள்கை**, தொகுதி 1,2., தஞ்சாவூர் : தமிழ்ப் பல்கலைக்கழகம்.
3. அப்துல் ரகுமான். 2008. **கம்பனின் அரசியல் கோட்பாடு,** சென்னை : நேஷனல் பப்ளிஷர்ஸ்.
4. மணவாளன் அ.அ. 2005. **இலக்கிய ஒப்பாய்வுக் காப்பியங்கள்,** சென்னை : நியூ செஞ்சுரி புக் ஹவுஸ் (பி) லிட்.
5. சுப்பிரமணியன் ச.வே. **காப்பியப் புனைதிறன்.**
6. வளனரசு பா. **தேம்பாவணித்திறன்.**
7. செண்பகம் எம். **ஐம்பெருங்காப்பியங்கள்.**
8. வையாபுரிப்பிள்ளை எஸ். **தமிழ் இலக்கிய சரிதத்தில் காவிய காலம், தொகுதி 1.**
9. வரதராசன் மு. 2016. **தமிழ் இலக்கிய வரலாறு,** சென்னை : சாகித்திய அகாதெமி.
10. விமலானந்தம் மது.ச. 1987. **தமிழ் இலக்கிய வரலாற்றுக் களஞ்சியம் (இரண்டு தொகுதிகள்),** சென்னை : ஐந்திணைப் பதிப்பகம்.

இணையதள முகவரிகள்:

1. www. tamilvu.org
2. www. sirukathaikal.com
3. www. noolulagam.com
4. www. katturaitamilblogspot.com

English Language Course – III

COURSE CODE: ELCO3 CREDITS: 3

Paper (III) - English for Proficiency Development I – (ELC03)

Objectives:

- To help learners enhance their interpretative skills
- To enable learners to put the language skills into practice
- To equip learners with grammar towards proficiency development

Module 1

R. K. Narayan – *Malgudi Days*
Anita Desai – *Where Shall We Go This Summer?*
Practicum: Exercises in summarizing and essay writing.

Module 2

Expressions of Introduction, Apologizing, Advising, Asking Directions, Giving Instructions, Agreeing and Disagreeing and Recommendations
Practicum: Communicative tasks in various modes of expressions.

Module 3

Auxiliary verb, -ing and Infinitive, Articles, Nouns, Pronouns, Determiners, Relative Clauses Adverbs, Adjectives, Conjunctions, Prepositions, Phrasal Verbs, Writing Business letter – Letter of Quotation and Invitation, Essay Writing
Practicum: Constructing new sentences using various grammatical groups of words.

Module 4

Present Continuous, Present Simple, Past Simple, Past Continuous, Present Perfect and Past Perfect, Past Perfect Continuous, Future, Modals, Conditionals and Wish, Passive, Reported Speech, Question
Practicum: Framing sentences expressing various tenses.

Module 5: Current Contours (For Continuous Internal Assessment only)

Essentials of grammar in the digital era-grammaticality in Social Media-practical application of the prosody of English language-language demands of the 21st century.

Textbooks:

Murphy, Raymond. *Intermediate English Grammar: Reference and Practice for South Asian Students with Answers*. Cambridge: Cambridge UP, 1994. Print. (Module III & IV)
Taylor, Grant. *English Conversation Practice*. New Delhi: Tata McGraw-Hill, 2004. Print. (Module II)

Reference:

Pillai, G. Radhakrishna and K. Rajeevan. *Spoken English for You Level 1*. New Delhi: Emerald Publishers, 2008. Print.

Course Outcome:

After completion of the course the students will be able to realise the following outcomes:

- Acquire the four language skills LSRW
- Use learned skills efficiently in everyday communication
- Apply effectively the nuances of speaking skills in dialogues, discussions and public speeches

- Recognize the nuances of reading skills to promote better comprehension
- Incorporate the writing skills in all forms of written communication
- Enhance the language skills for effective and efficient day-to-day communication

BIOINFORMATICS DATABASES & RESOURCES

COURSE CODE: 22BI3CC05 CREDITS: 4

COURSE OBJECTIVES

- To provide an elementary knowledge of bioinformatics and biological information on the web scope of bioinformatics
- To learn about the types of data bases and their use pairwise and sequence alignment, predictive methods
- To learn about the bioinformatics databases, databanks, data format and data retrieval from the online sources.
- To make students understand the essential features of the interdisciplinary field of science for better understanding biological data.
- To provide the student with a strong foundation for performing further research in bioinformatics.

UNIT- I BIOINFORMATICS AN OVERVIEW

History of Bioinformatics – Goal of bioinformatics as a separate discipline – Emerging branches of Bioinformatics: Genomics, Proteomics, Systems Biology, Chemoinformatics – Accessing Bioinformatics resources/databases – NCBI PubMed, EBI, EMBL and ExPASy – Applications and Limitations of Bioinformatics.

UNIT-II BIOLOGICAL SEQUENCE AND STRUCTURE FILE FORMATS

Genbank, Fasta and Swiss-Prot formats – Sequence Databases : Nucleotide Sequence Databases – GenBank, EMBL, DDBJ – Protein Sequence Databases – SWISS-PROT, TrEMBL, UniProt PIR – ExPASy tools: ProtParam – Genome Databases – GOLD, TIGR – Derived Databases – Prosite, PRODOM, Pfam, PRINTS, CATH, SCOP, DALI – Structure databases – PDB, MMDB, MDL MOL – Protein Structure Visualization Tools: RasMol, Swiss PDB Viewer.

UNIT-III SEQUENCE ANALYSIS

Sequence analysis of biological data – models for sequence analysis and their biological motivation – Basic concepts of sequence similarity, identity and homology – Definitions of homologues, orthologues and paralogues – Sequence Alignment: Dot matrix – Scoring matrices: PAM and BLOSUM Substitution matrices – Alignment scores and gap penalties – Pairwise Sequence Alignments: Local and Global alignment using LALIGN – Database searching tools– BLAST and FASTA algorithms – Various versions of basic BLAST and FASTA.

UNIT -IV MULTIPLE SEQUENCE ALIGNMENTS

Basic concepts of various approaches for MSA – progressive, hierarchical – CLUSTALW and TCOFEE and their application for sequence analysis - Use of hidden Markov model (HMM) based Algorithm for MSA. Phylogeny: Concept of dendrograms and its interpretation – Phylogenetic analysis – Maximum Parsimony and UPGMA methods – Phylogenetic trees – Rooted and unrooted trees – Phylogeny programs: PHYLIP, PAUP, MEGA.

UNIT-V GENOMIC DATABASES

GOLD, GDB – Microbial Genome Databases – IMG/M: Integrated Microbial Genomes & Microbiomes - NCBI Genome Databases – Mapviewer – Gene Finding Tools – prokaryotic and eukaryotic tools – Genescan, GLIMMER and MUMMER – Metabolic pathway databases – KEGG – Microarray databases – Informatics solutions for genomics, proteomics, metabolomics and interactomics.

UNIT-VI Current Contours: (For Continuous Internal Assessment only)

Advanced Genome Analysis Techniques - Comparative Genome Analysis - Open Problems about Evolution and Phylogeny - Open Problems about Protein Structure and Function

MATERIALS FOR STUDY AND REFERENCE

1. D.Mount, Bioinformatics: Sequence and Genome Analysis, Cold Spring Harbor Laboratory Press, New York. 2004
2. A.D.Baxevanis and B.F.Francis Ouellellette, Bioinformatics- A Practical Guide to the Analysis of Genes and Proteins, Wiley India Pvt Ltd, New Delhi, 2009
3. T.K.Attwood, D J Parry Smith, Samiron Phukan, Introduction to Bioinformatics, Pearson Education, UK, 2007
4. O.Bosu and S.K.Thukral, Bioinformatics Databases, Tools and Algorithms, OxfordUniv. Press, New Delhi, 2007.
5. Arthur M. Lesk, Introduction to Bioinformatics, Oxford University Press, New Delhi, 2003.
6. David W. Mount, Bioinformatics – Sequence and Genome analysis, Cold Spring Harbor Laboratory Press, New York, 2001.
7. G. Gibson & S.V.Muse, A Primer of Genome Science, Sinauer Associates, Inc. Publishers, 2002.
8. A. Baxevanis and B.F. Ouellette. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, Wiley- Interscience, Hoboken, NJ, 2005.
9. A. M.Campbell & L. J. Heyer, Discovering Genomics, Proteomics & Bioinformatics, CSHL Press, 2003.

WEB RESOURCE LINKS

- www.Bioinformatics.org
- www.bioinfo.mbb.yale.edu/mbb452a/intro/
- www.biology.ucsd.edu/others/dsmith/Bioinformatics.html

COURSE OUTCOMES

After completion of this course student would be able to

- To characterize the bioinformatics database.
- Understand the details about MMDB.
- Grasp the aspects of KEGG database.
- Know the details about VAST and DALI.
- Explain about: (1) Flat file (2) Relational database (3) Object orientated databases.
- Understand the facts about GenBank file format.
- Gain knowledge about text based search engines.

- Give details about viral genome database.
- Realize an overview of bioinformatics and applications.
- Understand the details about nucleotide sequence databases.
- Know the details about the BLAST tool.
- Describe the facts about metabolic pathway databases.
- Grasp the aspects of the NCBI map viewer.
- Study the features of Rooted and Unrooted phylogenetic trees.
- Be aware of the facts of pair wise sequence alignments.
- Learn the details about the structure databases

OBJECT ORIENTED PROGRAMMING IN C++

COURSE CODE: 22BI3CC06 CREDITS: 4

COURSE OBJECTIVES

- To understand the concept of object oriented programming
- To lean the knowledge of c++ features.

UNIT- I PRINCIPLES OF OBJECT ORIENTED PROGRAMMING
Object Oriented Programming (OOP) – Introduction – Basic concepts – Classes, Objects, Data abstraction and encapsulation – Inheritance – Polymorphism – Dynamic Binding and Message Passing – Object oriented Languages – Applications.

UNIT- II INTRODUCTION TO C++
Introduction to C++ – History – Applications – Procedure-Oriented Programming – Object Oriented Programming versus Procedure-Oriented Programming – Structure of C++ Program – Comparison between C and C++.

UNIT -III BASICS OF C++
Tokens, expressions, keywords, Identifiers, constants, Operators, Data types – Standard input and output statements – Use of << and >> operators – Declaration of variables – Sample Programs – C++ programs to compute Temperature conversion, pH, BMI, RCF, rpm and Average Mol. Wt of DNA.

UNIT -IV CONTROL STATEMENTS & FUNCTIONS
Branching statements – *if* and *switch* statements– looping statements – *while*, *do-while* and *for* statements – *goto* statement – sample programs – Functions, Function prototype – Inline Functions – Default arguments – Function overloading – Sample Programs.

UNIT -V CLASSES AND OBJECTS
Creating a class – Defining member functions – Creating objects – Accessing class member – Arrays within a class – Arrays of objects – Friend function – Local classes – Sample Programs.

UNIT -VI Current Contours: (For Continuous Internal Assessment only)
Memory management internals, exception handling and safety, templates and partial specialization , auto pointers, traits and traits classes, the Standard Library, the STL - its use

MATERIALS FOR STUDY AND REFERENCE

1. E. Balaguruswamy, Object Oriented Programming with C++, 4th Edition, Tata Mc-Graw Hill Publications, New Delhi, 2006.
2. Robert Lafore, Object Oriented Programming in C++, 4th Edition, Galgotia Publications, New Delhi, 2001.

WEB RESOURCE LINKS

- http://www.sgi.com/tech/stl/index.html
- http://www.open-std.org/jtc1/sc22/wg21/

- http://www.research.att.com/~bs/C++.html
- https://www.tutorialspoint.com/index.htm

COURSE OUTCOMES

After completion of this course student would be able to

- Understand the basic concepts of OOPS.
- Know the details about looping statements.
- Create the objects and access its members in C++.
- Explain the concept of function overloading.
- Create the arrays of objects in C++.
- Understand the Inline function in C++.
- Grasp the concept of default arguments in C++.
- Define and call friend function in C++.

PRACTICAL III : BIOINFORMATICS DATABASES & RESOURCES AND OOP IN C++ LAB

COURSE CODE: 22BI3LC03 CREDITS: 2

COURSE OBJECTIVES

- To provide an elementary knowledge of bioinformatics and biological information on the web scope of bioinformatics, types of data bases and their use, pair wise and sequence alignment, predictive methods.
- To learn about the bioinformatics databases, databanks, data format and data retrieval from the online sources.
- To make students understand the essential features of the interdisciplinary field of science for better understanding biological data.
- To provide the student with a strong foundation for performing further research in bioinformatics.
- To understand the concept of object oriented programming and to have through knowledge of c++ features

BIOINFORMATICS DATABASES & RESOURCES LAB EXCERCISES

1. Search on NCBI – PubMed bibliographic search – different options – author name, keyword in title, abstract, title and/or abstract, related articles – different display options
2. Search on EMBL for nucleic acid sequences
3. Study of sequence formats by ReadSeq and TranSeq
4. Perform a similarity search of PIR database for the given protein sequence
5. Perform a similarity search of UniProt database for the given protein sequence
6. Computation of protein sequence features using PROTPARAM tool
7. Retrieving genomic information using GOLD database
8. Perform pairwise sequence alignment for a set of two analogous proteins
9. Motif searching in derived databases PRINTS and BLOCKS databases
10. Structure exploration using PDB
11. To list SCOP lineages and CATH architecture description for a set of proteins
12. Structure visualization using RASMOL software
13. Structure visualization using PYMOL software
14. Pairwise sequence alignment by LALIGN tool
15. Sequence similarity search using NCBI-BLAST tool
16. To retrieve amino acid sequences (in FASTA format) of Bowman-Birk inhibitors from different species (monocots and dicots) and perform multiple alignment with ClustalW to evaluate their homology. To compare and comment on the conservation disulfide bridge pattern between monocots and dicots.
17. Searching metabolic pathway information in KEGG database and MetaCyc
18. MEGA –
    a) To perform phylogenetic analysis by neighbor joining method using the Kimura two-parameter model for a set of nucleotide sequences.
    b) To perform phylogenetic analysis by neighbor joining method using the Dayhoff PAM matrix for a set of amino acid sequences (ribonucleases).

OOP IN C++ - Write C++ programs for the following

1. a) Covert Centigrade scale to Fahrenheit scale.
   b) Convert Fahrenheit Scale to Centigrade scale.
2. a) Compute the relative centrifugal force using r_{max} (in cm) and rpm value.
   b) Compute the rpm value using r_{max} (in cm) and RCF value.
3. Calculate Body Mass Index (BMI) value.
4. a) Calculate pH of the solution using H^+ ion.
   b) Calculate pH of the solution using OH^- ion.
5. Calculate Average Molecular Weight of DNA.
6. Calculate Average of Two Numbers.
7. a) Find the biggest of three given numbers using if-else statement.
   b) Compute the nature of the solution based on the pH value using switch–case statement
8. a) Find the sum of n natural numbers using while.
   b) Find the sum of n natural numbers using for statement.
9. Compute multiplication & Division of two numbers using inline functions.
10. Compute Simple Interest using Default Arguments.
11. Compute Volume of Cube, Cylinder & Rectangular Box using function overloading.
12. Display the Item Number and Cost using Classes & Objects.
13. Enter employee details using Classes & Objects.
14. Compute the Mean Value using friend function.
15. Enter student details using Classes & Objects.

COURSE OUTCOMES:

After completion of this course student would be able to

- Retrieve pathway information of disease and note the results.
- Find the literature information about the disease.
- Calculate the simple interest using Default Arguments.
- Sum up the natural numbers using while loop.
- Find the biggest of three numbers.
- Compute multiplication and division of two numbers using inline.
- Calculate Average Molecular Weight of DNA.

BIOCHEMISTRY

COURSE CODE: 22BI3AIICC03 CREDITS: 3

COURSE OBJECTIVES

- To study about carbohydrates, proteins, lipids, nucleic acids, fatty acids
- To learn about its chemical structures and pathways.

UNIT- I CARBOHYDRATES

Definition – structure and classifications of carbohydrates – Properties and biological functions of carbohydrates – Monosaccharides, Disaccharides, Polysaccharides, storage polysaccharides, structural polysaccharides – glycoproteins, proteoglycans and blood grouping, storage and metabolism of carbohydrates

UNIT- II PROTEINS AND AMINO ACIDS

Structure and classification of amino acids – Polypeptides – Primary structure – types of bonding– confirmation – Secondary structure – alpha helix, beta sheets, turns and loops – Tertiary structure – Quaternary structure – Protein folding. Metabolism of proteins and Nitrogen balancing – Introduction to enzymes – Acids Base Balance

UNIT- III LIPIDS

Definition – classification – structure and functions of lipids – Storage lipids – Membrane lipids– Fatty acids – waxes – phospholipids – Eicosonoids – Terpenes – Steroids – Structure and composition of cell membrane –fluid mosaic model

UNIT -IV NUCLEIC ACIDS

Definition –structure and types of nucleic acids – DNA and RNA – types – structure and function – Nucleotides – nucleosides – sugars – Circular – double helix and super coiled DNA–Composition of Eukaryotic and prokaryotic genome

UNIT-V FATTY ACID, NUCLEIC ACID METABOLISM AND OXIDATIVE PHOSPHORYLATION

Overview of fatty acid metabolism – Synthesis and degradation of fatty acids – Nucleic acids – *De novo* synthesis of nucleotides – Intermediary metabolism – Oxidative phosphorylation – Energy transduction pathways – regulation – Light reactions of photosynthesis – Secondary metabolites.

UNIT -VI Current Contours: (For Continuous Internal Assessment only)

Cellular signal transduction, clinical chemistry, biochemical immunology, bioinorganic chemistry, genetic modeling of human disease, molecular biology of cancer, regulatory RNA, proteomics, and structural biochemistry.

MATERIALS FOR STUDY AND REFERENCE

1. J. M. Berg, J.L. Tymoczko and L.Styrer, Biochemistry, Fifth Edition, W.H. Freeman &Co., New York, 2002.
2. D.L. Nelson and M.M. Cox, Lehninger Principles of Biochemistry, Fifth Edition, W.H. Freeman & Co, New York, 2005.
3. U. Sathyanarayana, Biochemistry, Third Edition, Books and Allied (P) Ltd., Kolkatta, 2006.

4. R.I. Gumport, F.H. Deis and N.C. Gerber, Student Companion to Accompany Biochemistry, Fifth Edition, W.H. Freeman & Co., New York, 2002.
5. D. Voet and J. G, Voet, Fundamentals of Biochemistry, John Wiley, New York, 2005.

WEB RESOURCE LINKS

- vle.du.ac.in/mod/book/view.php?id=12963&chapterid=27926
- https://www.ck12.org/c/chemistry/amino-acids/?by=community
- www.bioinformatics.org/strap/createStrapLinks2.html

COURSE OUTCOMES

After completion of this course student would be able to

- Know the facts about structure and functions of carbohydrates.
- Understand about primary, secondary and tertiary structure of protein.
- Classify the lipids with examples and its functions.
- Describe the mechanism of glucose storage in the form of starch in plants.
- Understand the *de-nova* synthesis of nucleotides.
- Describe about the Citric acid cycle.
- Narrate the mechanism of oxidative phosphorylation.
- Know the various functions of storage lipids.

PROGRAMMING FOR LIFE SCIENCES

COURSE CODE: 22BI3NMEC01 CREDITS: 2

COURSE OBJECTIVES

- To learn character set, data types, statements, functions, structure, input or output operations, pointers, files etc.,
- To provide available in c language in order to write c programs.

UNIT I INTRODUCTION

Introduction to Computers – Need for Programming in Life Sciences – Hardware – Input and output devices, CPU, memory. Software – Programming languages – Operating Systems – Windows. Internet usage- Browsers – Internet Explorer, Mozilla – Search engines – Email – Internet resources for Life Sciences – Literature Databases- NCBI-PUBMED – protein and nucleic acid sequence databases-PIR, Swiss-prot, GenBank, PDB, SCOP.

UNIT II VARIABLES AND ASSIGNMENT

History of C – Identifiers and Keywords – Constants and Variables- Operators – arithmetic, unary, relational, logical, assignment, conditional- Hierarchy of operators – Input and output statements- Formatted input and output – Example programs form Life Sciences.

UNIT III CONDITIONS AND LOOPS

Control Statements in C – Branching Statements if-else, Switch-case, and goto -Looping statements while, do while and for statements – Example Programs from Life Sciences.

UNIT IV FUNCTIONS

User Defined Functions in C- Defining and Accessing Functions-Passing Arguments – Function prototypes-Introduction to Pointers, Advantages of Pointers, Pointer Declarations – Pointers and Arrays - Example programs from Life Sciences.

UNIT V STRUCTURES AND UNIONS

Structures and Unions data files – fopen (), fclose (), reading and writing – Example programs form Life Sciences.

MATERIALS FOR STUDY AND REFERENCE

1. Peter Norton, Introduction to Computers 6th Edn., Tata McGraw-Hill Pub. Co.Ltd., New Delhi, 2006.
2. Byron S. Gottfried, Schaum's Outlines Programming with C, 2nd Edn., Tata McGraw-Hill Pub. Co. Ltd., New Delhi, 1996.
3. E. Balagurusamy, ANSI C, 2nd Edn., Tata McGraw-Hill Pub.Co. Ltd., New Delhi,1998.
4. Y.Kanetkar, Let us C, 4th Edn., BPB Publications, New Delhi, 1991.
5. Frank H. Stephenson, Calculations for Molecular Biology and Biotechnology, Elsevier India Pvt, Ltd., New Delhi, 2004.
6. S. Parthasarathy, Essentials of programming in C for Life Sciences, 2nd Edn., Ane Books India New Delhi, 2011.

WEB RESOURCE LINKS

- http://www.dmoz.org/Computers/Security/Malicious_Software/Viruses/
- http://www.office.microsoft.com
- http://openoffice.org

- http://www.exforsys.com/tutorials/c-language
- http://www.grassrootsdesign.com/
- https://www.tutorialspoint.com/index.htm

COURSE OUTCOMES

After completion of this course student would be able to

- Understand the basic description, character set and variables of C language.
- Relate the basic operators and input/output statements in C.
- Describe the array and list out its types and library strings.
- Explain the concepts of branching control statements.
- Outline the basics of looping control statements.
- Define the accession and passing arguments in functions in C.
- Describe and access the structure in C and Union concepts.
- Learn the basics of file handling in C language.

SECOND YEAR

SEMESTER - IV

Part	Course Code	Name of the Course	Credits	Teach-ing Hours	Maximum Marks		
					CIA	ESE	Total
	SEMESTER – IV						
I	21P1TAM4	Language Course–IV (Tamil/Hindi/French)	3	6	25	75	100
II	ELC04	English Language Course – IV	3	5	25	75	100
III	22BI4CC07	Molecular Biology	4	4	25	75	100
	22BI4LC04	Practical IV : Molecular Biology Lab	2	3	40	60	100
	22BI4AII CC04	Analytical Biochemistry	3	3	25	75	100
	22BI4AIILC01	Allied Practical – I : Analytical Biochemistry Lab	2	3	40	60	100
IV	22BI4NMEC02	Basics of Bioinformatics	2	3	25	75	100
V	22BI4EA01	Extension Activities	2	--	100	--	100
		Seminar, Library, Leveraging E-Resources	--	3	--	--	--
		Total	21 (84)	30	305	495	800 (2900)

LANGUAGE COURSE – IV (TAMIL)

COURSE CODE: 21P1TAM4 CREDITS:3

பண்டைய இலக்கியம்

நோக்கம்

- பழந்தமிழ் இலக்கிய வளத்தை உணர்த்துதல்.
- சங்க இலக்கியங்களை அறிமுகப்படுத்தி நூல் அமைப்பினையும் சிறப்பினையும் எடுத்துரைத்தல்.
- சங்க இலக்கியங்கள் அமைக்கப்பட்டிருக்கும் அகப்புற மரபுகளைப் பற்றிய தெளிவினை ஏற்படுத்துதல்.
- அக இலக்கியங்கள் வெளிப்படுத்தும் பழந்தமிழர் வாழ்வியலைத் தெளிவுபடுத்துதல்.
- புற இலக்கியங்கள் காட்டும் வாழ்வியல் அறங்களை உணர்த்துதல்.
- அற இலக்கியங்கள் வாழ்வியல் அறக்கருத்துகளை வெளிப்படுத்துதல்.

பாடத்திட்ட அமைப்பு

- பரிபாடல் தவிர்ந்த எட்டுத்தொகை நூல்கள், பத்துப்பாட்டுள் சிறுபாணாற்றுப்படை, திருக்குறள், நாலடியார், பழமொழி நானூறு ஆகிய அற இலக்கியங்கள், அவற்றினைத் தெளிவுபடுத்தும் இலக்கிய வரலாறு, கட்டுரைகள் ஆகியவற்றின் அடிப்படையில் அலகுகள் திட்டமிடப்பட்டுள்ளன.

அலகு 1. குறுந்தொகை ,நற்றிணை ,ஐங்குறுநூறு : பண்டைய இலக்கிய அறிமுகம் - அக இலக்கியங்கள் - குறுந்தொகை - அறிமுகம் - நற்றிணை - இலக்கியச் சிறப்பு - ஐங்குறுநூறு.

1.குறுந்தொகை 1. **வில்லோன்** எனத் தொடங்கும் பாடல் (பா.எ. 07)
2. **அகவன்** எனத் தொடங்கும் பாடல் (பா.எ. 23)
3. **கான** எனத் தொடங்கும் பாடல் (பா.எ. 38)
4. **தலைப்புணை** எனத் தொடங்கும் பாடல் (பா.எ. 222)
5. **பாலும்** எனத் தொடங்கும் பாடல் (பா.எ. 396)

2. நற்றிணை 1. **நின்றசொல்லர்** எனத் தொடங்கும் பாடல் (பா.எ. 01)
2. **தடமருப்பு** எனத் தொடங்கும் பாடல் (பா.எ. 120)

3. ஐங்குறுநூறு - 1. **பாலைத்திணை - தலைவி இரங்கு பத்து**
(331 முதல் 340 வரை) - 10 பாடல்கள்

குறியிலக்குகள் (Objectives)

1. **சங்க அகப்பாடல்கள்** பற்றிய அறிமுகத்தைப் பெறுவர்.
2. குறுந்தொகை நூலின் சிறப்பைக் கற்றறிவர்.

3. நற்றிணைப் பாடல்கள் வெளிப்படுத்தும் கருத்துகளை அறிவர்.
4. ஐங்குறுநூற்றின் அமைப்பு, சிறப்பு ஆகியவற்றை அறிவதோடு தலைவி இரங்கு பத்து வெளிப்படுத்தும் அகச்செய்திகளைக் கற்றுணர்வர்.

அலகு 2. கலித்தொகையும் சிறுபாணாற்றுப்படையும் : கலித்தொகை -கலிப்பாக்கள் -குறிஞ்சிக்கலிப் பாக்கள் -சிறப்பு -நெய்தற்கலிப் பாக்கள் -சிறுபாணாற்றுப்படை -நூல் அமைப்பும் சிறப்பும் -இடைக்கழி நாட்டு நல்லூர் நத்தத்தனார் -ஓய்மாநாட்டு நல்லியக் கோடன் -கடையேழு வள்ளல்கள் -பாரி -ஓரி -காரி -அதியமான் -பேகன் -நள்ளி -ஆய் -மூவேந்தர் -நல்லியக்கோடனின் கொடைவளம் -ஓய்மாநாட்டு வளம்.

1. கலித்தொகை - 1. குறிஞ்சிக்கலி- சுடர்த்தொடீஇ எனத் தொடங்கும் பாடல் (பா.எ. 15)
2. நெய்தற்கலி - மாமலர் எனத் தொடங்கும் பாடல் (பா.எ. 16)
3. சிறுபாணாற்றுப்படை (முழுவதும்)

குறியிலக்குகள் (Objectives)

1. **கலிப்பா, கலிப்பாட்டு என்றழைக்கப்படும் கலித்தொகையின்** அறிமுகத்தையும் சிறப்பையும் உணர்வர்.
2. கலித்தொகையின் இலக்கிய வளத்தையும் ஓரங்க நாடகமாக அமையும் திறத்தையும் கற்றறிவர்.
3. குறிஞ்சிக்கலி, நெய்தற்கலிப் பாடல்கள் வெளிப்படுத்தும் கருத்துகளை அறிவர்.
4. பத்துப்பாட்டுள் ஆற்றுப்படை நூல்கள் பற்றிய அறிமுகத்தையும் சிறுபாணற்றுப்படை நூலமைப்பையும் கற்றறிவர் .
5. ஓய்மாநாட்டு நல்லியக் கோடனின் கொடைச் சிறப்பையும் இடைக்கழி நாட்டு நல்லூர் நத்தத்தனாரின் இலக்கிய வளத்தையும் கற்றுணர்வர்.

அலகு 3. அகநானூறும் புறநானூறும் : அகப்பொருள் -அகநானூறு -நெடுந்தொகை - அடிவரையறை - நூற்சிறப்பு - தொகுப்புச் சிறப்பு - நூல் அமைப்பும் சிறப்பும் -புறப்பொருள் -புறநானூறு - புறத்திணைச் செய்திகள் - அறக்கருத்துகளும் வாழ்வியல் கருத்துகளும்.

1. **அகநானூறு -** 1. **அகல்அறை** எனத் தொடங்கும் பாடல் (பா.எ. 105)
   2. **நோகோ** எனத் தொடங்கும் பாடல் (பா.எ. 153)

2. **புறநானூறு -** 1. **வள்ளியோர்** எனத் தொடங்கும் பாடல் (பா.எ.47)
   2. **நின்னயந்து** எனத் தொடங்கும் பாடல் (பா.எ.163)
   3. **உண்டாலம்ம** எனத் தொடங்கும் பாடல் (பா.எ. 182)
   4. **ஈயென** எனத் தொடங்கும் பாடல் (பா.எ. 204)
   5. **நினைக்குங்காலை** எனத் தொடங்கும் பாடல்(பா.எ. 217)

குறியிலக்குகள் (Objectives)

1. **புறம், புறப்பாட்டு என்றழைக்கப்படும் புறநானூற்றின்** இலக்கியச் சிறப்பை உணர்வர்.
2. புறத்திணை புலப்படுத்தும் சிந்தனைகளைக் கற்றறிவர்.

3. புறநானூறு வெளிப்படுத்தும் அறக்கருத்துகளையும் வாழ்வியல் விழுமியங் களையும் அறிவர்.
4. அகத்திணை பற்றிய கருத்துகளைக் கற்றறிவர் .
5. நெடுந்தொகை என்றழைக்கப்படும் அகநானூற்றின் திணை அமைப்பையும் நூலமைப்பையும் தெளிவர்.

அலகு 4. அற இலக்கியங்கள் : தமிழில் அற இலக்கியங்களின் தோற்றம் - பதினெண் கீழ்க்கணக்கு நூல்கள் - திருக்குறள் - நூற்சிறப்பு -அறக்கருத்துகள் - நாலடியார் -நூல் அமைப்பும் சிறப்பும் -சமண அறம் -பழமொழி நானூறு -பழமொழிகளின் சிறப்பு - அறக்கருத்துகளில் வாழ்வியல் சிந்தனைகள்.

1. திருக்குறள் - 1. **புறங்கூறாமை** (அதிகாரம் 19)
2. **மானம்** (அதிகாரம் 97)
3. **நெஞ்சொடு கிளத்தல்** (அதிகாரம் 125)

2. நாலடியார் - 1. **அரும்பெறல்** எனத் தொடங்கும் பாடல் (பா.எ. 34)
2. **கல்லாதுபோகிய** எனத் தொடங்கும் பாடல் (பா.எ. 169)
3. **கோட்டுப்பூப்போல** எனத் தொடங்கும் பாடல் (பா.எ.215)
4. **நன்னிலைக்கண்** எனத் தொடங்கும் பாடல் (பா.எ. 248)
5. **ஒருநன்றி** எனத் தொடங்கும் பாடல் (பா.எ.357)

3**. பழமொழி நானூறு -**1. **புலமிக்கவரை** எனத் தொடங்கும் பாடல் (பா.எ.07)
2. **முல்லைக்கு** எனத் தொடங்கும் பாடல் (பா.எ.74)
3. **பூத்தாலூம்** எனத் தொடங்கும் பாடல் (பா.எ.93)
4. **செயல்வேண்டா** எனத் தொடங்கும் பாடல் (பா.எ.263)
5. **நாடிநமரென்று** எனத் தொடங்கும் பாடல் (பா.எ.346)

குறியிலக்குகள் (Objectives)

1. **பதினெண் கீழ்க்கணக்கு நூல்களுள் அறநூல்களைப் பற்றிய அறிமுகத்தைப் பெறு**வர்.
2. திருக்குறளின் மேன்மையையும் நூல் அமைப்பையும் கற்றறிவர்.
3. நாலடியாரின் நூற்சிறப்பை அறிவதோடு நாலடியார் விளக்கும் சமண அறக் கருத்துகளைக் கற்பர்.
4. பழமொழிகளின் சிறப்பையும் பழமொழி நானூறு வெளிப்படுத்தும் வாழ்வியல் சிந்தனைகளையும் கற்றறிவர்.

அலகு 5. இலக்கிய வரலாறும் பொதுக் கட்டுரைகளும் : சங்க இலக்கியம் - பாட்டும்

தொகையும் - பத்துப்பாட்டு நூல்கள் - எட்டுத்தொகை நூல்கள் - அகப்புற நூல் பாகுபாடு - ஆற்றுப்படை இலக்கியங்கள் - பதினெண்கீழ்க்கணக்கு - அறநூல்கள் அகநூல்கள் - புறநூல்கள் - பொதுக் கட்டுரைகள் - மனிதநேயம் - வாழ்வியல் அறங்கள் - மொழி உணர்ச்சி - அறிவியல் வளர்ச்சி.

1. **இலக்கிய வரலாறு -** (1) சங்க இலக்கியம் (பாட்டும் தொகையும்)

(2) பதினெண் கீழ்க்கணக்கு

2. **பொதுக்கட்டுரை தலைப்புகள் :** (1) மனிதநேயம்
(2) வாழ்வியல் அறங்கள்
(3) மொழிஉணர்ச்சி
(4) அறிவியல் வளர்ச்சி

குறியிலக்குகள் (objectives)

1. சங்க இலக்கியங்கள் வெளிப்படுத்தும் பழந்தமிழர்களின் வரலாறு, வீரம், காதல், கொடை முதலிய வாழ்வியல் விழுமியங்களைக் கற்பர்.
2. அகத்திணை, புறத்திணை வழி சங்க இலக்கியங்கள் பகுக்கப்பட்டுள்ள முறையைக் கற்றுணர்வர்.
3. பதினெண்கீழ்க்கணக்கு நூல்களைப் பற்றிய அறிமுகத்தைப் பெறுவர்.
4. பதினெண்கீழ்க்கணக்கு நூல்கள் அறநூல்கள், அகநூல்கள், புறநூல்கள் எனப் பகுக்கப்பட்டுள்ளமையைத் தெரிந்து கொள்வர்.
5. மனிதநேயம், வாழ்வியல் அறங்கள், மொழி உணர்ச்சி, அறிவியல் வளர்ச்சி ஆகிய கட்டுரைகளைக் கற்றறிவர்.

பயிற்று முறை :

- சங்க இலக்கிய நூல்களின் அமைப்பையும் அகப்புற நூல்களின் சிறப்பையும் கற்பித்தல்.
- சங்க அக இலக்கியங்கள் வெளிப்படுத்தும் பண்டைத் தமிழரின் காதல் உணர்வை வெளிப்படுத்துதல்.
- சங்கப் புறநூல்கள் காட்டும் பண்டைத்தமிழரின் வாழ்வியல் சிந்தனைகளைப் பயிற்றுவித்தல்.
- பதினெண் கீழ்க்கணக்கு நூல்களை அறிமுகப்படுத்தி அவற்றின் சிறப்புகளை எடுத்துரைத்தல்.
- அறச்சிறப்பு மனிதநேய மாண்பு, மொழி உணர்வு ஆகியவற்றை உருவாக்குதல்.

பாடநூல்

1. சோமசுந்தரனார் பொ.வே. (உரை), 1966. **ஐங்குறுநூறு,** சென்னை : சைவ சித்தாந்த நூற்பதிப்புக் கழகம்.
2. சாமிநாதையர் உ.வே. 2000. **குறுந்தொகை மூலமும் உரையும்,** சென்னை : உ.வே.சா. நூல் நிலையம்.
3. பின்னத்தூர் நாராணசாமி ஐயர் அ. 1976. **நற்றிணை,** சென்னை: திருநெல்வேலி, தென்னிந்திய சைவசிந்தாந்த நூற்பதிப்புக் கழகம்.
4. வேங்கடசாமி நாட்டார் ந.மு. (உ.ஆ). **அகநானூறு,** சென்னை: திருநெல்வேலி, தென்னிந்திய சைவசிந்தாந்த நூற்பதிப்புக் கழகம்.
5. நச்சினார்கினியர் 1943. **கலித்தொகை,** திருநெல்வேலி : திருநெல்வேலித் தென்னிந்திய சைவசிந்தாந்த நூற்பதிப்புக் கழகம்.

6. பதிப்பாசிரியக் குழு. 1957. **பத்துப்பாட்டு,** சென்னை : எஸ். ராஜம்.
7. பரிமேலழகர் (உ. ஆ.), **திருக்குறள் மூலமும் உரையும்.**
8. **பதிப்பு ஆசிரியர் குழு**. 1981. **பதினெண் கீழ்க்கணக்கு, சென்னை : நியூ செஞ்சுரி புக் ஹவுஸ்.**
9. ஆனந்தன் சு. 2015. **தமிழ் இலக்கிய வரலாறு,** திருச்சிராப்பள்ளி : கண்மணி பதிப்பகம்.

பார்வை நூல்கள்

1. வையாப்புரிப்பிள்ளை எஸ். 1967. **சங்க இலக்கியம் (பாட்டும் தொகையும் 1),** சென்னை : பாரி நிலையம்.
2. வையாப்புரிப்பிள்ளை எஸ். 1967. **சங்க இலக்கியம் (பாட்டும் தொகையும் 1),** சென்னை : பாரி நிலையம்.
3. செயராமன் நா. **சங்க இலக்கியத்தில் பாடாண் திணை.**
4. வேலுப்பிள்ளை ஆ. **தமிழிலக்கியத்தில் காலமும் கருத்தும்.**
5. கைலாசபதி க. **பண்டைத் தமிழர் வாழ்வும் வழிபாடும்.**
6. இராமையா நா. **சங்ககால நாட்டுத் தொண்டு.**
7. வித்தியானந்தன் சு. 1954. **தமிழர் சால்பு,** கண்டி : தமிழ் மன்றம்.
8. சுப்பிரமணியன் கா. **சங்ககால சமுதாயம்.**
9. மாணிக்கம் வ.சுப. **தமிழ்க் காதல்.**
10. அகத்தியலிங்கம் ச. 2012. **சங்க இலக்கியங்கள் செவ்வியல் இலக்கியங்களே,** சென்னை : மணிவாசகர் பதிப்பகம்.
11. முத்துக் கண்ணப்பர். **சங்க இலக்கியத்தில் நெய்தல் நிலம்.**
12. சிங்கார வடிவேலன். **சங்க இலக்கியத்தில் உவமைகள்.**
13. கந்தசாமி சோ. ந. **குறுந்தொகைத் திறனாய்வு.**
14. குருசாமி ம. ரா. போ. **சங்க காலம்.**
15. தமிழண்ணல். **குறிஞ்சிப்பாட்டு இலக்கியத் திறனாய்வு விளக்கம்.**
16. குழந்தை. **சங்க இலக்கியச் செல்வம்.**
17. சாரங்கபாணி. **பரிபாடல் திறன்.**
18. மு.வ. **நற்றிணைச் செல்வம்.**
19. 2004. **பரிபாடல் மூலமும் உரையும்,** சென்னை : நியூ செஞ்சுரி புக் ஹவுஸ்.
20. **சேதுராமன் சி.** 2012. **தமிழ் இலக்கிய வரலாறு, சென்னை : பாவை பப்ளிகேஷன்ஸ்.**
21. **பாலசுப்பிரமணியன் சி.** 2012. **தமிழ் இலக்கிய வரலாறு, சென்னை : பாவை பப்ளிகேஷன்ஸ்.**
22. **அருணாசலம் மு.** 2005. **தமிழ் இலக்கிய வரலாறு** (14 தொகுதிகள்), **சென்னை : பார்க்கர் பதிப்பகம்.**

இணையதள முகவரிகள்

1. www. tamilvu.org
2. www. sirukathaikal.com
3. www. noolulagam.com
4. www. katuraitamilblogspot.com

ENGLISH LANGUAGE COURSE – IV

COURSE CODE: ELC04 CREDITS:3

Title of the Paper: (IV) English for Proficiency Development II – (ELC04)

Objectives

- To help learners to strengthen their communication skills
- To make learners improve their writing skills for their career development
- To equip learners with grammar towards advance level communication

Module 1

Communication – Types of Communication- Importance of Communication-Verbal and Non-Verbal Communication – Barriers of Communication – Group Communication – Presentation Skills-Interview Skills-Group Discussion

Practicum: Conducting mock-interview, mock-GD and mock presentations.

Module 2

Writing Reports, Resume, Proposals, e-mails

Practicum: Writing different types and forms of Reports, Resume, Proposals, e-mails

Module 3

Nouns and Compounds, Articles, Determiners and Quantifiers, Relative Clauses and other types of clause, Pronoun, Substitution and Leaving out words, Adjectives, Adverbs and Conjunction, Prepositions, Organizing Information

Practicum: Identifying and analyzing the grammar of grammatical words.

Module 4

Tenses, Modals – Be, have, do, make- Passives, Questions, Verb, Infinitives,-ing forms, Reporting

Practicum: Constructing new sentences using various grammatical groups of words.

Module 5: Current Contours (For Continuous Internal Assessment only)

Present job requirements-global job market needs-life skills and professional communication – recent demands in various professional jobs.

Textbooks:

Hewings, Martin. *Advanced English Grammar: A Self Study Reference and Practice Book for Advanced South Asian Students with Answers*. New Delhi: Cambridge UP, 1999. Print. (Module III & IV)

Raman, Meenakshi and Sangeeta Sharma. *Technical Communication: Principles and Practice*. Oxford UP. New Delhi, 2011.Print. (Module I & II)

Course Outcome:

After completion of the course the students will be able to realise the following outcomes:

- Acquire the four language skills LSRW

- Use learned skills efficiently in everyday communication
- Apply effectively the nuances of speaking skills in dialogues, discussions and public speeches
- Recognize the nuances of reading skills to promote better comprehension
- Incorporate the writing skills in all forms of written communication
- Enhance the language skills for effective and efficient day-to-day communication

MOLECULAR BIOLOGY

COURSE CODE: 22BI4CC07 CREDITS:4

COURSE OBJECTIVES

- To understand the molecular basis of the cell structure function
- To learn about familiarise the recent development and techniques in the field of molecular biology

UNIT-I NUCLEIC ACIDS – AN INTRODUCTION

Evolution of genetic material – Identification of genetic material – Chemistry of nucleic acids – Structure – types of DNA and RNA, Organization –prokaryotic and eukaryotic DNA, Mitochondrial and Chloroplast DNA Griffith, Avery and Hershey and Chase experiments..

UNIT-II DNA REPLICATION AND REPAIR

DNA replication: Meselson –Stahl experiment, Molecular mechanisms of DNA Replication – bidirectional and rolling circle replication – Differences in prokaryotic and eukaryotic replication, Enzymes of DNA replication, DNA repair – mechanism of excision repair, SOS repair and mismatch repair.

UNIT-III TRANSCRIPTION

Transcription process – Prokaryotic and Eukaryotic, Regulatory signal elements – features of promoters and enhancers, transcription factors, ribozymes – Post transcriptional modification of RNAs

UNIT-IV TRANSLATION

Genetic Code – Wobble hypothesis – Translation – ribosomes and tRNAs, Mechanism and regulation of protein synthesis – Post Translational modification of proteins.

UNIT-V GENE REGULATION

Concept of gene: Genetic fine structure – cistron, muton and recon – exons and introns, Gene Regulation in Prokaryotes: Types of gene regulation, Operon concept – Lac and Trp operons – Gene regulation in eukaryotes – Downstream regulation.

UNIT -VI Current Contours: (For Continuous Internal Assessment only)

PCR primer design and optimization will be covered in theory and practice. Quantitative (real-time) PCR is covered in detail, and lab activities using different primer systems are performed. Systems for gene knockdown and knockout are examined, including lab exercises using RNA interference (RNAi).

MATERIALS FOR STUDY AND REFERENCE

1. Freifelder. D., Essentials of Molecular Biology, 3rd Edition, Jones and Bartlett Publications Inc., London, 1998.

2. Lewin Benjamin, Gene VIII, Pearson Education, New Jersey, 2004.
3. Watson. J.D., Molecular Biology of the Gene, 5th Edition, Pearson Education, New Jersey, 2004.

WEB RESOURCE LINKS

- http://www.cellbiol.com/education.php
- http://www.cellbiol.com/sequence_tools.php/#basic-tools
- http://www.cellbiol.com/sequence_tools.php/#basic-tools

COURSE OUTCOMES

After completion of this course student would be able to

- Describe about the various experiments which lead to the identification of DNA as genetic material.
- Explain about the various DNA repair mechanisms.
- Know the details on the prokaryotic transcription process.
- Understand the mechanism of translational process.
- Explain in detail about the *trp* operon and its regulation by attenuation.
- Grasp the regulation of the *lac* operon.
- Describe the mechanism and regulation of protein synthesis.
- Explain the structure and regulation of gene in prokaryotes/eukaryotes.

PRACTICAL IV : MOLECULAR BIOLOGY LAB

COURSE CODE: 22BI4LC04 CREDITS:2

COURSE OBJECTIVES

- To understand the molecular basis of the cell structure function and to familiarize the recent development and techniques in the field of molecular biology.

1. Isolation of genomic DNA from bacteria
2. Quantitative analysis of DNA
3. Qualitative analysis of DNA – Agarose Gel Electrophoresis
4. Isolation of genomic DNA from plant
5. Isolation of genomic DNA from animal tissue
6. Isolation of plasmid DNA from bacteria
7. Isolation and qualitative analysis of RNA from bacteria
8. Separation and qualitative analysis of protein – SDS PAGE
9. Effect of UV – radiation on bacterial growth

COURSE OUTCOMES:

After completion of this course student would be able to

- Isolate of genomic DNA from bacteria.
- Learn the principles and methods of isolation and qualitative analysis of bacterial RNA.
- Get ability to separate and qualitative analyze the protein by SDS PAGE.
- Understand the effects of UV – radiation on bacterial growth.
- Analyze the DNA using agarose gel electrophoresis.
- Grasp the aspects to amplify a target gene by PCR.
- Understand the quantitative analysis of RNA by Orcinol method.
- Master the spectrophotometric analysis of nucleic acids.

ANALYTICAL BIOCHEMISTRY

COURSE CODE: 22BI4AIICC04 CREDITS:3

COURSE OBJECTIVES

- The intends of the course is to enlighten the students in the area of analytical biochemistry
- To develop the skills of the application of techniques employed in quantitative as well as qualitative analysis of biomolecules.

UNIT-I: HOMOGENIZATION AND CENTRIFUGATION TECHNIQUES

Cell homogenization and centrifugation Methods of tissue homogenization: (Potter-Elvejham, mechanical blender, sonicator and enzymatic). Centrifugation techniques, principles and applications- differential, density gradient. Ultra-centrifugation- preparative and analytical.

UNIT-II: CHROMATOGRAPHIC TECHNIQUES

Types of chromatographic techniques, Principle and applications - Paper chromatographysolvents, Rf value, applications; Thin layer chromatography- principle, choice of adsorbent and solvent, Rf value, applications; Gel filtration, Ion- exchange- principle, resins, action of resins, experimental techniques, applications, separation of metal ions; Affinity chromatography.

UNIT-III: SPECTROSCOPY

Spectroscopy and tracer techniques Electromagnetic radiation, Beer-Lambert's law. Colorimetric and Spectrophotometer, spectrofluorimetry, flame photometry. Tracer techniques: Radio isotopes, units of radio activity, half life, β and γ- emitters, use of radioactive isotopes in biology, ELISA, RIA.

UNIT-IV: ELECTROPHORESIS

Electrophoresis- principles and applications of paper, polyacrylamide (native and SDS) and agarose gel electrophoresis, isoelectric focusing, immune-electrophoresis-types and applications.

UNIT-V: MICROBIAL TECHNIQUES

Microscopy: Basic principles of light microscopy, phase contrast, electron microscope and fluorescent microscope and their applications. Preparation of different growth media, isolation and culturing and preservation of microbes, Gram's staining- Gram positive and Gram negative bacteria, motility and sporulation, Sterilization techniques-Physical methods, chemical methods, radiation methods, ultrasonic and. Antibiotic resistance.

COURSE OUTCOMES

- Students will be able to explain the isolation, purification, quantification techniques of biomolecules.
- Perform procedure to characterize the biomolecules.
- Perform the characterization of cells and cellular components using microscopy and flow cytometry.

ALLIED PRACTICAL – I: ANALYTICAL BIOCHEMISTRY LAB

COURSE CODE: 22BI4AIILC01 CREDITS:2

COURSE OBJECTIVES

- Students should know the principles and calculations of each experiment.
- To prepare and standardize all the solutions by themselves.

Practical Biochemical Techniques List of Experiments:

1. Isolation of RNA and DNA from tissue/culture.
2. Qualitative Identification of DNA, RNA and Nitrogen Bases
3. Agarose gel electrophoresis.
4. Separation of dye using Paper chromatography
5. Separation of secondary metabolite from phyto medicine by thin layer chromatography
6. Isolation of casein from milk.
7. Separation of amino acids by paper chromatography.
8. Protein separation using HPLC (demo)
9. Protein separation using SDS-PAGE
10. Estimation of Protein by spectroscopic method.
11. Separation of serum proteins by paper electrophoresis.

Recommended books:

1. Principles and Techniques of practical Biochemistry. Eds. Williams and Wilson.
2. Techniques in Molecular biology Ed. Walker & Gastra, Croom Helm, 1983.
3. Principles of instrumental analysis, 2nd Ed, Holt-Sanders, 1980.
4. An introduction to spectroscopy for Biochemistry. Ed. Brown S.N., Academic press
5. Analytical Biochemistry, Holmes and Hazel peck, Longman, 1983.
6. An introduction to practical biochemistry. David T. Plummer, Tata Mac Grew-Hill.
7. Biophysical chemistry, Edshall & Wyman, Academic press Vol. II & I.
8. A textbook of quantitative inorganic analysis including elementary instrumental analysis, Vogel ELBS.
9. Biochemical calculations Seigel, IH, 2nd Edit, John Wiley & sons Inc., 1983.
10. Analytical Biochemistry by Friefelder David, Freeman, 1976.

COURSE OUTCOMES

- The students will explain the principle and working of basic instruments in analytical laboratory
- The students will perform in handling various instruments in Analysis.

BASICS OF BIOINFORMATICS

COURSE CODE: 22BI4NMEC02 CREDITS:2

COURSE OBJECTIVES

- To learn about the bioinformatics databases, databanks, data format and data retrieval from the online sources.
- To make students understand the essential features of the interdisciplinary field of science for better understanding biological data.
- To provide the student with a strong foundation for performing further research in bioinformatics.

UNIT I INTRODUCTION

Bioinformatics – An overview, Definition & History; Information Networks – Internet in Bioinformatics – Bioinformatics databases & tools on the Internet.

UNIT II BIOLOGICAL SEQUENCE ANALYSIS

Biological Sequence analysis – Pairwise sequence comparison – Sequence queries against biological databases – BLAST and FASTA - Multiple sequence alignments - Phylogenetic alignment.

UNIT III GENOME SEQUENCES

Genomics and Proteomics – Sequencing genomes– Genome databases on the web.

UNIT IV PROTEIN INFORMATION RESOURCES

Proteins – Amino acids – Peptide bond — Levels of protein structure - □-helix, β-sheet and β-turns – Ramachandran Map - Super secondary structures – Domains - quaternary structure - DNA and RNA structure - Watson and Crick model - A, B and Z forms of DNA - RNA secondary structure.

UNIT V PROTEIN STRCTURE AND VISUALIZATION TOOLS

Protein structure visualization tools –Swiss PDB Viewer, RasMol, PyMOL, Chimera - Structure – Classification, alignment and analysis – SCOP, CATH, FSSP.

MATERIALS FOR STUDY AND REFERENCE

1. T.K. Attwood and D.J. Parry-Smith, *Introduction to Bioinformatics,* Pearson Education Ltd., New Delhi (2004).
2. D.R. Westhead, J.H. Paris and R.M. Twyman, *Instant Notes: Bioinformatics* – Viva Books Private Ltd, New Delhi (2003).
3. Arthur M. Lesk, *Introduction to Bioinformatics,* Oxford University Press, New Delhi (2003).
4. D. Higgins and W. Taylor (Eds), *Bioinformatics- Sequence, structure and databank*s, Oxford University Press, New Delhi (2000).

WEB RESOURCE LINKS

- www.Bioinformatics.org
- www.bioinfo.mbb.yale.edu/mbb452a/intro/
- www.biology.ucsd.edu/others/dsmith/Bioinformatics.html
- https://pymol.org/2/
- https://www.cgl.ucsf.edu/chimera/

COURSE OUTCOMES

After completion of this course student would be able to

- Understand the features of DNA sequence analysis
- Analyze the pair wise sequence alignment methods.
- Use and explain the application of bioinformatics.
- Follow the details on Watson and Crick model.
- Decipher the importance of bioinformatics.
- Master the aspects of protein-protein interaction, BLAST and PSI-BLAST.
- Describe the features of the databases of local and multiple alignments.
- Interpret the characteristics of phylogenetic methods and bioinformatics applications.

THIRD YEAR

SEMESTER - V

Part	Course Code	Name of the Course	Credits	Teach-ing Hours	Maximum Marks		
					CIA	ESE	Total
	SEMESTER – V						
III	22BI5CC08	Computational Biology	4	4	25	75	100
	22BI5CC09	Bioinformatics Programming in PERL	4	4	25	75	100
	22BI5CC10	Structural Bioinformatics	4	4	25	75	100
	22BI5CC11	Biostatistics using R	5	5	25	75	100
	22BI5LC05	Practical V: Computational Biology and PERL Lab	3	4	40	60	100
	22BI5SEC01	Skill Based Elective Course 1. Protein Engineering 2. Pharmacology	5	5	25	75	100
IV	22BI5SK01	Soft Skills	2	2	100	--	100
V	22BI5GS01	Gender Studies	2	2	100	--	100
		Seminar, Library, Leveraging E-Resources	--	--	--	--	--
		Total	29 (113)	30	365	435	800 (3700)

COMPUTATIONAL BIOLOGY

COURSE CODE: 22BI5CC08 CREDITS: 4

COURSE OBJECTIVES

- To provide an elementary knowledge of bioinformatics and biological information on the web.
- To understand the scope of bioinformatics, types of data bases and their use pairwise and sequence alignment, predictive methods

UNIT I SEQUENCE ALIGNMENT ALGORITHMS

Definition of Sequence alignment – Local and Global alignment concepts – Methods for sequence alignment: Dot matrix – Scoring matrices: PAM and BLOSUM matrices, Dynamic programming –Needleman and Wunsch algorithm, Smith-Waterman algorithm–FASTA and BLAST programs – Statistics of alignment score – P value and E value.

UNIT II MULTIPLE SEQUENCE ALIGNMENT

Multiple sequence alignment (MSA) – Methods of Multiple Sequence Alignment: Progressive alignment – Clustal W, T-Coffee, Iterative Method – DIALIGN – Blocks, patterns and Profiles.

UNIT III PHYLOGENETIC ANALYSIS

Phylogenetic tree: Rooted and Unrooted – Methods for phylogenetic tree construction: Character (NJ) and Distance based methods (MP and ML) – Tree evaluation (Bootstrap)– lineage sorting, orthology, paralogy, xenology; "basal" lineages– crown vs. stem groups– Phylogram vs. cladogram.

UNIT IV PROTEIN SECONDARY STRUCTURE PREDICTION

Protein Secondary structure prediction – Chou-Fasman , GOR methods (SOPMA) and Neural network concepts – Nearest Neighbour method –Transmembrane structure prediction. Online Analysis tools – PSIPRED and J-Pred

UNIT V GENE PREDICTION

Gene finding methods: content and signal methods – Analysis and prediction of regulatory regions – Probabilistic models: Markov chain – random walk – Hidden Markov models – Gene identification and other applications.

MATERIALS FOR STUDY AND REFERENCE

1. Arthur M. Lesk, Introduction to Bioinformatics, Oxford University Press, New Delhi 2003.
2. David W. Mount, Bioinformatics – Sequence and Genome analysis, Cold Spring Harbor Laboratory Press, New York, 2001.
3. A. Baxevanis and B.F. Ouellette. Bioinformatics: A practical Guide to the Analysis of Genes and Proteins, Wiley- Interscience, Hoboken, NJ (1998).
4. P.E. Bourne and H. Weissig (Eds.) Structural Bioinformatics, John-Wiley and Sons, 2003.
5. J.Pevsner, Bioinformatics and Functional Genomics, John-Wiley and Sons, 2009.
6. Salemi, M., Lemey, P., &Vandamme, A. M. (Eds.). (2009). The phylogenetic handbook: a practical approach to phylogenetic analysis and hypothesis testing. Cambridge University Press
7. Rastogi, S. C., Mendiratta, N., &Rastogi, P. (2013). Bioinformatics: Methods And Applications: (Genomics, Proteomics and Drug Discovery). PHI Learning Pvt. Ltd.

ADDITIONAL REFERENCES:

1. Computational Molecular Evolution, conducted by Technical University of Denmark. https://www.coursera.org/course/molevol
2. Experimental Genome Science, conducted by University of Pennsylvania. https://www.cour sera.org/course/genomescience
3. Bioinformatic methods I, conducted by University of Toronto. https:// www.Coursera.org/ course/bioinfomethods1
4. Bioinformatics algorithms (Part 1), conducted by University of California San Diego. https://www.coursera.org/course/bioinformatics
5. Bioinformatics: introduction and methods conducted by Peking University. https://www. coursera.org/course/pkubioinfo
6. http://www.ncbi.nlm.nih.gov/education/tutorials/
7. http://www.ncbi.nlm.nih.gov/books/NBK143764/

COURSE OUTCOMES

- Students would be able to analyze DNA, RNA, and protein sequences using computer.
- To solve the biological problem using computational biology.
- To lean evolutionary analysis of biological sequences using computer.

BIOINFORMATICS PROGRAMMING IN PERL

COURSE CODE: 22BI5CC09 CREDITS: 4

COURSE OBJECTIVES

- To have a thorough understanding of Working Environment - Navigating in UNIX
- Understand and Learn the basics of perl concepts

UNIT- I UNIX - COMMANDS AND EDITORS

UNIX - Working Environment – kernel, shell, file system - Navigating in UNIX - emacs editor - Vi editor. UNIX commands – ls-cat-more-uniq-sort-grep and directory commands. UNIX-LINUX differences

UNIT- II INTRODUCTION TO PERL

Introduction to Perl - scalars, Arrays and Hashes - Perl Interpreter – Operators - Using standard Perl modules – CPAN – Array-Based Character Manipulation - simple programs.

UNIT -III CONTROL STRUCTURES ANDPERL SUBROUTINES

Perl debugger - Perl control structures-if, elsif, else, unless, while, do-while, until, do-until, for and foreach - Perl subroutines and Functions - simple programs.

UNIT -IV PERL REGULAR EXPRESSIONS AND PATTERNS

Perl regular expressions – match, substitute and translate – Metacharacters - Patterns – Atoms, Special Atoms, Quantifiers, Assertions and Alternatives - Perl one liners using command-line options and its application.

UNIT -V FILE HANDLING AND BIOPERL

FILE Handling - Input/Output operator - open() and close() commands – Introduction to BioPERL Modules – BioSeq, BioSeqIO, BioPrimarySeq, BioSearch, BioDB - simple bioinformatics application programs.

UNIT -VI Current Contours: (For Continuous Internal Assessment only)

Exception handling, the debugger, and the Perl symbol table. It overlaps Intermediate Topics in Perl and Object-Oriented Programming.

MATERIALS FOR STUDY AND REFERENCE

1. Sumitabha Das, UNIX Concepts and Applications, 4th Edition, Tata McGraw-Hill, New Delhi, 2006.
2. Chan Bernard Ki Hong, Perl 5 Tutorial, First Edition, 2003.
3. James Tisdall, Beginning Perl for Bioinformatics, O'Reilly, 2001.
4. D. Curtis Jamison, Perl Programming for Biologists, John Wiley & Sons, INC., 2003.
5. Michael Moorhouse, Paul Barry, Bioinformatics Biocomputing and Perl, Wiley, 2004.
6. http://bioperl.org
7. Matrin C Brown, The Complete Reference PERL, 2nd Edn, Tata McGraw Hill, New Delhi, 2001.

WEB RESOURCE LINKS

- https://www.tutorialspoint.com/perl/index.htm
- lwp.interglacial.com/ch12_03.htm
- www.perlmonks.org/?node_id=585436
- https://www.tutorialspoint.com/index.htm

COURSE OUTCOMES

After completion of this course student would be able to

- Understand the basics of Unix/Linux Operating Systems with file systems and navigation commands.
- Describe the basic text editors and terminal in Unix/Linux.
- Explain the Perl features, applications and Perl interpreter with debugger.
- Analyze the data types and Operators in Perl.
- Describe the control statements and Perl subroutines using simple programs.
- Unravel the basics of regular expression concept and pattern matching.
- Learn the file handling in Perl with application to bioinformatics.
- Grasp the details about Perl subroutines.

STRUCTURAL BIOINFORMATICS

COURSE CODE: 22BI5CC10 CREDITS : 4

COURSE OBJECTIVES

- To study introduction of structural bioinformatics, conformational analysis of proteins and nucleic acids
- To understand the protein structure prediction, and molecular interactions.

UNIT-I INTRODUCTION

Overview of structural bioinformatics – understanding structural basis for biological phenomena – challenges in structural bioinformatics – integration of structural data with other data. Role of structural bioinformatics in drug discovery

UNIT -II CONFORMATIONAL ANALYSIS OF PROTEINS

Overview of protein structure - Conformational Analysis of proteins– Forces that determine protein structure – polypeptide chain geometries – Ramachandran Map – potential energy calculations.

UNIT- III CONFORMATIONAL ANALYSIS OF NUCLEIC ACIDS

Overview of nucleic acid structure - Conformational analysis of nucleic acids and carbohydrates – general characteristics of nucleic acid structure – geometries, glycosidic bond – rotational isomers and ribose puckering - forces stabilizing ordered forms – base pairing – base stacking.

UNIT -IV PROTEIN STRUCTURE PREDICTION

Structure Prediction Methods – Homology Modeling – Fold Recognition Methods – *ab initio* methods –Rosetta – Homology Modeling vs *ab initio* - CASP.

UNIT- V MOLECULAR INTERACTIONS

Interactomes – Macromolecular interactions – Protein-DNA interactions – Protein-Ligand interactions (Only introduction) – Interactions database – ProNIT - Docking – principles and methods.

UNIT -VI Current Contours: (For Continuous Internal Assessment only)

Genome sequencing – Proteomics – Phylogeny – Gene expression – Protein-protein interaction network

MATERIALS FOR STUDY AND REFERENCE

1. C.R.Cantor&P.R.Schimmel, Biophysical Chemistry Part - I, W.H. Freeman & Co., in San Fransisco, 1980.
2. C. Branden and J. Tooze, Introduction to Protein Structure, 2nd Edition, Garland Publishing Inc., New York, 1999.
3. P.E. Bourne and H. Weissig (Eds.) Structural Bioinformatics, John-Wiley and Sons,2003.
4. David W. Mount, Bioinformatics – Sequence and Genome analysis, Cold Spring Harbor Laboratory Press, New York, 2001.
5. J.Pevsner, Bioinformatics and Functional Genomics, John-Wiley and Sons, 2009.

WEB RESOURCE LINKS

- https://academic.oup.com/bioinformatics/article/31/1/146/2366253
- https://en.wikipedia.org/wiki/Structural_bioinformatics
- https://www.nature.com/articles/s41586-019-1923-7?BZB_TOKEN=11cf2d2ae5b81f5f4ccd09a5cd23fc4c

COURSE OUTCOMES

After completion of this course student would be able to

- Understand the basic concepts on macromolecular structures and their interactions with special emphasis on computational biology.
- Grasp the structural basis for biological phenomena.
- Know the conformational analysis of proteins using computational methods.
- Conceive the forces that determine the conformational analysis of nucleic acids and carbohydrates.
- Decipher the methods involved for protein structure prediction.
- Recognize the principles and methods of macromolecular interactions.
- Understand the forces to determine the protein structure.
- Interpret the details about ribose puckering.

BIOSTATISTICS USING R

COURSE CODE: 22BI5CC11 CREDITS : 5

COURSE OBJECTIVES

- To provide the basic concept of Biostatistics and interpret results of descriptive statistical methods effectively; communicate the results of statistical analyses accurately and effectively.
- To explore and understand how to use the R documentation.

UNIT-I INTRODUCTION TO DESCRIPTIVE STATISTICS

Introduction- Statistical Terms – Data collection, classification and Representation-Measures of Central Tendency – Mean, Median, Mode, Geometric and Harmonic Mean –Measures of Dispersion – Range, Inter-Quartile Range – Stem & Leaf Diagram – Boxplot – Mean Deviation -Variance and Standard deviation, Coefficient of Variation and Standard error – R commands mean(x), median(x), sd(x), length(x), plot(x,y), etc.

UNIT-II INFERENTIAL STATISTICS AND PROBABILITY DISTRIBUTION

Events and Probability – Conditional probability – Baye's Theorem – Probability distribution – Binomial Distribution, Poisson Distribution – Normal distribution and Application problems – R commands binorm(size, prob), norm(mesn,sd), pois(lambda), etc.

UNIT -III CORRELATION AND REGRESSION

Introduction – Correlation –Types – Measures – Scatter plot – Spearman's rank correlation coefficient – Karl Pearson's correlation coefficient – Regression Analysis – Types – Method of Least Square – Regression coefficient – Difference between Regression and Correlation – R commands cor(x,y), Im(), glm(), etc.

UNIT -IV HYPOTHESIS TESTING

Small sample - One and Two sided confidence intervals – types of error – Student's t test – F-test – Chisquare test – paired samples – Independent samples – equal variances – unequal variances – R commands chisq(df,ncp), t(df,ncp), etc.

UNIT -V ANALYSIS OF VARIANCE

ANOVA – Variation – Assumption – Test – One-way analysis of variance – sources of variation – Multiple comparisons procedures - Applications of ANOVA – R commands aov(), summary(), one.way(), two.way(), etc.

UNIT -VI Current Contours: (For Continuous Internal Assessment only)

Single DNA sequence analysis: - Signal modeling- Pattern analysis- Multiple DNA/protein sequence analysis- Detailed study of pair wise alignment algorithms and substitution matrices.

MATERIALS FOR STUDY AND REFERENCE

1. Sheri Sanders, Introduction to R for Biologists Version 2, Self Published, 2020.
2. Edward Curry, Introduction to Bioinformatics with R – A Practical Guide for Biologists, CRC Press, New York, 2020.
3. Avril Coghlan, A Little Book of R For Bioinformatics, Open source book, 2017
4. Andrew Beckerman, Dylan Childs, & Owen Petchey, Getting Started with R An Introduction for Biologists, Second Edition, Oxford University Press 2017.
5. P. Mariyappan, Biostatics: An Introduction, Pearson, Chennai, 2013.

6. Joseph Adler, R in a NUTSHELL, O'Reilly, 2010.
7. Robert Gentleman, R Programming for Bioinformatics, Chapman & Hall/CRC, Taylor & Francis Group, 2009.
8. Sundar Rao, An Introduction to Biostatistics, Prentice- Hall of India, 3rd Edition, 2004.
9. N. Gurumani, An Introduction to Biostatistics, 2nd Revised Edition, MJP Publishers, Chennai, 2000.
10. B.K. Mahajan, Methods in Biostatistics for Medical Students and Research Workers, Jaypee Publishers, 6th Edition, 1997.

WEB RESOURCE LINKS

- http://mste.illinois.edu/hill/dstat/dstat.html
- https://www.probabilitycourse.com/
- http://web.pdx.edu/~newsomj/statlink.htm

COURSE OUTCOMES

After completion of this course student would be able to

- Find the range for the given data and to compute the mean deviation for the ungrouped data.
- Analyze the variance and standard deviation of discrete and continuous frequency distributions.
- Explain the random experiments and to find the sample space and define the event and write its various types of events.
- Distinguish between one and two way analysis of variance tests
- State in students own words about the type I and type II errors for a given problem.
- Grasp the characteristics of the Binomial, Poisson and Normal distribution and to calculate all the terms of ANOVA table.
- Distinguish between coefficient r and rank correlation coefficient R.
- Calculate the value of mean of x and mean y for the given two regressions lines.
- Use the R programming language to explore data from a variety of sources by building inferential models and generating charts, graphs and other data representation

PRACTICAL V: COMPUTATIONAL BIOLOGY AND PERL LAB

COURSE CODE: 22BI5LC05 CREDITS : 3

COURSE OBJECTIVES

- To describe the basic internet concepts and to explain java, HTML and applied tools for internet programming.
- To provide an elementary knowledge of bioinformatics and biological information on the web. scope of bioinformatics, types of data bases and their use pair wise and sequence alignment, predictive methods

UNIX COMMANDS AND PERL PROGRAMMING

1. Unix Command – ls, more and cat
2. Unix files and directory Commands
3. Unix Command – sort, uniq and grep
4. Working with Vi Editor and its Commands
5. a. Write a simple Perl program to get a DNA sequence and print.
   b. Write a Perl program to demonstrate joining two DNA fragments.
6. a. Write a Perl program to demonstrate Array Handling using amino acids.
   b. Write a Perl program to demonstrate printing array in different ways.
   c. Write a Perl program to demonstrate Array creation by splitting the mRNA sequences.
7. Write a Perl program to demonstrate Hash Tables using nucleotide bases.
8. Write a Perl program to demonstrate assignment, logical and conditional operators.
9. a. Write a Perl program to counting the nucleotides of a DNA sequence.
   b. Write a Perl program to find the complementary DNA sequence using subroutines.
10. Write a Perl program to demonstrate regular expressions using DNA base pairs.
11. Write a Perl program to find a motif in DNA sequence.
12. a. Write a Perl program to convert DNA to mRNA in a given nucleotide sequence file.
    b. Write a Perl program to get the 3D coordinates of a given protein PDB structure file.

COMPUTATIONAL BIOLOGY

1. To perform the dot matrix analysis using Dot matcher.
2. Analyze the sequence similarity of given sequence using BLAST tool.
3. To find the conserved /consensus region in the given sequence using MEME/Interpro.
4. To compute the primary feature of protein sequence using PROTPARAM
5. To perform the prediction of gene location for a given sequence using GENSCAN.
6. To perform phylogenetic analysis using MEGA.
7. To predict the Secondary structure by SOPMA
8. To perform the Protein structure prediction by SWISS-MODEL and validation by SAVES servers.
9. To perform the Protein tertiary structure prediction by HOMOLOGY MODELING (MODELLER) and validation by SAVES server and Ramachandran plot.

COURSE OUTCOMES:

After completion of this course student would be able to

- Write the ability of the UNIX navigation commands.
- Explain the basics of Vi editor commands for the manipulation of a text.
- Gain knowledge about to create and interpret a Perl program.
- Put in writing a Perl program to demonstrate the basic data types and operators.
- Write down a Perl program to demonstrate the subroutines and regular expression concept.
- Note down a Perl program related to biological application.
- Compute the various physical and chemical parameters of a protein using PROTPARM.
- Predict the secondary structure of the given protein sequence using SOPMA.
- Forecast the internal and terminal exons and intergenic regions in the DNA sequence. encoding for the protein using GenScan.
- Learn to carry out protein structure modeling and validation.

SKILL BASED ELECTIVE COURSE

PROTEIN ENGINEERING

COURSE CODE: 22BI5SEC01 CREDITS : 5

COURSE OBJECTIVES

- Understand the proteins folding pathways and mechanisms
- Explain the mechanism of bacteriorhodopsin- photosynthetic centers
- Apply the basic synthetic enzymes - Drug designing.
- Observe the protein experiments of protein engineering.
- Appreciate correlation of protein with other bio medical sciences

UNIT I PRIMARY AND SECONDARY STRUCTURE

Primary structure and its determination - secondary structures - super secondary structures- proteins folding pathways and mechanisms

UNIT II RECEPTORS

Membrane proteins and receptors- bacteriorhodopsin- photosynthetic centers - epidermal growth factor. Insulin and PDGF receptors and their interaction with effectors - protein phosphorylation - immunoglobulins- Nucleotide and binding proteins- enzymes serine proteases- ribonuclease-lysozyme

UNIT III ENGINEERING OF MACROMOLECULES

Basic outline - Rational and steps involved in protein engineering - Protein design principles, methods and examples

UNIT IV DATA ANALYSIS METHODS

Protein database analysis methods - to alter primary structure of proteins – Theory - Interactive graphics programme – perturbation

UNIT V APPLICATIONS OF PROTEIN ENGINEERING

Bacterial and Phage Display Technology - Epitope Mapping – Vaccine Development – Synthetic Enzymes - Drug Designing

MATERIALS FOR STUDY AND REFERENCE

1. Moody PCE and Wilkinson AJ , Protein Engineering, IRL press oxford 1990.
2. Branden C, Tooze R, Introduction of Protein structure, Garland 1993.
1. Creighton, TE, Proteins, Freeman WH Second Ed 1993.
2. Jeffrey L. Cleland, Charles S. Craik, Protein Engineering: Principles and Practice, Wiley-Liss, 1996.

COURSE OUTCOMES

- After completion of this course student would be able to
- Analyze the structure of proteins with databases
- Explain the classification and construction of proteins
- Analyze and compare the amino acid sequences and structures of proteins and relate this information to function

SKILL BASED ELECTIVE COURSE

PHARMACOLOGY

COURSE CODE: 22BI5SEC01 CREDITS : 5

COURSE OBJECTIVES

- Understand the pharmacological actions of different categories of drugs
- Explain the mechanism of drug action at organ system/sub cellular/macromolecular levels.
- Apply the basic pharmacological knowledge in the prevention and treatment of various diseases.
- Observe the effect of drugs on animals by simulated experiments
- Appreciate correlation of pharmacology with other bio medical sciences

UNIT-I GENERAL PHARMACOLOGY

Theories and mechanism of drug action, Pharmacokinetic principles and parameters, Factors modifying drug action- Pharmacogenetics- Chronopharmacology- Adverse effects of drugs-Drug dependence-Toxicology-Dose response relationships- Structure-activity relationships-Physiological and biochemical basis of drug action-Etiopathogenesis of diseases relevant to therapeutic use of drugs.

UNIT-II SYSTEMIC PHARMACOLOGY, CHEMOTHERAPY AND THERAPEUTICS

Pharmacology of drugs acting on autonomic, peripheral and central nervous systems; cardiovascular, endocrine, respiratory, renal, gastrointestinal and haemopoietic systems, treatment of diseases affecting these systems-Pharmacology of anti-microbial and anti-parasitic drugs and treatment of infective diseases- Cancer chemotherapy, immunopharmacology-Gene therapy and evidence based medicine.

UNIT-III BIOCHEMICAL PHARMACOLOGY

Preparing standard operative practice for Bioavailability and bioequivalence studies-Introduction to simple analytical methods-Basic principles and applications-Quantitative estimation using Colorimetry and Spectrophotometry, flame photometry, HPLC and ELISA-Toxicological Studies using chemical and biological tests-Identifying toxic drugs using chemical and biological tests (alkaloids, glycosides, steroids, barbiturates, salicylates).

UNIT-IV EXPERIMENTAL PHARMACOLOGY

Experimental methodologies involved in the discovery of drugs (in vivo, in vitro, ex vivo) - Animal handling and animal care - Methods of anaesthetizing animals and methods of euthanasia - Restraining and blood collection methods- Drug screening methods.

UNIT-V CLINICAL PHARMACOLOGY

Development of new drugs, protocol designing, phases, methodology and ethics of clinical trials, clinical pharmacokinetics and phramcodynamic studies, post marketing surveillance, therapeutic drug monitoring, pharmacovigilance, ADR monitoring, Drug information service, drug utilization studies, therapeutic audit, essential drug concept and rational prescribing, GLP and GMP - Recent advances in understanding of mechanism of drug action and treatment of diseases; new drugs and new uses of old drugs.

MATERIALS FOR STUDY AND REFERENCE

1. Rang H. P., Dale M. M., Ritter J. M., Flower R. J., Rang and Dale's Pharmacology,.Churchil Livingstone Elsevier
2. Katzung B. G., Masters S. B., Trevor A. J., Basic and clinical pharmacology, Tata Mc Graw-Hill
3. Goodman and Gilman's, The Pharmacological Basis of Therapeutics
4. Marry Anne K. K., Lloyd Yee Y., Brian K. A., Robbin L.C., Joseph G. B., Wayne A. K., Bradley R.W., Applied Therapeutics, The Clinical use of Drugs, The Point Lippincott Williams & Wilkins
5. Mycek M.J, Gelnet S.B and Perper M.M. Lippincott's Illustrated Reviews- Pharmacology
6. K.D.Tripathi. Essentials of Medical Pharmacology, JAYPEE Brothers Medical Publishers (P) Ltd, New Delhi.
7. Sharma H. L., Sharma K. K., Principles of Pharmacology, Paras medical publisher
8. Modern Pharmacology with clinical Applications, by Charles R.Craig& Robert,
9. Ghosh MN. Fundamentals of Experimental Pharmacology. Hilton & Company, Kolkata.
10. Kulkarni SK. Handbook of experimental pharmacology. VallabhPrakashan,

COURSE OUTCOMES

- The main purpose of the subject is to understand what drugs do to the living organisms and how their effects can be applied to therapeutics.
- The subject covers the information about the drugs like, mechanism of action, physiological
- The biochemical effects (pharmacodynamics) as well as absorption, distribution, metabolism and excretion (pharmacokinetics) along with the adverse effects, clinical uses, interactions, doses, contraindications and routes of administration of different classes of drugs.

SOFT SKILLS

COURSE CODE: 22BI5SK01 CREDITS : 2

COURSE OBJECTIVES

- To develop communicative competence among the Students.
- To enhance the learner's soft skills by giving adequate exposure in LSRW and sub skills.
- To enable learners to put the life skills into practice with confidence.

UNIT- I KNOW THYSELF / UNDERSTANDING SELF:
Introduction to Soft skills – Self discovery – Developing positive attitude - Improving perceptions - Forming values.

UNIT –II INTERPERSONAL SKILLS/ UNDERSTANDING OTHERS:
Developing interpersonal relationship - Team building-group dynamics - Net working - Improved work relationship

UNIT –III COMMUNICATION SKILLS / COMMUNICATION WITH OTHERS:
Art of listening –Art of reading –Art of speaking –Art of writing-Art of writing e-mails e mail etiquette.

UNIT- IV CORPORATE SKILLS / WORKING WITH OTHER
Oral Presentation – Memos - Note taking - Note making and preparing Minutes - Reports, Proposals, Abstracts - Technical Writing.

UNIT –V SELLING SELF / JOB HUNTING
Writin`g resume/cv-interview skills-Group discussion- Mock interview-Mock GD – Goal setting - Career planning.

MATERIALS FOR STUDY AND REFERENCE

1. N. Krishnasamy, Manju Dhariwel and Lalitha Krishnasamy(2015). Mastering Communication Skills and Soft Skills – Bloomburg.
2. Meena.K and V.Ayothi (2013) A Book on Development of Soft Skills (Soft Skills : A Road Map to Success), P.R. Publishers & Distributors,
3. Meera Banerjee and Krishna Mohan: Developing Communication Skills, Trinity Publishers- (Lakshmi Publications.
4. Alex K. (2012) Soft Skills – Know Yourself & Know the World, S.Chand & Company LTD, Ram Nagar, New Delhi- 110 055.

COURSE OUTCOMES:

- Develop listening, speaking, reading and writing skills in English.
- Enhance soft skills and engage in a range of communicative tasks and activities
- Comprehend a text and identify specific and global information
- Promote communicative ability in both spoken and written form of the language
- Develop interpersonal skills to maintain human relationship
- Develop corporate skills to promote leadership qualities and team spirit.

GENDER STUDIES

COURSE CODE: 22BI5GS01 CREDITS : 2

COURSE OBJECTIVES

- To make students to aware of Gender constructions and gendering Process
- To explore existing gender biases in the society and to understand the need to work towardsthe inclusive society
- To inculcate sensitivity and build gender perspectives.
- To use the course to bring attitudinal cum behavioral changes towards genderneutral ambience and promote the humanistic values.

UNIT- I INTRODUCTION TO GENDER STUDIES CONCEPTS

Gender Spectrum.-Sex – Gender distinction – Biological Determinism – Patriarchy – Feminism–Gender Socialization and Stereotyping-Gender Discrimination – Gender Division of labour and roles– Gender Sensitivity and awareness – Gender Equity – Equality – Gender Main streaming and Gender Analysis.

UNIT- II UGC INITIATIVES ON WOMEN'S STUDIES

Definition of Women's Studies –Gender Studies –UGC Initiatives and guidelines on Women's Studies - Beijing Conference, UN Initiatives – Convention on Elimination of All forms of Discrimination Against Women (CEDAW)- Sustainable Development Goals on Gender Equality (SDG 5) and targets

UNIT- III AREAS OF GENDER DISCRIMINATION

Gender Socialization- Sex Ratio– Health and Nutrition– – Literacy and Education – Employment- Governance – participation in decision making- politics- property rights and access to credit- gender based violence- Social institutions –Family, Caste, Class, religion, gender, State. Market – Media – Politics – Judiciary

UNIT –IV WOMEN DEVELOPMENT AND GENDER EMPOWERMENT

Towards Equality Report of Status of Women in India 1974 – International Women's Decade – International Women's Year –National Policy for Empowerment of Women 2001

UNIT –V WOMEN'S MOVEMENTS AND SAFEGUARDING MECHANISM :

In India National /State Commission for Women(NCW) – All Women Police Station – Family Court Legislations safeguarding women –Transgender Policy—Constitutional amendments for women's political participation

UNIT – VI CURRENT CONTOURS: (for continuous internal assessment only):

Tamil Nadu State Policy for Women 2021- National Policy for Women 2015 – Prevention of Sexual Harassment at Work places Act 2013-BProtection of Children from Sexual Offences Act, 2012 - Analysis of regressive and progressive High court and supreme court judgments-women proactive policies, programmes, interventions

MATERIALS FOR STUDY AND REFERENCE

1. Bhasin Kamala, Understanding Gender:Gender Basics, New Delhi:Women Unlimited, 2004
2. Bhasin Kamala, Exploring Masculinity:Gender Basics, New Delhi:Women Unlimited ,2004
3. Bhasin Kamala, What is Patriarchy? :Gender Basics, New Delhi :Women Unlimited,1993
4. Arya Sadhna Women, Gender Equality and the State ,New Delhi: Deep & Deep Publication,2000
5. Mishra.O.P, Law Relating to Women & Child, Allahabad: Central Law Agency, 2001
6. Uma Chakravarti, Gendering Caste Through a Feminist Lens, Sage Publication 20 Women's Integrated National Development Trust
7. https://www.schooloflegaleducation.com/women-and-law-in-india-e-book/

COURSE OUTCOMES:

- Students would have gained a perspective and understood the social reality of gender society understood the differences of gender and sex and may resort to building alternative perspectives and critical thinking.
- Gained knowledge on the various social institutions governing gender and the intersectionality.
- Exposed to the kind of initiatives of the State towards gender equality

THIRD YEAR

SEMESTER - VI

Part	Course Code	Name of the Course	Credits	Teach-ing Hours	Maximum Marks		
					CIA	ESE	Total
	SEMESTER – VI						
III	22BI6CC12	Genomics	4	4	25	75	100
	22BI6CC13	Microbiology	4	4	25	75	100
	22BI6CC14	Numerical Methods	4	4	25	75	100
	22BI6CC15	Molecular Modeling and Drug Design	4	4	25	75	100
	22BI6LC6	Practical VI : Genomics and Molecular Modeling and Drug Design Lab	2	4	40	60	100
	22BI6SEC02	Skill Based Elective Course 1. Cancer Biology 2. Molecular Pathogenesis	5	5	25	75	100
	22BI6CP01	Project	4	5	40	60	100
		Seminar, Library, Leveraging E-Resources	--	--	--	--	--
		Total	27 (140)	30	205	495	700 (4400)

GENOMICS

COURSE CODE: 22BI6CC12 CREDITS: 5

COURSE OBJECTIVES

- To study prokaryotic and eukaryotic genomes,
- General methods of genome sequencing techniques, genome analysis and annotations, genome mapping techniques and applications of genomics.

UNIT I INTRODUCTION

Genome structure and anatomy of prokaryotic and eukaryotic genome – Nuclear genomes – Organelle genomes – Repetitive DNA sequence – Transposable elements – Pseudo genes – Genome databases – organisms-specific databases.

UNIT II GENOME SEQUENCING

DNA sequencing techniques: Maxam Gilbert method – Sanger's method – Pyrosequencing – Whole genome sequencing – Gene Contig and Shotgun method – Human genome project - HapMap Project and the 1000 genome project.

UNIT III GENOME ANALYSIS AND ANNOTATION

Searching and locating Genes – Programs and databases – Determining function of genes – Gene Prediction – Methods of gene prediction – Softwares and tools.

UNIT IV GENOME MAPPING

Mapping databases – Types of mapping – Genetic mapping: DNA markers – RFLP, SSLP, RH maps, SNP – Linkage analysis – Physical mapping: Restriction mapping – FISH – STS mapping.

UNIT V APPLICATIONS OF GENOMICS

DNA microarray and its applications – Medical applications: Development of Antibiotics – Vaccines – Drug discovery – Human genetics diseases: Identification – Gene Diagnosis and Gene therapy– Genomics in Plant Biology - Applications of Next Generation sequencing (NGS).

MATERIALS FOR STUDY AND REFERENCE

1. Brown T.A., Genomes 3 (3rd Ed), Garland Science Publishing, New York, 2007.
2. Brown T.A., Gene Cloning and DNA Analysis – An Introduction (6th Ed), A John Wiley & Sons, Ltd., Publications, UK, 2010.
3. Jeremy W. Dale and Malcolm von Schantz, From Genes to Genomes – Concepts and Applications of DNA Technology, John Wiley & Sons, Ltd., Publications, UK, 2002.
4. Richard J. Reece, Analysis of Genes and Genomes, John Wiley & Sons, Ltd., Publications, UK, 2004.
5. Primrose .S.B., and Twyman R.M., Principles of Genome Analysis and Genomics (3rd Ed), Blackwell Publishing, UK, 2003.
6. Zhumur Ghosh and Bibekanand Mallick, Bioinformatics – Principles and Applications, Oxford University Press, New Delhi, 2008.
7. Sensen CW, Hand book of Genome Research, Wiley – VCH Verlag GmBh & Co, Weinheim, 2005.

COURSE OUTCOMES

- This course aims to provide the knowledge and practical skills of functional genomics
- The course also teaches the techniques used in functional genomics such as microarrays, NGST, mRNA expression and miRNA expression.
- By the end of the course, students will have the necessary learning to radically advance our understanding of life and transform medicine

MICROBIOLOGY

COURSE CODE: 22BI6CC13 CREDITS: 5

COURSE OBJECTIVES

- To describe some of the various activities of microorganisms that are beneficial to humans , some staining techniques
- To learn about the science of microbiology and describe some of the general methods used in the study of microorganisms.

UNIT I INTRODUCTION OF MICROBIOLOGY

Definition – Scope of Microbiology – History and recent developments – Theory of spontaneous generation – Biogenesis – Contributions of Anton van Leeuwenhoek, Joseph Lister, Paul Ehrlich, Edward Jenner, Louis Pasteur, Robert Koch and Alexander Fleming – Microscopy: simple – compound light microscopy-dark microscopy – Phase contrast – Fluorescence and Electron Microscopy.

UNIT II DIVERSITY OF MICROORGANISMS AND NUTRITION

Morphological and differentiating characters of microorganisms – Prions, viroids and Viruses, Bacteria, Rickettsia, Protozoa, Algae, Fungi (Molds and Yeasts),– Nutrition – physiology and growth of bacterial cells – different phases of growth – use of different types of media in bacterial cultivation – Environmental factors affecting growth.

UNIT III CONCEPT OF STERILIZATION

Definition of sterilization – dry and moist heat - pasteurization – tyndalization – radiation – ultrasonication, filtration – Physical and Chemical methods of sterilization: disinfection, sanitization, antisepsis sterilants and fumigation with different gases – Determination of phenol coefficient of disinfectant

UNIT IV STAINS AND STAINING TECHNIQUES

Definition of auxochrome – chromophores – dyes – Classification of stains – Theories of staining – Mechanism of gram staining – acid fast staining, negative staining, capsule staining, flagella staining, endospore staining.

UNIT V APPLICATIONS OF MICROBIOLOGY

Medical microbiology: Penicillin and Streptomycin – Food and dairy microbiology – Agricultural microbiology – Industrial microbiology – Environmental microbiology- Futures of Microbiology.

MATERIALS FOR STUDY AND REFERENCE

1. M.J. Pelczar Jr., E.C.S Chan and N.R. Krieg, *Microbiology*, Fifth edition, Tata McGraw-Hill, New Delhi, 2005.
2. L.M. Prescott, J.P. Harley and D.A. Klen, Microbiology, Fifth edition, McGraw Hill publications, New York, 2002.
3. B.D. David, R. Delbecco, H.N. Eisen and H.S.Ginsburg, *Microbiology,* 5th Edition, Harper & Row, New York, 1990.

COURSE OUTCOMES

- This fundamental paper discusses the importance of microorganisms
- The course throws light on types of microorganisms in and around humans
- At the end of the course, the student has understanding on the metabolism and mechanism of microbial life

NUMERICAL METHODS

COURSE CODE: 22BI6CC14 CREDITS: 5

COURSE OBJECTIVES

- To develop numerical methods aided by technology to solve algebraic, transcendental, and differential equations.
- To calculate derivatives and integrals. The course will also develop an understanding of the elements of error analysis for numerical methods and certain proofs.
- To obtain the necessary knowledge to solve numerical problems through Scilab capacities.

UNIT I NUMERICAL SOLUTION TO ALGEBRAIC AND TRANSCENDENTAL EQUATIONS

Definition: Algebraic and transcendental equations - Finding a root of the given equation Using Bisection Method - Regula falsi method -Newton Raphson Method - Iterationmethod – Scilab commands for Bisection, Regula falsi, N-R and Iteration methods.

UNIT II CURVE FITTING AND NUMERICAL SOLUTION OF EQUATIONS

Method of Least squares - Fitting a straight line - Fitting a parabola - Fitting an exponential curve- Fitting a curve of the form $y=ax^b$ - Calculation of the squares of the residuals – Scilab code for matrix and least square methods.

UNIT III FINITE DIFFERENCES AND INTERPOLATION

First and higher order differences - Forward differences and backward differences and central Differences - Differences of polynomial - Properties of operations -Factorial polynomials - Shifting operator E - Relations between the operators -Interpolation – Newton-Gregory Forward and Backward Interpolation formulae - Scilab commands for Forward differences and backward differences.

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UNIT IV NUMERICAL DIFFERENTIATION AND INTEGRATION

Newton's forward and backward differences – formulae to compute first and higher order derivatives - Trapezoidal rule - Simpson's one third rule and three eighth rule – Scilab code for Trapezoidal and Simpson's rules.

UNIT V NUMERICAL SOLUTIONS FOR ORDINARY DIFFERENTIAL EQUATIONS

Solution by Taylor's series - Euler's Methods - Improved and modified Euler's method - Runge- kutta methods of second order & fourth order – Scilab command for Eulers method and Runge kutta methods.

UNIT -VI Current Contours: (For Continuous Internal Assessment only) Approximation theory; spline theory; special functions; wavelets; numerical solution

MATERIALS FOR STUDY AND REFERENCE

1. V.Rajaraman, Computer oriented Numerical Methods, PHI, NewDelhi, 2019.
2. M. K. Jain, S. R. K. Iyengarn and R.K. Jain, Scilab Textbook Companion for Numerical Methods for scientific and Engineering Computation, New Age International (P) Limited, 2016.
3. S. Pal, Scilab Textbook Companion for Numerical Methods: Principles, Analysis And Algorithms, Oxford University Press, 2009.

4. S. Sastry, *Introductory Methods of Numerical Analysis,*2001.
5. M.K. Venkataraman, *Numerical Methods in Science and Engineering,* National Publishing Co., 1999
6. M.K. Jain, SRK Iyengar and R.L. Jain, *Numerical Methods for scientific andengineering computation,* Wiley Eastern Ltd.,1987.

WEB RESOURCE LINKS

- https://www.purplemath.com/
- http://www.seemath.com/
- https://www.nctm.org/mathforum/

COURSE OUTCOMES

After completion of this course student would be able to

- Fit a curve for a straight line, Parabola and exponential equations.
- Find the roots of the given equation using Newton Raphson method, bisection and False position method.
- Construct a forward and backward table for the given data.
- Find the relation between operators like forward, backward, shift and differential operators.
- Compute the formula for first and higher derivative at a value using Newton' forward and Backward differences.
- Find the solution for ODE's using Taylor's series, Euler's method, Improved and Modified Euler method and RungeKutta for first and fourth order.
- Calculate the squares of the residuals.
- Use the Newton's Backward Difference formula write the formulae for the first and second order derivatives at the end of value x=xn upto the fourth order difference term.
- To understand and apply Scilab as computational tool.

MOLECULAR MODELING AND DRUG DESIGN

COURSE CODE: 22BI6CC15 CREDITS: 4

COURSE OBJECTIVES

- To understand the molecular modeling in drug design and drug targets
- To understand the applications of computer modeling and simulation of biological macro molecules.
- The targeted areas are in protein and nucleic acids structure modeling, structure-based drug design, intermolecular interactions and binding.

UNIT – I INTRODUCTION TO THE CONCEPTS OF MOLECULAR MODELING Molecular structure and internal energy - Application of molecular graphics – Energy minimization of small molecules – Empirical representation of molecular energies – Use of force fields and the molecular mechanics method –Discussion of global energy minimum - Types of Force Fields: Biomolecular force fields (AMBER, GROMOS)

UNIT – II MOLECULAR MODELING AND MOLECULAR MECHANICS
Introduction to Molecular Modelling, Protein Secondary and Tertiary structure elements, Homology Modelling – steps to get a model, Refinement of the model, Empirical Force Fields for Molecular Mechanics: bond stretching, angle bending, torsion, improper torsion, Lennard-Jones potential and van der waals interactions.

UNIT – III MACROMOLECULAR MODELING
Design of ligands for known macromolecular target sites. Drug-receptor interactions. Classical SAR/QSAR studies and their Implications to the 3-D modeler. 2-D and 3-D database searching - pharmocophore identification and novel drug design - Drug-receptor interaction visualization tools – LigPlot and PoseView

UNIT – IV FINDING DRUG TARGETS
Finding new drug targets to treat disease - New targets for anti-cancer drugs - Drugs that rescue mutant p53‟s.

UNIT – V ENZYMES
Enzyme background – Theories of enzyme inhibition - Enzyme inhibition as a tool for drug development – Structured-based drug design – structural bioinformatics in drug discovery - Examples.

UNIT - VI Current Contours: (For Continuous Internal Assessment only) 'Mathematical modeling for systems biology'- Computational Systems Biology Stochastic modeling and analysis

MATERIALS FOR STUDY AND REFERENCE

1. Andrew Leach, Molecular Modelling: Principles and Applications 2ndEdn.,Addison Wesley Longman, Essex, England, 1996.

2. Alan Hinchliffe, Modelling Molecular Structures, 2ndEdn., John- Wiley, 2000.
3. Alan Hinchliffe, Molecular Modelling for Beginners, John-Wiley, 2008.
4. N. Cohen (Ed.), Guide Book on Molecular Modeling in Drug Design, Academic Press, San Diego, 1996
5. D. Frenkel and B. Smith, Understanding Molecular Simulations From Algorithms to Applications, Academic Press, San Diego, California, 1996.
6. C. Rauter and K. Horn, X-ray Crystallography and Drug Design, Elsevier, 1984.
7. M. Kalos and P. A. Whitlock, Monte Carlo Methods, John Wiley & Sons, New York, 1986.
8. J.A. McCammon and S.C. Harvey, Dynamics of Proteins and Nucleic Acids,Cambridge University Press, Cambridge, 1987.
9. D.C. Rapaport, The Art of Molecular Dynamics Simulation, Cambridge University Press, Cambridge, England, 1995.
10. Shyve Cox Gad, Drug Discovery Hand Book, Wiley Inter Science, 2005.

WEB RESOURCE LINKS

- https://www.ncbi.nlm.nih.gov/Structure/MMDB/mmdb.shtml
- www.zyvex.com/nanotech/compChemLinks.html
- www.zyvex.com/nanotech/compChemLinks.html
- https://www.ebi.ac.uk/thornton-srv/software/LIGPLOT/
- https://proteins.plus/

COURSE OUTCOMES

After completion of this course student would be able to

- Learn the aspects of protein kinase inhibitors in drug discovery.
- Realize the features about structure-based and ligand-based virtual screening.
- Understand the details on the impact of SAR/QSAR studies to the 3D modeller.
- Be aware of an outlook on the techniques in drug discovery.
- View on structural bioinformatics in drug discovery.
- Describe the features about the two types of energy minimization methods.
- Name the details on the types and usage of force field.
- Explain the principles and applications of molecular modelling

PRACTICAL VI: GENOMICS AND MOLECULAR MODELING AND DRUG DESIGN LAB

COURSE CODE: 22BI6LC6 CREDITS: 3

COURSE OBJECTIVES

- To understand the drug stereochemistry drug design and molecular modeling in drug design using bioinformatics tools and databases.
- To understand the molecular basis of the cell structure function and to familiarize the recent development and techniques in the field of molecular biology.

GENOMICS LAB

1. Genome Scale Tree Construction and Genome Correlation – (IMG)
2. Genome Synteny Map Viewer – (CoGe:SYNMAP)
3. Origin Of Replication Finder – (oriTfinder)
4. Comparative Genomics for Orphan Gene Discovery – (MetaCyc).
5. Putative Subsystem Discovery – (MetaCyc).
6. Metabolic Reconstruction – (KBase).
7. Oprediction of Regulatory Elements – (PRODORIC).
8. Yeast Genome Database – (SGD).
9. Transcriptome Annotation – (BDGP)
10. RNA Secondary Structure Prediction – (GeneBee)
11. Restriction Mapping – (NEBcutter)
12. Operon Identification – (Operon-mapper)

MOLECULAR MODELING AND DRUG DESIGN LAB

1. To perform the consensus secondary structure prediction for a given protein sequence at NPS@ by selecting six different methods
2. To identify the fold for a given protein sequence using 3-D PSSM fold recognition server
3. To find the structural neighbours of a given protein (2TRX) according to SCOP, CATH, FSSP and CE. To find out if any particular structure is identified by all these classifications.
4. Protein structure prediction and validation
    a. Primary feature computing by PROTPARAM
    b. Secondary structure by SOPMA
    c. 3D structure by PSI-BLAST tool, SWISS-MODEL and SAVS server (MODELER software)
5. Protein structural alignment and classification
    a. Pairwise structural alignment by DALITE server
    b. Multiple structural alignments by DALI/ConSurf server
    c. Structural classification by SCOP and CATH servers
6. Data mining for retrieval chemical information form PUBCHEM and Ligand databases
7. Retrieving pharmacological information from Pharma base and MSDchem database
8. Prediction of binding affinity of ligand by protein-ligand interaction/ReLiBase database tools
9. Ligand design and analysis by ISIS ChemDraw, VMD and TSAR software
10. Protein-protein interaction prediction by Hex and Discovery Studio software
11. Protein-ligand interaction prediction by ArgusLab and Discovery Studio software

12. Pharmacophore identification of ligand by TSAR software
13. Protein-Protein Binding Site Prediction- BSpred
14. Molecular properties prediction by VEGAZ software
15. Molecular dynamics simulation by GROMAS and INSIGHT II software
16. Molecular force field analysis by TINKER software
17. Drug activity test by ADMETox tools
18. Linear discriminate analysis of set of ligand structures by TSAR software
19. Regression analysis of set of ligand structures by TSAR
20. Cluster analysis of dissimilar set of ligand structures by TSAR software
21. Analysis of hydrophobic features of target by BioEdit software
22. Protein-Protein interaction prediction by online tool – HADDOCK server

COURSE OUTCOMES

- This course aims to provide the knowledge and practical skills of functional genomics
- By the end of the course, students will have the necessary learning to radically advance our understanding of life and transform medicine
- The role played by pharmacokinetics and pharmacodynamics profiling in discovering new leads for therapeutic efficacy.
- Besides the computational success of molecular modeling in drug discovery, we highlighted the experimental corroboration of *insilico* discovered drug candidates.

SKILL BASED ELECTIVE COURSE

CANCER BIOLOGY

COURSE CODE: 22BI6SEC02 CREDITS: 5

COURSE OBJECTIVES

- To know Chemical Carcinogenesis Metabolism of Carcinogenesis, Oncogenes / Proto Oncogenes activity
- To learn the Different forms of therapy, Chemotherapy, Radiation Therapy

UNIT –I FUNDAMENTALS OF CANCER BIOLOGY

Regulation of Cell cycle- Mutations that cause changes in signal molecules- effects on receptor-signal switches- tumour suppressor genes- Modulation of cell cycle-in cancer- Different forms of cancers- Diet and cancer.

UNIT -II PRINCIPLES OF CARCINOGENESIS

Chemical Carcinogenesis- Metabolism of Carcinogenesis- Natural History of Carcinogenesis- Targets of Chemical Carcinogenesis- Principles of Physical Carcinogenesis- X-Ray radiation – Mechanism of radiation Carcinogenesis.

UNIT-III PRINCIPLES OF MOLECULAR CELL BIOLOGY OF CANCER

Oncogenes- Identification of Oncogenes- Retroviruses and Oncogenes- detection of Oncogenes- Growth factor and Growth factor receptors that are Oncogenes- Oncogenes / Proto Oncogenes activity- Growth factors related to transformations.

UNIT -IV PRINCIPLES OF CANCER METASTASIS

Clinical significances of invasion- heterogeneity of metastatic phenotype- Metastatic cascade- Basement membrane disruption- Three step theory of invasion- Proteinases and tumour cell invasion.

UNIT -V NEW MOLECULUS FOR CANCER THERAPY

Different forms of therapy- Chemotherapy- Radiation Therapy- Detection of Cancers- Prediction of aggressiveness of Cancer- Advances in Cancer detection.

UNIT -VI Current Contours: (For Continuous Internal Assessment only)

Molecular biology of cancer (oncogene and tumor suppressors) cancer cells, with emphasis on growth control and cell division, genome stability and aneuploidy

MATERIALS FOR STUDY AND REFERENCE

1. King R.J.B., *Cancer Biology*, Addision Wesley Longmann Ltd, U.K., 1996.
2. Ruddon.R.W.,*Cancer Biology*, Oxford University Press, Oxford, 1995.

REFERENCES BOOKS

1. Maly B.W.J., *Virology a practical approach*, IRL press, Oxford, 1987.
2. Dunmock.N.J and Primrose S.B., *Introduction to modern Virology*, Blackwell Scientific

Publications, Oxford, 1988.

WEB RESOURCE LINKS

- https://www.cancer.gov/research/areas/biology
- https://biology.mit.edu/faculty-and-research/areas-of-research/cancer-biology/
- https://biology.mit.edu/faculty-and-research/areas-of-research/cancer-biology/

COURSE OUTCOMES

After completion of this course student would be able to

- Learn the aspects of regulation of cell cycle.
- Describe the features of modulation of cell cycle-in cancer.
- Explain the facts about the Diet and cancer.
- List the details about Natural History of Carcinogenesis.
- Demonstrate the mechanism of radiation Carcinogenesis.
- Outline the methods of the identification of Oncogenes.
- Explain the facts about three step theory of invasion.
- Use the knowledge in cancer detection.

SKILL BASED ELECTIVE COURSE

MOLECULAR PATHOGENESIS

COURSE CODE: 22BI6SEC02 CREDITS: 5

COURSE OBJECTIVES

- To describe some of the various activities of microorganisms that are beneficial to humans , some staining techniques
- To define the science of microbiology and describe some of the general methods used in the study of microorganisms.

UNIT I-AN OVERVIEW

Historical perspective - discovery of microscope, Louis Pasteur's contributions, Robert Koch's postulates, early discoveries of microbial toxins, toxic assays, vaccines, antibiotics and birth of molecular genetics and modern molecular pathogenesis studies, Various pathogen types and modes of entry.

UNIT -II HOST-DEFENSE AGAINST PATHOGENS AND PATHOGENIC STRATEGIES

Attributes & components of microbial pathogenesis, Host defense: skin, mucosa, cilia, secretions, physical movements, limitation of free iron, antimicrobial compounds, mechanism of killing by humoral and cellular defense mechanisms, complements, inflammation process, general disease symptoms, Pathogenic adaptations to overcome the above defenses.

UNIT -III MOLECULAR PATHOGENESIS (WITH SPECIFIC EXAMPLES)

Virulence, virulence factors, virulence-associated factors and virulence lifestyle factors, molecular genetics and gene regulation in virulence of pathogens, Vibrio Cholerae: Cholera toxin, co-regulated pili, filamentous phage, survival *E.coli* pathogens: Enterotoxigenic *E.coli* (ETEC), labile & stable toxins, Entero- pathogenic *E.coli* (EPEC), type III secretion, cytoskeletal changes, intimate attachment; Enterohaemerrohogic *E.coli* (EHEC), mechanism of bloody diarrhoea and Hemolytic Uremic Syndrome, Enteroaggregative *E.coli* (EAEC). Shigella: Entry, macrophage apoptosis, induction of macropinocytosis, uptake by epithelial cells, intracellular spread, inflammatory response, tissue damage Plasmodium: Life cycle, erythrocyte stages, transport mechanism and processes to support the rapidly growing schizont, parasitiparous vacuoles, and knob protein transport, Antimalarials based on transport processes. Influenza virus: Intracellular stages, Neuraminidase & Haemagglutinin in entry, M1 & M2 proteins in assembly and disassembly, action of amantidine.

UNIT- IV EXPERIMENTAL STUDIES ON HOST-PATHOGEN INTERACTIONS

Virulence assays: adherence, invasion, cytopathic, cytotoxic effects. Criteria & tests in identifying virulence factors, attenuated mutants, molecular characterization of virulence factors, signal transduction & host responses.

UNIT -V MODERN APPROACHES TO CONTROL PATHOGENS

Classical approaches based on serotyping. Modern diagnosis based on highly conserved virulence factors, immuno & DNA-based techniques. New therapeutic strategies based on recent findings

on molecular pathogenesis of a variety of pathogens, Vaccines - DNA, subunit and cocktail vaccines.

UNITVI Current Contours: (For Continuous Internal Assessment only)
Microbial pathogenesis, the molecular mechanisms of bacterial virulence and host-pathogen Recent advances in bacteriology.

MATERIALS FOR STUDY AND

1. Iglewski B.H and Clark V.L "Molecular basis of Bacterial Pathogenesis", Academic Press, 1990.
2. Peter Williams, Julian Ketley & George Salmond, "Methods in Microbiology: Bacterial Pathogenesis, Vol. 27", Academic Press, 1998.

REFERENCE BOOKS

1. Recent reviews in Infect. Immun., Mol. Microbiol, Biochem. J., EMBO etc.Nester, Anderson, Roberts, Pearsall, Nester, "Microbiology: A Human Perspective", McGraw-Hill, 3rd Edition, 2001.
2. Eduardo A. Groisman, Principles of Bacterial Pathogenesis, Academic Press, 2001.

WEB RESOURSE LINKS

- http://www.microbeworld.org/
- https://www.asm.org/
- http://commtechlab.msu.edu/sites/dlc-me/zoo/

COURSE OUTCOMES

After completion of this course student would be able to

- List the scientific accomplishments of Louis Pasteur and Robert Koch.
- Describe the aspects on the various pathogen types and their modes of entry in to the host.
- Write the features about the cellular defence mechanisms.
- Explain the details about the signal transduction process.
- Compare the attributes about the virulence assays.
- Predict the aspects on the types of vaccines.
- Analyze the new therapeutic strategies.
- Investigate the details about the inflammation process.

PROJECT

COURSE CODE: 22BI6CP01 CREDITS: 4

Maximum marks for CIA	=	40
Maximum marks for ESE	=	60
Total	=	100

FOURTH YEAR

SEMESTER VII

Course Code	Name of the Course	Credits	Teaching Hours	Maximum Marks		
				CIA	ESE	Total
SEMESTER – VII						
22BI7CC16	Proteomics	5	5	25	75	100
22BI7CC17	Bioinformatics Programming in Python	5	5	25	75	100
22BI7CO01	Core Choices Course (At least Two Choices) 1.Genetic Engineering 2.Enzyme Engineering	5	5	25	75	100
22BI7EC01	Elective Course (At least Two Choices) 1. Cheminformatics 2. Medicinal Chemistry	4	5	25	75	100
22BI7LC07	Practical – VII: Genetic Engineering Lab	3	5	40	60	100
22BI7LC08	Practical – VIII: Proteomics and Python Lab	3	5	40	60	100
	Seminar, Library, Leveraging E-Resources	--	--	--	--	--
	Total	25 (165)	30	180	420	600 (5000)

PROTEOMICS

COURSE CODE: 22BI7CC16 CREDITS: 5

COURSE OBJECTIVES

- To understand the proteins enclosed by the genes with respect to structure, function
- T learn protein – protein interactions, techniques for separation and analysis, database and applications.

UNIT -I INTRODUCTION

Proteomics introduction – Protein sequencing – Protein Digestion Techniques – Mass Spectrometers for Protein and Peptide Analysis – Protein Identification by Peptide Mass Fingerprinting – Software Tools for Peptide Mass Fingerprinting: Finding the Matches – Peptide Sequence Analysis and Protein Identification with Tandem Mass Spectrometry

UNIT -II PROTEOME DATABASES

Proteome databases – Comparative proteomics methods – 2D gel databases – Protein interaction data bases – Metabolic pathway databases – resources for interaction prediction – network and pathway visualization tools – Protein network analysis

UNIT -III PROTEOMICS TOOLS

2D gel electrophoresis and Mass spectra – Protein identification from 2D gel, mass spectra and sequence data – Protein property prediction – bulk, active sites, modification sites, interactive sites, location, localization, stability, shape, domains properties, secondary and tertiary structures – Protein identification programs – Muscot – Peptldent – Protein prospector – GFS

UNIT- IV FUNCTIONAL PROTEOMICS

Functional proteomics – protein phenotypes – Protein-Protein Interaction Mapping: Experimental – Yeast two-hybrid system – phage display – protein fragment complementation assays – Computational approach

UNIT -V APPLICATION OF PROTEOMICS

Applications of Proteomics – Protein Expression Profiling – Identifying Protein – Protein Interactions and Protein Complexes – Mapping Protein Modifications – Protein Arrays and Protein Chips – Application of proteomics to medicine, toxicology and pharmaceuticals

UNIT -VI Current Contours: (For Continuous Internal Assessment only)

Computational *Proteomics* and. Metabolomics- Sequence comparison. – Genome sequencing. – *Proteomics*. – Phylogeny. – Gene expression – Enzymology

MATERIALS FOR STUDY AND REFERENCE

1. Baxevanis D and Ouellette BFF, Bioinformatics: A practical guide to the analysis of genes and proteins (3rd Edn.), John Wiley & Sons, Inc. 2005.
2. Baxevanis D and Ouellette BFF, Bioinformatics: A practical guide to the analysis of

genes and proteins (2nd Edn.), John Wiley & Sons, Inc. 2002.
3. Brown TA, Genomes (2nd Edn.), BIOS Scientific Publishers, Oxford, UK, 2002.
4. Sensen CW, Essentials of Genomics and Bioinformatics, Wiley–VCH. 2002.
5. Sensen CW, Hand book of Genome Research, Wiley–VCH Verlag GmBh & Co, Weinheim. 2005.
6. Pennigton SR and Dunn MJ, Proteomics, Viva Books Pvt. Ltd, New Delhi, 2002.
7. Sándor Suhai, Genomics and Proteomics: Functional and Computational Aspects, Kluwer Academic Publishers, 2002.
8. Daniel C. Liebler, John R. Yates, Introduction to Proteomics: Tools for the New Biology, Humana Press Inc. 2002.
9. Timothy Palzkill, Proteomics, Kluwer Academic Publishers, 2002.

WEB RESOURCE LINKS

- https://www.journals.elsevier.com/journal-of-proteomics
- https://www.news-medical.net/life-sciences/What-is-Proteomics.aspx
- https://www.sciencedirect.com/topics/neuroscience/proteomics

COURSE OUTCOMES

After completion of this course student would be able to

- Give a detailed description on protein sequencing.
- Provide an overview of proteome databases.
- Explain the aspects of experimental approaches for mapping protein-protein interactions.
- Understand the details about protein expression profiling.
- Unravel the facts about the KEGG database and SWISS 2D PAGE.
- Gain knowledge on phylogenetic profiles.
- Explain the details about the Peptide Mass Fingerprinting.
- Describe the features of Yeast two-hybrid system.

BIOINFORMATICS PROGRAMMING IN PYTHON

COURSE CODE: 22BI7CC17 CREDITS: 5

COURSE OBJECTIVES

- To have a thorough understanding of Python basic concepts, functions, module packages
- To learn web programming in Python

UNIT- I INTRODUCTION TO PYTHON

Introduction to Python – History, Installation, Interpreter, Running Python Program Interactive/Batch mode - Output, Input and the raw input – Syntax and Style - Comments – Operators – Variables and Assignment - Code Blocks Use Indentation - Basic data types in Python – properties of sequences - Numbers, Strings, Lists

UNIT- II CONTROL STATEMENTS AND FILE HANDLING

Basic data types in Python - Tuples and Dictionaries - Conditional and Loop statements – if-else-elif, while, for, break, Continue, Pass-else, for statements - Built-in Function – Files handling - open/close files – CSV file - Example programs

UNIT- III FUNCTIONS AND MODULES

Functions - definition, Modularizing Python code using Functions, Function Parameter Options, Passing Arguments, Generators - Example programs - Introduction to Modules - Using Modules, Importing Modules, Creating Modules, Packages – *string, math, random, sys, time, os* modules

UNIT- IV REGULAR EXPRESSION

Regular Expressions – Introduction, syntax, Special Symbols and Metacharacters for REs, RegEx – search, match and substitute, the *re* module – compiling a pattern - Bioinformatics Example programs

UNIT -V WEB PROGRAMMING AND BIOPYTHON

Introduction to Web Programming - Web Surfing with Python - Creating Simple Web Clients, Building CGI Application, Related Modules. Introduction to Biopython – Sequence objects - Sequences and Alphabets, MutableSeq objects - simple Bioinformatics application programs

UNIT -VI Current Contours: (For Continuous Internal Assessment only)

Exception handling, Python object orientation, *numpy* module. High-throughput sequence analyses, Image and Signal processing by Python

MATERIALS FOR STUDY AND REFERENCE

1. David Ascher, Mark Lutz “Learning Python,” 2/e, O’Reilly Media Publishers, 2003.
2. Alex Martelli “Python in a Nutshell”, O’Reilly Media Publishers, 2007.
3. Tim J. Stevens and Wayne Boucher “Python programming for biology, bioinformatics, and beyond”, University Printing House, Cambridge, 2015.
4. Sebastian Bassi, Python for bioinformatics, 2/e, CRC Press, 2018.
5. Miguel Rocha and Pedro G. Ferreira, Bioinformatics Algorithms Design and Implementation in Python, Academic Press publications, 2018.
6. http://www.biopython.org

WEB RESOURCE LINKS

- https://www.tutorialspoint.com/perl/index.htm
- lwp.interglacial.com/ch12_03.htm
- www.perlmonks.org/?node_id=585436

COURSE OUTCOMES

After completion of this course student would be able to

- Understand the Python features, applications and Python interpreter with debugger.
- Explain the details about the data types and operators in Python.
- Write the control statements and functions in Python.
- Describe the basics of Regular Expression and Pattern matching in Python.
- List the details about modules in Python.
- Handle the files in Python with application to bioinformatics.
- Discuss the details on BioPython modules.
- Create the web page using python programming.

GENETIC ENGINEERING

COURSE CODE: 22BI7CO01.1 CREDITS: 5

COURSE OBJECTIVES

- To learn various types of vector-host systems and steps in creating a recombinant DNA molecule
- To gain knowledge on various recombinant DNA techniques and their applications.

UNIT-I SCOPE OF GENETIC ENGINEERING

Basics of Genetic Engineering. Milestones in Genetic Engineering, Biosafety issues – Genetic engineering guidelines. Molecular Tools in Genetic Engineering – Medical Genetics, GeneTherapy, Human Genome Project, Plant Genetic Engineering. Applications of Genetic Engineering in Biopharmaceutical industries. Recombinant DNA technology. Restriction mapping of DNA fragments and Map construction, Nucleic acid Amplification (PCR analysis) and its applications. Real time PCR. Bioethics in Genetic Engineering.

UNIT-II GENE CLONING STRATEGIES

Restriction enzymes and DNA Modifying enzymes (Polymerases, Reverse Transcriptase, Ligases, Alkaline phosphatase, Terminal deoxynucleotide transferases, Nucleases - S1 nucleases-Gene Cloning vectors (Plasmids, bacteriophages, cosmids, phagemids, Artificial chromosomes), Gene Cloning strategies, Transformation and selection of recombinants; Construction of DNA libraries (Genomic library and cDNA library preparations –mRNA enrichment, reverse transcription, use of linkers and adaptors); and their screening; Alternative strategies of Gene cloning; Cloning of differentially expressed genes. Site directed Mutagenesis and Protein Engineering.

UNIT-III GENE EXPRESSION

Basics of Gene expression – hybridization techniques, Northern blot analysis, Primer extension, S1 mapping, RNAase protection assays, Reporter assays), Nucleic acid microarrays. Gene expression in bacteria and Yeast, expression in insects and insect cells, expression in mammalian cells, expression in plants – characterization of recombinant proteins, stabilization of proteins; Phage display, Yeast Two- and three Hybrid system.

UNIT-IV TRANSGENIC TECHNOLOGY

Principles of Transgene Technology-Scope of Transgenetic Technology - Gene tagging (T-DNA tagging and Transposon tagging) in gene analysis (identification and isolation of gene), Transgenic and Gene Knockouts Technologies - Targeted gene replacement, Chromosome engineering- Gene Therapy, Strategies of gene delivery, gene replacement/ augmentation, gene correction, gene editing and silencing,

UNIT- V APPLICATIONS

Role of Genetic Engineering in Forensic Medicine-Genetic defects and detection; DNA profiling- Transgenic plants-Transgenic fishes-Genetically engineered microbes for bio-products. Ethical, legal, social and environmental Issues related to rDNA Technology.

MATERIALS FOR STUDY AND REFERENCE

1. Gene Cloning and DNA Analysis, An Introduction. T.A.Brown, Wiley –Blackwell publication, 2010.
2. Principles of Gene Manipulation and Genomics, Sandy B. Primrose, Richard M. Twyman, Blackwell Scientific Publication, 2009

COURSE OUTCOMES

After completion of this course student would be able to

- Understand the steps in Biopharmaceutical industries
- Explain the features of Transformation and selection of recombinants characterization of recombinant proteins
- Chromosome engineering, Gene Therapy, Strategies of gene delivery, gene replacement/augmentation
- Role of Genetic Engineering in Forensic Medicine

ENZYME ENGINEERING

COURSE CODE: 22BI7CO01.2 CREDITS: 5

COURSE OBJECTIVES

- To know Classification of enzymes, Kinetics of single substrate reactions, turnover number, Enzyme Inhibition, Pre-steady state kinetics
- To understand Kinetics of multi-substrate reactions, Allosteric enzymes

UNIT- I INTRODUCTION TO ENZYMES
Classification of enzymes, specificity of enzyme action – monomeric and oligomeric enzymes,-Factors modifying enzyme activity, biotechnological applications of enzymes and applications of enzymes in various industries.

UNIT- II CHEMICAL NATURE OF ENZYME CATALYSTS
Structural Components of Enzymes – Structure, apoenzymes, prosthetic group, cofactors, Mechanisms of reactions catalysed by enzymes – Metal activated enzymes – metalloenzymes – involvement of co enzymes.

UNIT -III FREE AND IMMOBILISED ENZYME KINETICS
Classification of enzymes, Kinetics of single substrate reactions, turnover number, Enzyme Inhibition, presteady state kinetics, Kinetics of multi-substrate reactions, Allosteric enzymes – The Monad – Changeux – Wyman model (MCW) and The Koshland – Nemethy – Filmer (KNF) model, Temperature and pH effects on enzyme activity. Methods of immobilization of enzymes, Kinetics of immobilized enzymes – Effects of external mass transfer and intra – particle diffusion.

UNIT - IV EXTRACTION AND PURIFICATION OF ENZYMES
Methods of production of enzymes, Extraction of Enzymes –soluble enzymes – membrane bound enzymes – Nature of extraction medium – purification of enzyme – criteria of purity – Determination of molecular weight of enzymes.

UNIT -V INSTRUMENTAL TECHNIQUES IN ENZYMATIC ANALYSIS
Principles – Manometry – Spectrophotometry – Spectrofluorimetry – Electrochemical methods – Enthalpimetry – Radio chemical methods – Automation in enzymatic analysis.
UNIT -VI Current Contours: (For Continuous Internal Assessment only)
Metalloenzymes Changeux – Wyman model (MCW) *Advances* in Biological Regulation, Applied Biochemistry and Biotechnology - Part A *Enzyme Engineering* and Biotechnology

MATERIALS FOR STUDY AND REFERENCE

1. Trevor Palmer and Philip Bonner," *Enzymes*", 2nd edition, East West Press, New Delhi, 2008.
2. Robert A. Copeland, *"Enzymes-A Practical Introduction* to Structure, Mechanism and Data Analysis", 2nd edition, John Wiley and Sons, 2004.

3. Harwey W. Blanch and Douglas S. Clark. "*Biochemical Engineering"* ,CRC Press,1997

WEB RESOURCE LINKS

- https://www.omicsonline.org/.../currentissue-enzyme-engineering-open-access.php
- www.imedpub.com/scholarly/enzyme-engineering-journals-articles-ppts-list.php
- https://www.researchgate.net › ... › Biotechnology › Industrial Biotechnology

COURSE OUTCOMES

After completion of this course student would be able to

- Know the aspects of monomeric and oligomeric enzymes.
- Use the biotechnological applications of enzymes and applications of enzymes in various industries.
- Learn the mechanisms of reactions catalysed by enzymes.
- Describe the facts about metalloenzymes.
- Explain the kinetics of immobilized enzymes.
- Understand the methods of production of enzymes.
- List the details of Spectrofluorimetry.
- Become acquainted with the knowledge on automation in enzymatic analysis.

CHEMINFORMATICS

COURSE CODE: 22BI7EC01.1 CREDITS: 4

COURSE OBJECTIVES

- To know therapeutic categories such as vitamins, Drug and Pharmaceutical Industry
- To learn the therapeutic agents, their use and economics

UNIT -I REPRESENTATION OF STRUCTURES
Representation and Manipulation of 2D Molecular Structures- Representation and Manipulation of 3DMolecular Structures.

UNIT- II MOLECULAR DESCRIPTORS AND MODELS
Molecular Descriptors-Introduction- Descriptors Calculated from the 2D Structure-Descriptors Based on 3D Representations- Data Verification and Manipulation-Computational Models- Introduction- deriving a QSAR Equation- Simple and Multiple Linear Regression- Designing a QSAR "Experiment"- Principal Components Regression-Partial Least Squares- Molecular Field Analysis and Partial Least Squares.

UNIT- III SIMILARITY METHODS
Similarity Methods- Similarity Based on 2D Fingerprints- Similarity Coefficients- 2D Descriptor Methods- 3D Similarity- Selecting Diverse Sets Of Compounds- Cluster Analysis-Dissimilarity-Based selection methods- Cell-Based Methods- Optimization Methods-Comparison and Evaluation of Selection Methods.

UNIT -IV HIGH THROUGHPUT AND VIRTUAL SCREENING
Analysis of High-Throughput Screening Data- Data Visualization- Data Mining Methods-Virtual Screening-Drug-Likeness and Compound Filters- Structure-Based, Shape based, Pharmacophore based Virtual Screening- The Prediction of ADMET Properties. c.

UNIT -V COMBINATORIAL CHEMISTRY AND LIBRARYDESIGN
Diverse and Focused Libraries- Library Enumeration- Combinatorial Library Design Strategies- Approaches to Product-Based Library Design- Multi objective Library Design-Practical Examples of Library Design.

UNIT -VI Current Contours: (For Continuous Internal Assessment only)
Cutting edge research techniques in drug design and molecular pharmacology, and in evaluating mechanisms of drug action at the molecular level through to complex integrated systems.

MATERIALS FOR STUDY AND REFERENCE

1. Andrew R Leach, Valerie J Gillet, *An Introduction to Chemoinformatics*, Kluwer academic publishers, 2003.
2. Tudor I Oprea, Raimund Mannhold, Hugo Kubinyi, Gerd Folkers, *Chemoinformatics in Drug Discovery*, Wiley-VCH, 2006.

REFERENCE BOOKS

1. Johann Gasteiger, Thomas Engel, *Chemoinformatics- A Textbook*, Wiley-VCH, 2003.
2. Jürgen Bajorath,*Chemoinformatics: Concepts, Methods, and Tools for Drug Discovery*, Humana press, 2004.

WEB RESOURCE LINKS

- vle.du.ac.in/mod/book/view.php?id=12963&chapterid=27926
- https://www.ck12.org/c/chemistry/amino-acids/?by=community
- www.bioinformatics.org/strap/createStrapLinks2.html

COURSE OUTCOMES

After completion of this course student would be able to

- Provide the details about the manipulation of 2D molecular structures.
- Explain the details about the manipulation of 3D molecular structures.
- List the details about the multi objective library design.
- Write the details of combinatorial library design strategies.
- Gain knowledge about the structure-based virtual screening.
- Predict the ADMET Properties.
- Discuss the detail about the QSAR.
- Synthesize the analysis of High-Throughput Screening.

MEDICINAL CHEMISTRY

COURSE CODE: 22BI7EC01.2 CREDITS: 4

COURSE OBJECTIVES

- To study introduction to medicinal chemistry and computational modeling
- To learn combinatorial chemistry, anti-infective agents and analogs studies.

UNIT I INTRODUCTION

Introduction to Medicinal Chemistry-Folk and Herbal Medicine -Introduction to Important Functional Groups in Medicinal Chemistry-Physico-chemical Aspects and Principals of Drug Action-Functional Groups and Isosteres (peptidomimetics)

UNIT II COMPUTATIONAL MODELING

Introduction to Computational Molecular Modeling- Quantitative Structure Activity Relationships (QSAR) Metabolism and Prodrugs - Drug-Receptors Interactions and Receptor-Effector Theories- Enzymes: catalysis, representative mechanisms of action and inhibition/inactivation-Receptors and transporters -DNA-interactive drugs.

UNIT III COMBINATORIAL CHEMISTRY

Combinatorial Chemistry and Rapid Parallel Syntheses - General properties, chemistry, biological action, structure activity relationship and therapeutic applications of Alicyclic compounds-Alkaloids-Vitamins-Hormones

UNIT IV ANTI-INFECTIVE AGENTS

Anti-Infective Agents: Anti-viral Agents-Anti-bacterial Agents-Neuroactive Agents: CNS Depressants-CNS Stimulants-Cholinergic Agents-Adrenergic, Dopaminergic and Serotenergic Agents

UNIT V ANALOGS STUDIES

Neuroactive Amino Acid Analogs: GABA, Glutamate and Glycine -Cardiovascular Agents (Renin-Angiotensin, etc.)-Antineoplastic Agents (mustards, anti-folates, etc.) -Steroids, Hormones and Cholesterol Lowering Agents

UNIT VI Current Contours: (For Continuous Internal Assessment only)

Chemo genomics, synthetic chemistry including combinatorial methods, bioorganic chemistry, natural compounds, high-throughput screening, pharmacological in vitro and in vivo investigations, drug-receptor interactions on the molecular level, structure-activity relationships, drug absorption, distribution, metabolism, elimination, toxicology and pharmacogenomics.

MATERIALS FOR STUDY AND REFERENCE

1. Foye's Principles of Medicinal Chemistry, 5th edition; David A. Williams, William O. Foye, Thomas L. Lemke; Lippincott Williams & Wilkins: Philadelphia, 2002.

2. Wilson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical Chemistry, 11th edition; Delgado & Remers, Eds.; Lippincott Williams & Wilkins: Philadelphia, 2004
3. Delgado, J and Remers, W., "Textbook of Organic Medicinal and Pharmaceutical Chemistry," Lippincott-Raven, Philadelphia, 1998.
4. Perum J. and Propst C.L. Computer-Aided Drug Design Methods and Applications. Marcel Dekker Inc., New York, 1989
5. Richard B. Silver. The Organic Chemistry of Drug Design and Drug Action. Academic Press, Pnen, Inc., USA, 1992

WEB RESOURCE LINKS

- https://benthamscience.com/journals/medicinal-chemistry/
- https://pubs.acs.org/journal/jmcmar
- https://www.journals.elsevier.com/bioorganic-and-medicinal-chemistry

COURSE OUTCOMES

After completion of this course student would be able to

- Explain about the Functional Groups in Medicinal Chemistry.
- Understand the details about Quantitative Structure Activity Relationships.
- Identify the applications of Combinatorial Chemistry.
- Apply the therapeutic applications of Alicyclic compounds.
- Know the details about Neuroactive Agents.
- Get knowledge on Cholesterol Lowering Agents.
- Understand the Dopaminergic and Serotenergic Agents.
- Describe the steps involved in Drug Discovery.

PROTEOMICS AND PYTHON LAB

COURSE CODE: 22BI7LC08 CREDITS: 3

COURSE OBJECTIVES

- To understand the proteins enclosed by the genes with respect to structure, function, protein – protein interactions, techniques for separation and analysis, database and applications.
- To have a thorough understanding of Pythons concepts, Working Environment - Navigating in UNIX.
- To understand the proteins enclosed by the genes with respect to structure, function, protein – protein interactions, techniques for separation and analysis, database and applications.

PROTEOMICS LAB

1. ProtParam - Computation of various physical and chemical parameters for a given protein.
2. CDD - Conserved Domain Prediction.
3. SWISS-2DPAGE - Proteins identified on various 2-D PAGE and SDS-PAGE reference maps.
4. PeptideCutter - Predicts potential cleavage sites cleaved by proteases or chemicals in a given protein sequence.
5. Mascot Server - Peptide Mass Fingerprint and MS/MS database searches.
6. PSORT - Program for the prediction of protein localization sites in cells.
7. PROSITE - Protein Domain, Family & Functional Site Prediction.
8. KEGG Pathway Database - Metabolic Pathway Prediction.
9. RADAR - Detection and alignment of repeats in protein sequences.
10. epestfind - Identification of PEST motifs.
11. STRING - Known and Predicted Protein-Protein Interactions.
12. EAWAG-BBD - Microbial biocatalytic reactions and biodegradation pathway database.

WRITE A PYTHON PROGRAM FOR THE FOLLOWING

1. To demonstrate the basic I/O using interactive and batch mode
2. To get, print and find the length of a protein sequence
3. To demonstrate the different string operations and methods
4. To demonstrate the different list operations and methods
5. To demonstrate the dictionaries using protein sequences
6. To demonstrate the if-elif-else, while and for statements using nucleotide sequence
7. To find the reverse complement of a DNA sequence
8. To convert DNA to RNA using sequence file
9. To demonstrate the searching, matching, replacing, and parsing nucleotide text using regular expression module

10. To create the module for counting the bases namely ‘baseCount’ and access the module by ‘baseCount.count’
11. To find a motif in DNA sequence
12. To calculate the charge of the protein sequence
13. To find the molecular weight of a double-stranded DNA
14. To calculate the bond length between two atoms in PDB file
15. To demonstrate the BioPython modules of Alphabet, Seq, SeqIO and SeqRecord

COURSE OUTCOMES

After completion of this course student would be able to

- Retrieve the protein sequence from uniprot database.
- Retrieve the Protein network from string database.
- Attain the knowledge to calculate protein protein interaction using PIC.
- Retrieve information about the metabolic pathway from KEGG database.
- Analyse the protein patterns and profiles using PROSITE database.
- Scan the various physical and chemical properties of the given protein using Protparam database.
- Study the conserved domain prediction by CDD.
- Explain the facts about the Peptide Cutter.
- Employ the Python program to calculate the bond length between two atoms in PDB file.
- Understand the details about the comparative Metabolomics for putative subsystem discovery.
- Discuss the details on the steps and tools involved for metabolic reconstruction.
- List the details about functional prediction of hypothetical proteins using combined bioinformatics approaches.
- Use the BioPerl program to fetch the multiple sequences from SWISS-PROT database.
- Demonstrate the basic operators with Python program

FOURTH YEAR

SEMESTER VIII

Course Code	Name of the Course	Credits	Teaching Hours	Maximum Marks		
				CIA	ESE	Total
SEMESTER – VIII						
22BI8CC18	Immunology and Immunoinformatics	5	5	25	75	100
22BI8CC19	Mathematical and Statistical Techniques	5	5	25	75	100
22BI8CO02	Core Choices Course (At least Two Choices) 1. Database Management Systems 2. Machine Learning in Bioinformatics	5	5	25	75	100
22BI8EC02	Elective Course (At least Two Choices) 1. Medical Informatics 2. Metabolic Engineering	4	5	25	75	100
22BI8LC09	Practical – IX: Immunology and Immunoinformatics Lab	3	5	40	60	100
22BI8NMEC03	Non-Major Elective Course Medical Coding	2	3	25	75	100
	Seminar, Library, Leveraging E-Resources	--	2	--	--	--
	Total	24 (189)	30	165	435	600 (5600)

IMMUNOLOGY AND IMMUNOINFORMATICS

COURSE CODE: 22BI8CC18 CREDITS: 5

COURSE OBJECTIVES

- To study overview of immune system, antigen and antibodies,
- To understand immunological techniques, immune effectors mechanism, immune system in health and disease
- To study application of all bioinformatics options to explore more information about protecting the immune system.

UNIT – I INTRODUCTION TO IMMUNOLOGY

Overview of Immune system –Innate and adaptive immunity, Humoral and Cellular immune response. Cells of the Immune system –Lymphoid cells, B-Lymphocytes, T-Lymphocytes, NK cells, Phagocytes, Granulolytic cells, Mast cells, Dentritic cells, Organs of the Immune System – Primary and Secondary Lymphoid organs Antigens –Immunogenicity Vs Antigenicity, Haptens, Epitopes, Adjuvants Antibodies –Basic structure, Antibody classes and Biological Activity, Monoclonal Antibodies.

UNIT-II IMMUNE EFFECTOR MECHANISM

MHC-Organization and expression, Antigen Processing and presentation –Cytosolic pathway, Endocytic pathway, Complement system and its pathway–Classical and Alternative Pathway, Hypersensitivity reactions –Type I,II,III and IV, Cytokines and its types. Autoimmunity–Organ specific, Systemic. Immuno deficiency disorder -AIDS, Transplantation. Vaccines –Active and Passive Immunization, Live and Attenuated Vaccines, Inactivated or Killed Vaccines, DNA Vaccines. Vaccines and immunization schedule. Immunological disorders.

UNIT-III IMMUNOLOGICAL TECHNIQUES

Antigen –Antibody Interactions–Cross reactivity, Precipitation Reactions, Agglutination Reactions, Radioimmunoassay, ELISA, Western Blotting, Immunofluorescence. Immunocytochemistry, Hybridoma technology

UNIT-IV IMMNOINFORMATICS TOOLS

Prediction of Conformational B-Cell Epitopes-Prediction of B Cell Epitopes from Antigen Sequences-Hybrid Methods for B-Cell Epitope Prediction-Multiplex Peptide-Based B Cell Epitope Mapping-Customized Predictions of Peptide–MHC Binding and T-Cell Epitopes-T-Cell Epitope Prediction Methods-Antigenic Epitope Prediction-Prediction of Allergenic Proteins- Prediction of Virulence Factors

UNIT V SYSTEMS BIOLOGY IN IMMUNOINFORMATICS

A Systems Biology Approach to Study Systemic Inflammation-Immunoinformatics and Systems Biology in Personalized Medicine-The Role of Small RNAs in Vaccination-T-Cell

Vaccine Design-Molecular Modeling, and Cancer Vaccines-Host–Pathogen Behavior and Their Interaction Using Genome-Scale Metabolic Network Models- MUTANT MOUSE: bona fide Biosimulator for the Functional Annotation of Gene and Genome Networks-Artificial Immune Systems

UNIT VI Current Contours: (For Continuous Internal Assessment only)
Antibody development for clinical use - Stem cells – Vaccines- Mechanisms of tumor escape from host immunity

MATERIALS FOR STUDY AND REFERENCE

1. Immunoinformatics (2008) Christian Schönbach, Shoba Ranganathan, Vladimir Brusic. Springer
2. Bioinformatics for Immunomics (2010) Darren D.R. Flower, Matthew Davies, Shoba Ranganathan. Springer
3. Clinical Applications of Immunomics (2009) Andras Falus. Springer Immunoinformatics (2014) Rajat K. De, Namrata Tomar.Springer
4. Richard A.Golds,T.J. K indt, Kuby Immunology (6th Edition) W.H.Freeman 2007.
5. Ivan Riot, Essentials of Immunology(6th Edition),Blakswell Scientific Publications, Oxford, 1988.
6. Paul W.E.(Eds.), Fundamentals of Immunology, Raven Press, New York,1988.
7. Harlow and David Lane, Antibodies A Laboratory Manual, Coldspring Harbor Laboratory, 1988.
8. Abul K. Abbas, Andrew H. Lichtman, Basic Immunology, Elsevier, 2008.
9. Richard M.Hyde, Microbiology and Immunology, Springer, 1995.

WEB RESOURCE LINKS

- https://www.immunology.org/public-information/what-is-immunology
- https://www.news-medical.net/health/What-is-Immunology

COURSE OUTCOMES

After completion of this course student would be able to

- Provide the details about the key events taking place during the antigen processing.
- Explain the facts about different types of antibody and its functions.
- Give the details about the production and applications of monoclonal antibodies.
- Explain the features about recognition between APC‟s and T cells.
- Describe the aspects of histotope and Paratope.
- Provide the details of immunogen.
- Explain the features of Radioimmunoassay.
- Describe the details about the Cytosolic pathway.

- Immunoinformatics is an emerging sub-discipline of bioinformatics.
- Utilizes mathematics, information science, computer engineering, genomics, proteomics and immunological methods to bridge immunology and informatics.
- Similar to bioinformatics which became a driving force in genome research, immunoinformatics enables data-driven research strategies and systems approaches that aim at understanding the networks regulating the immune system.
- Considering the breath of topic, Immunoinformatics was composed to provide a cross-section of research ranging from data integration, epitope predictions to systems level applications.
- Discusses research strategies for immunologists and bioinformaticians who wish to endeavor existing and new approaches to gain insight into the workings of the immune system.

MATHEMATICAL AND STATISTICAL TECHNIQUES

COURSE CODE:22BI8CC19 CREDIT: 5

COURSE OBJECTIVES

- To introduce the basic concept of differential equation and classification, find the solution for first and second order equations.
- To provide the basic concept of Biostatistics. Select from, use and interpret results of, descriptive statistical methods effectively

UNIT – I NATURE OF BIOLOGICAL AND CLINICAL EXPERIMENTS

Collection of experimental data - Measures of central tendency of a set of observations - Purpose of statistical investigations - arithmetic mean - mean of grouped data - median – mode - range, mean deviation, variants and standard deviation.

UNIT – II CORRELATION AND REGRESSION

Scatter diagram – Karl Pearson's Coefficient of Correlation - Correlation Coefficient for a bivariate frequency distribution - Rank correlation - Linear regression - Principles of least squares – Student's 't' test for mean, difference of means – paired 't' test for difference of means– test for correlation and regression coefficients – Chi-square test for goodness of fit and independence of attributes - Simple problems based on biochemical data.

UNIT – III BASIC CONCEPTS OF PROBABILITY

Sample space and events - The use of counting methods in probability - Addition law - Conditional probability - Simple problems involving the estimation of probabilities - Normal Distribution and Binomial and Poisson distributions – Z-score, P-value and E-value – Hidden Markov models – Neural networks – applications in bioinformatics - Needleman and Wunsch algorithm, Smith-Waterman algorithm.

UNIT – IV MATRICES AND VECTORS

Matrix algebra – Types of matrices – determinant – inverse, rank of matrix – solution of simultaneous equations – rotation matrices and co-ordinate transformation

Vectors: Vector algebra - addition and subtraction of vectors – product of vectors, dot & cross products - scalar triple product – vector calculus – gradient, divergence, curl of a vector & identities – applications – Geometrical analysis of protein structures – Coordinate transformations, Bond lengths, Bond angles, Hydrogen bonds, Torsion angles, Ramachandran map.

UNIT–V BASIC DIFFERENTIATION OF ALGEBRAIC & TRIGONOMETRIC FUNCTIONS

Maxima and Minima - Integration of simple functions - Definite and non-definite integrals – Table of integrals – Numerical methods for differentiation and integration – applications to systems biology.

UNIT - VI Current Contours: (For Continuous Internal Assessment only)
Single DNA sequence analysis:- Signal modelling- Pattern analysis- Multiple DNA/protein sequence analysis- Detailed study of pairwise alignment algorithms and substitution matrices

MATERIALS FOR STUDY AND REFERENCE

1. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, 11th Edn., Sultan Chand & Sons, New Delhi, 2002.
2. D.W. Jordan and P. Smith, Mathematical Techniques, 3rdEdn., Oxford University Press, New Delhi, 2002.
3. L. Forthofer, Introduction to Biostatistics, Academic Press, 1995.
4. Robert R. Sokal and F.J. Rohlf, Introduction to Biostatistics (Biology-Statistics Series), W.H. Freeman & Company, New York, 1987.
5. E. Batschelet, Introduction to Mathematics for Life Scientists, 2nd Edn., Springer International Student Edn., Narosa Publishing House, New Delhi, 1991.
6. N Gautham, Bioinformatics: Databases and Algorithms, Narosa Books, Chennai, 2006.

WEB RESOURCE LINKS

- http://mste.illinois.edu/hill/dstat/dstat.html
- https://www.probabilitycourse.com/
- http://web.pdx.edu/~newsomj/statlink.htm

COURSE OUTCOMES

After completion of this course student would be able to

- Understand the aspects of the bond length, bond angle and torsion angle subtended at the C – alpha (CA) atom in the main chain.
- Know the facts about the various steps involved in hypothesis testing.
- Comprehend the ability to perform the Smith-Waterman and Needleman-Wunch algorithm of finding the optimal pairwise sequence alignment.
- Study the facts about the Hidden Markov models and neural networks with their applications.
- Become acquainted with the knowledge to distinguish between mean deviation and standard deviation and to compute them for number of amino acids in a PDB file.
- Distinguish between the coefficient r and rank correlation coefficient r.
- Find the solution for ODE's using Taylor's series, Euler's method, improved and modified Euler method, Runge Kutta for first and fourth order.
- State and prove Baye's theorem and to explain its applications in bioinformatics.

DATABASE MANAGEMENT SYSTEMS

COURSE CODE: 22BI8CO02.1 CREDIT: 3

COURSE OBJECTIVES

- To study about relational databases, database design, structured query language
- To learn transaction processing and concurrency control, trends in database technology.

UNIT I INTRODUCTION TO DBMS

File Systems Organization – Purpose of Database System- Purpose of Database System – Views of data – Data Models – Database Languages –Database System Architecture – Database users and Administrator – Entity– Relationship model (E-R model) – E-R Diagrams -- Introduction to relational databases.

UNIT II DATABASE DESIGN

Design Issues in choosing attributes or entity set or relationship set- Constraints- Super Key- Candidate Keys- Primary Key- ER Diagram Notations- Goals of ER Diagram- Weak Entity Set- ER Diagram Construction- Tabular Representation of Various ER Schema- Views.

UNIT III STRUCTURED QUERY LANGUAGE

SQL Standards - Data types - Database Objects- DDL-DML-DCL-TCL-Embedded SQL- Static Vs Dynamic SQL - The Form of Basic SQL Query, UNION, INTERSECT, and EXCEPT- Nested Queries-Aggregate Functions- Null Values.

UNIT IV TRANSACTION PROCESSING AND CONCURRENCY CONTROL

Introduction-Properties of Transaction- Serializability- Concurrency Control – Locking Mechanisms-TwoPhase Locking–Intent Locking – Deadlock- Serializability –Recovery Isolation Levels–SQL Facilities for Concurrency.

UNIT V TRENDS IN DATABASE TECHNOLOGY

Overview of Physical Storage Media – Magnetic Disks – RAID – Tertiary storage – File Organization – Organization of Records in Files – Indexing and Hashing –Ordered Indices – B+ tree Index Files – B tree Index Files – Static Hashing – Dynamic Hashing - Introduction to Distributed Databases- Client server technology- Multidimensional and Parallel databases- Spatial and multimedia databases- Mobile and web databases- Data Warehouse-Mining- Data marts.

UNIT VI Current Contours: (For Continuous Internal Assessment only)

Signal-Oriented Data Stream Management System -advanced data management- including issues in relational database management systems, data-centric applications

MATERIALS FOR STUDY AND REFERENCE

1. Ramez Elmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", 6th Edition , Pearson / Addision wesley, 2011.
2. Raghu Ramakrishnan, "Database Management Systems", 3rd Edition, McGrawHill, 2003.
3. Abraham Silberschatz, Henry F. Kroth, S. Sudarshan, Database System Concepts, 6th Edition, McGraw- Hill Higher Education, USA, 2010.
4. S.K.Singh, "Database Systems Concepts, Design and Applications", 1st Edition, Pearson Education, 2006.

WEB RESOURCE LINKS

- https://www.geeksforgeeks.org/database-management-system-introduction-set-1/
- https://www.studytonight.com/dbms/overview-of-dbms.php
- https://www.tutorialspoint.com › Dbms › DBMS

COURSE OUTCOMES

After completion of this course student would be able to

- Provide the details about the advantage of DBMS approach.
- Explain the Database design using ER model.
- Understand the facts about Relational Database and their integrity constrains.
- Describe the mechanisms for concurrency control.
- Comment on the details about Data Warehouse and Data Marts.
- Explain the aspects about the advantage of DBMS approach.
- Describe the purpose of Data Marts.
- Expound the purpose of Database Administrator.

MACHINE LEARNING IN BIOINFORMATICS

COURSE CODE: 22BI8CO02.2 CREDIT: 5

COURSE OBJECTIVES

- To know Basic algorithms, Learning algorithms, Applications: general aspects, proteins, DNA and RNA
- To learn the dynamic programming and structure prediction

UNIT-I INTRODUCTION

Introduction-Bayesian modeling-Cox Jaynes axioms- Bayesian inference and induction-models structures- examples. Machine learning applications in genetics and genomics.

UNIT-II DYNAMIC PROGRAMMING

Dynamic programming- EM/ GEM algorithms-Markov chain Monte carlo methods-simulated annealing- genetic algorithm-Neural networks.

UNIT-III STRUCTURE PREDICTION

Sequence coding- correlations- Prediction: secondary structure, signal peptides and cleavage sites-applications for DNA & RNA nucleotide sequences- Performance evaluation.

UNIT-IV ALGORITHMS AND ITS APPLICATIONS

Introduction- likelihood & Basic algorithms- Learning algorithms- Applications: general aspects, proteins, DNA and RNA

UNIT-V PHYLOGENTIC ANALYSIS

Models for phylogeny-substitution probabilities-Data likelihood-optimal trees- modeling for array data

UNIT-VI Current Contours: (For Continuous Internal Assessment only)

Genetic Linkage Analysis Algorithms and Their Implementation, sequence search and alignment algorithms

MATERIALS FOR STUDY AND REFERENCE

1. Soren Brunak, Pierre F Baldi, Bioinformatics: The Machine Learning approach, MIT Press, 2001.
2. Steffen Schulze-Kremer, Molecular Bioinformatics: Algorithms and Applications, Walter de Gruyter, 1996.
3. Balas Kausik Natarajan, Machine Learning: A Theoretical Approach, Morgan Kaufmann, 1991.
4. Yi-Ping Phoebe. Chen, Bioinformatics Technologies, Springer, 2005.

WEB RESOURCE LINK

- bioinformaticsalgorithms.com
- https://www.elsevier.com/books/bioinformatics-algorithms/
- https://www.coursera.org/specializations/bioinformatics

COURSE OUTCOMES

After completion of this course student would be able to

- Explain the basic outline of machine learning theories and methods.
- Apply the machine learning to biological sequence analysis, gene expression data analysis.
- Describe the methods which are involved for gene prediction.
- Explain the facts about machine learning methods for dynamic programming
- Describe the aspects about machine learning in structure prediction.
- Provide the details about machine learning algorithms and applications.
- Gain the knowledge to develop machine learning methods for proteins, DNA and RNA.
- Explain the facts about the models for phylogeny.

MEDICAL INFORMATICS

COURSE CODE: 22BI8EC02.1 CREDIT: 4

COURSE OBJECTIVES

- To study introduction to medical informatics, computer based medical report, hospital management
- To learn the information systems, endoscopy, applications, telemedicine and tele-surgery

UNIT-I INTRODUCTION

Introduction- Hospital management and information system: functional area- pre-requisites- integrated hospital information systems- health information system- and disaster management plan

UNIT-II COMPUTER BASED MEDICAL REPORTS

Artificial intelligence- expert systems- materials and methods- computer based patient Records- computer assisted medical education

UNIT-III HOSPITAL MANAGEMENT AND INFORMATION SYSTEMS

Hospital Management and Information systems- structure and functions- computer assisted patient education- computer assisted patient surgery

UNIT-IV ENDOSCOPY AND APPLICATIONS

Three-dimensional imaging: limitations of endoscopy and imaging- benefits of virtual endoscopy- materials and methods- limitations- applications- merits and demerits- surgical simulation- virtual environment

UNIT-V TELE-MEDICINE AND TELE-SURGERY

Tele-medicine- needs- materials and methods- Internet tele-medicine- controversial issues- reliability- cost-analysis- applications- tele-surgery- the Internet

UNIT-VI Current Contours: (For Continuous Internal Assessment only)

Population Research & Public Health Informatics- Introduction to Health IT & Informatics - Biomedical Informatics

MATERIALS FOR STUDY AND REFERENCE

1. Mohan Bansal, *Medical Informatics- a primer*, Tata McGraw-Hill, 2003.
2. Charles P. Friedman, Jeremy C. (EDT) Wyatt, Evaluation Methods in Medical Informatics- Springer Verlag, 1997.
3. Hsinnchun Chen, *Medical Informatics: Knowledge Management And Data Mining in Biomedicine*, Springer, 2005.
4. F. T. De Dombal,*Medical Informatics: The Essentials*, Butterworth-Heinemann, 1996.

WEB RESOURCE LINKS

- https://medicalinformatics.conferenceseries.com/
- www.uni-heidelberg.de/courses/prospective/academicprograms/med_infor_ma.html
- https://www.journals.elsevier.com/international-journal-of-medical-informatics

COURSE OUTCOMES

After completion of this course student would be able to

- Explain the facts on health information system.
- Describe the aspects of disaster management plan.
- Apply the advantages of computer based patient records.
- Describe the role of artificial intelligence in computer based medical record.
- Present the details about computer assisted patient surgery
- Describe the benefits of virtual endoscopy.
- Explain the features of surgical simulation.
- Comment on the limitations of internet tele-medicine.

METABOLIC ENGINEERING

COURSE CODE: 22BI8EC02.2 CREDIT: 4

COURSE OBJECTIVES

- To know importance of metabolic engineering, isotope labelling, bottom up and top down approaches
- To learn metabolic flux analysis and metabolic networks

UNIT-I INTRODUCTION TO METABOLOMICS

Overview of metabolomics- Metabolomics *in Arabidopsis thaliana*- Lipidomics.

UNIT-II METABOLOME INFORMATICS

Introduction to the ARM Database- The Genome-Based E-CELL Modeling (GEM) System-Large-Scale Simulation of Metabolism-Metabolomics and Medical Sciences

UNIT-III INTRODUCTION TO METABOLIC ENGINEERING

Importance of metabolic engineering-comprehensive models for cellular reactions-material balances & data consistency- metabolic pathway synthesis.

UNIT-IV METABOLIC FLUX ANALYSIS AND ITS APPLICATION

Theory-determination of flux by isotope labeling-Metabolic control analysis- (control coefficients and summation theorems, FCC determination)-Grouping of reactions (gFCC, identification of independent pathways).

UNIT-V FLUX ANALYSIS OF METABOLIC NETWORKS

Bottom up and Top down approaches- case study-optimization of flux amplification-consistency tests and experiment validation

UNIT-VI ADVANCED TOPICS AND LATEST DEVELOPMENTS (Not for exams)

The study of small metabolites, Bioinformatics, proteomics, systems biology

MATERIALS FOR STUDY AND REFERENCE

1. M. Tomita, T. Nishioka, *Metabolomics- The Frontier of Systems Biology,* Springer Publications, 2003.
2. Gregory N. Stephanopoulos, *Metabolic Engineering- Principles and Methodologies*, Academic press, First Edition, 1998.

REFERENCE BOOKS

1. S. Cortassa, *An Introduction to Metabolic and Cellular Engineering*, World scientific public company Ltd., 2002.
2. Wolfram Weckwerth, *Metabolomics: Methods and Protocols*, Humana Press, 2007.

WEB RESOURCE LINKS

- https://www.sciencedirect.com/topics/medicine-and-dentistry/metabolomics
- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4850886/
- www.cell.com/cell-metabolism/abstract/S1550-4131(16)30503-4

COURSE OUTCOMES

After completion of this course student would be able to

- Know the facts about Lipidomics.
- Give an introduction to the ARM Database.
- Discuss the aspects of genome-based E-CELL modelling (GEM) system.
- Write the importance of metabolic engineering.
- Provide the details about metabolic pathway synthesis.
- Give an explanation about the determination of flux by isotope labelling.
- Explain the aspects of the bottom up and top down approaches in Metabolomics.
- Describe the details about the optimization of flux amplification.

IMMUNOLOGY AND IMMUNOINFORMATICS LAB

COURSE CODE: 22BI8LC09 CREDIT: 3

COURSE OBJECTIVES

- The candidate will gain hands-on knowledge and acquire adequate skill required to identify and enumerate immune cells and also perform agglutination reactions.
- To handle immunoblotting techniques

IMMUNOLOGY AND IMMUNOINFORMATICS LAB

1. Identification of various immune cells by morphology – Leishman staining, Giemsa staining.
2. Differential counts.
3. Heamagglutination Reactions- Blood Grouping – forward and reverse, Rh Typing, Coomb's test, TPHA
4. Immuno Blot
5. Passive Agglutination Assay
6. Enzyme Linked Immunosorbent Assay (ELISA) / Tridot test
7. Prediction of epitope structure and dynamics
8. Prediction of allergens
9. Peptide vaccine designing
10. Subunit vaccine designing
11. Network analysis of large-scale immunological data

COURSE OUTCOMES

- At the end of the course, learners will be able to
- Identify various immune cells and enumerate them
- Competently perform serological diagnostic tests such as RF, ASO, CRP.
- Identify blood groups and types
- Diagnose syphilis by performing TPHA test
- Analyze the components of human sera by performing agarose and polyacrylamide gel electrophoresis

FOURTH YEAR

SEMESTER IX

Course Code	Name of the Course	Credits	Teaching Hours	Maximum Marks		
				CIA	ESE	Total
SEMESTER – IX						
22BI9CC20	Systems Biology	4	4	25	75	100
22BI9CC21	Synthetic Biology	4	4	25	75	100
22BI9EIBC01	Applied Bioinformatics and IPR	4	4	25	75	100
22BI9CO03	Core Choices Course (At least Two Choices) 1. Pharmacoinformatics 2. Agriculture Bioinformatics	5	5	25	75	100
22BI9EC03	Elective Course (At least Two Choices) 1. NGS Techniques and Data Analysis 2 Drug and pharmaceutical biotechnology	4	5	25	75	100
22BI9LC10	Practical – X: Systems and Synthetic Biology Lab	3	5	40	60	100
22BI9NMEC04	Non-Major Elective Course Bioethics, Biosafety and IPR	2	3	25	75	100
	Seminar, Library, Leveraging E-Resources	--	-	--	--	--
	Total	26 (213)	30	190	510	700 (6300)

SYSTEMS BIOLOGY

COURSE CODE: 22BI9CC20 CREDIT: 4

COURSE OBJECTIVES:

- To know Advanced Measurement Systems,
- Introduction to Biological Networks and
- Basic Concepts, Systems biology software project

UNIT-I INTRODCUTION TO SYSTEMS BIOLOGY

Introduction to Computational Systems Biology; Types of data used in modeling; Types of models (gene regulatory, metabolic, Signal pathway, disease, population); types of modeling frameworks (Deterministic vs Stochastic; Static vs. Dynamics; Robustness and Stability of systems. Databases and softwares for Systems Biology: KEGG, EMP, MetaCyc, Cytoscape, visANT & Cell Designer.

UNIT-II METHODS USED IN SYSTEMS BIOLOGY

Methods used in systems biology (Ordinary differential equations (ODE) ▪ Linear ODEs; Non-linear ODEs, steady states - Stability analysis - Linear systems; Non-linear systems; Phase plane analysis; Stable and unstable limit cycles; Oscillations; Bistability; Positive and negative feedback - Parameter estimation and validation –Data sources, Regression techniques (maximum likelihood, least squares methods), optimization algorithms ▪ Michaelis-Menten and Hill functions

UNIT-III STOCHASTIC MODELING AND SIMULATION TOOLS

Stochastic modeling and Simulation, Chemical master equation; Gillespie algorithm; Stochastic ODEs -Logical modeling, Logic gates; Graph construction; Boolean networks - Metabolic control analysis (MCA), Control and elasticity coefficients; Summation theorems, connectivity relations theorems-Biochemical Systems Theory (BST), Power law representation; S-Systems and General Mass Action; Comparison of MCA and BST modeling approaches - Flux Balance Analysis (FBA): Linear Programming; Constraints - Neural Modeling: Hodgkin-Huxley model, Markov models, Action potentials, Voltage-activated Ion channels, Nernst Equation, Electrical Properties of Neurons Tools and databases: SBML; Modeling tools- Gepasi, Virtual cell, Cell Designer, GENESIS

UNIT-IV BASICS OF NETWORK ANALYSIS

Graph Theory; Euler path/circuits; Cliques; Network motifs; bipartite networks; directed and undirected graphs/networks with examples - Models of networks: ER model of a random network; real-world networks; Barabasi-Albert model; scale-free nature of a network; scale-free v/s random networks; robustness and fragile nature of scale-free network; modularity, heterogeneity and randomness of networks-Centrality measures- degree centrality, betweeness, closeness, eigen value, page-rank etc; hubs, bottlenecks, modules

UNIT-V PROTEIN-PROTEIN INTERACTION NETWORKS

Protein-protein interaction networks; data resources; lethality-centrality rule; spatio-temporal aspect; Dichotomy of hubs: Date and party hubs; local and global hubs and their molecular characteristics; hub nodes as ensemble of various isoforms possible due to alternative splicing for genes-Gene networks/basic concepts, example: Lac-operon-Host-pathogen protein-protein interaction networks both bipartite and bridge networks- Disease-disease networks

MATERIALS FOR STUDY AND REFERENCE

1. An Introduction to Systems Biology: Design Principles of Biological Circuits by Uri Alon Published by Chapman & Hall/CRC Mathematical and Computational Biology
2. Analysis of Biological Networks Edited by Björn H. Junker and Falk Schreiber Published by Wiley

COURSE OUTCOMES:

- Describe how naturally occurring organisms regulate the expression of their genes
- Describe how the regulation of the genes and properties of gene products can be altered with synthetic biology methods used during the course
- Describe how synthetic biology alters the properties of the cell or the organism
- Apply a scientific approach to the planning, execution, reporting and interpretation of advanced projects with the aim at creating replicating systems with new properties that can be regulated, and to critically analyse the results and generate testable hypotheses from these experiments
- Critically analyse, present and defend scientific literature in synthetic biology, including practical applications such as biofuel and metabolic engineering
- Develop ethical perspectives in synthetic biology

SYNTHETIC BIOLOGY

COURSE CODE: 22BI9CC21 CREDIT: 4

COURSE OBJECTIVES

- Synthetic biology is an emerging field that spans the boundary of biology, engineering, and physical sciences with its goal of engineering biomolecular systems and cellular capabilities for a variety of applications.
- This course aims to offer an introduction to this rapidly evolving field and equip students with foundational skills and critical mindsets that are required for synthetic biology research.
- This foundational knowledge will be subsequently applied and illustrated through the examination of representative functional circuits at different scales and in different organisms.

UNIT-I OVERVIEW OF SYNTHETIC BIOLOGY

Overview of synthetic biology: history, current, and future-Central dogma: transcription, reverse transcription, translation, post-translational modification-Transcriptional regulation: Biology & engineering systems-Post-transcriptional regulation: Biology & engineering systems

UNIT-II EXPERIMENTAL FOUNDATION FOR GENE CIRCUIT CONSTRUCTION

Experimental foundation for gene circuit construction-Genetic engineering and genome engineering-: DNA assembly and synthesis-Directed and continuous evolution-Chemical kinetics (M-M equation and Hill function)

UNIT-III MATHEMATICAL MODELING AND SIMULATION

Mathematical modeling and simulation - Deterministic models - Stochastic models-Spatiotemporal models-Noise in gene expression: Origin, propagation, consequences, and control-Robustness and evolvability of genetic networks

UNIT-IV CIRCUIT DESIGN PRINCIPLES AND TOOLS

Circuit design principles and tools-Engineered functional circuits: from modules and systems-Bacterial circuits: Toggle switch and repressilator-Bacterial circuits: Feedback, feed-forward, signal propagators, and band filter -Bacterial communication circuits: Population control and patterning systems-Bacterial communication circuits: Synchronized oscillators

UNIT-V FUNCTIONAL SYNTHETIC SYSTEMS

Functional synthetic systems: From modules to systems-Gene circuit design and engineering: Biobricks/BioFAB and designing software-Synthetic circuits beyond bacteria: Phage, virus, and eukaryotes-Applications of synthetic biology-Biomedicine, biomaterials-Biofuels and bioremediation. Potential Hazards of Synthetic Biology, iGEM (International Genetically Engineered Machine).

MATERIALS FOR STUDY AND REFERENCE

1. Uri Alon, An Introduction to Systems Biology: Design Principles of Biological Circuits, Chapman & Hall/CRC (2006).
2. Eric Davidson, The Regulatory Genome: Gene Regulatory Networks In Development And Evolution, Academic Press (2006).

3. Hamid Bolouri, Computational Modeling Of Gene Regulatory Networks - A Primer, Imperial College Press (1st edition) (2008).

COURSE OUTCOMES:

- Through the course, the students will achieve a deep knowledge in the field of synthetic biology. On completion of the course, the student should be able to:
- describe how naturally occurring organisms regulate the expression of their genes
- describe how the regulation of the genes and properties of gene products can be altered with synthetic biology methods used during the course
- describe how synthetic biology alters the properties of the cell or the organism
- apply a scientific approach to the planning, execution, reporting and interpretation of advanced projects with the aim at creating replicating systems with new properties that can be regulated, and to critically analyse the results and generate testable hypotheses from these experiments
- critically analyse, present and defend scientific literature in synthetic biology, including practical applications such as biofuel and metabolic engineering
- develop ethical perspectives in synthetic biology

APPLIED BIOINFORMATICS AND IPR

COURSE CODE: 22BI9EIBC01 CREDITS: 4

COURSE OBJECTIVES

- To study commercial bioinformatics, genome analysis and pharmaceutical bioinformatics
- To study drug discovery, transgenic plants and animals and bar coding

UNIT -I INTRODUCTION

Commercial bioinformatics – Survey of bioinformatics companies in India and abroad – Economics prospects – pharamainformatics – combinatorial chemistry – HT screening – in silico screening - from lead to commercialization

UNIT -II GENOME ANALYSIS

Sequence assembly and Finishing methods – Sequence assemblers – finishing and visualization programmes – Gene expression analysis – Data collection – Image processing - Measures of expression – Finding significant genes –Clustering approaches – SNP – Types – SNP discovery methods –databases and browsers – genotyping - Comparative genomics – algorithms – viewing –genomic alignments – gene prediction and phylogenetic foot printing

UNIT -III APPLICATION OF GENOMICS

Application of genomics to agriculture – gene discovery and gene function – model systems – technologies – methods to introduce novel genes – Pharmaceutical bioinformatics and drug discovery – Introduction - novel gene discovery – methods for identifying novel targets – protein classification and functional assignments – Disease – target gene relationship – Nanotechnology and its applications – Genomics and proteomics in medicine, diagnostics, drug discovery and target findings.

UNIT- IV INTELLECTUAL PROPERTY RIGHTS (IPR)

IPR –Importance of IPR, Organization –WIPO & WTO – Agreements and Treaties – GATT– TRIPS –Types of IPR – patents – copyrights – trademarks and trade secrets – Plant Breeder Rights(PBR) – Geographical Indications - Technology Transfer (TT) –Traditional Knowledge – Importance of patents – Patenting of biological materials –Patenting of biotechnological inventions –Sharing the benefits from biotechnology transfer – IPR in India –IPR impacts on Biotechnology Research in India – significance biotechnological patents in India.

UNIT -V BIOSAFETY AND BIOETHICS

Biosafety –Topics of concern – Hazards of Genetically Engineered Microorganisms – Bioremediation –Framework of biosafety regulations in India (committees, Pressure points for the Biosafety Regulations –Assessment of structural changes. Ethics – Bioethics–The ethical and social impacts of biotechnology andbioinformatics.

UNIT -VI Current Contours: (For Continuous Internal Assessment only) Computational Proteomics and Computational Proteomics and Metabolomics.

MATERIALS FOR STUDY AND REFERENCE

1. T. A. Brown, Genomes, 2nd Edition, BIOS Scientific Publishers, Ltd., Oxford, UK, 2002.

2. Baxevanis D and Ouellette BFF, Bioinformatics: A practical guide to the analysis of genes and proteins, 3rd Edition, John Wiley & Sons, Inc.,2005.

3. Sensen CW, Essentials of Genomics and Bioinformatics,Wiley-VCH, 2002.Jenson, O.N., in Proteomics. A Trends Guide (eds Black Stock, Co- and Mann), Elsevier Science, London,1998.

4. S.R.Pennington and M.J.Dunn, Proteomics, Viva Books Pvt. Ltd., New Delhi,2002.

5. Relevant papers from Drug Discovery Today - Trendsjournals

6. N.R.Subbaram, what everyone should know about patents, 2ndEdition, Pharma Book Syndicate,Hyderabad,2006.

7. Philip W.Grubb, Patents for Chemicals, Pharmaceuticals and BiotechnologyFundamentals of Global Law practices and strategy, 4th Edition, Oxford University Press,2006.

8. R.C. Dubey, A Textbook of Biotechnology, S.Chand & Company,1993.

9. Ben Mepham, Bioethics-an Introduction for the biosciences, Oxford University Press, 2005.

WEB RESOURCE LINKS

- https://abi.inf.uni-tuebingen.de › Teaching › Previous Semesters › WS 2011/12 ¬ https://link.springer.com/journal/40282
- https://bioinf.mpi-inf.mpg.de/teaching/atngsa_13_14.php

COURSE OUTCOMES:

- After completion of this course student would be able to
- Learn the details about *in silico* screening.
- Provide the details about sequence assemblers and finishing method.
- Explain the SNP Types and discovery methods and Databases.
- Write the Intellectual property rights and details about the types of IPR.
- List the details about the Framework of bio safety regulations in India.
- Describe the scope of pharmaceutical bioinformatics.
- Be familiar with the details about the novel gene discovery.
- Understand the details about Microarray techniques.

PHARMACOINFORMATICS

COURSE CODE: 22BI9CO03.1 CREDIT: 5

COURSE OBJECTIVES

- The course intends to provide knowledge about pharmacogenomics and drug design using genomic applications for drug action and toxicity.
- To understand how individualization of drug therapy can be achieved based on a person's genetic makeup while reducing unwanted drug effects.

UNIT I PHARMACOGENOMICS

Pharmacogenetics - Roots of pharmacogenomics and it is not just pharmacogenomics, Genetic drug response profiles, the effect of drugs on Gene expression, pharmacogenomics in drug discovery and drug development. Concept of individualized drug therapy, Drivers and the promise of personalized medicine- Strategies for application of pharmacogenomics to customize therapy, Barriers.

UNIT II HUMAN GENOME

Expressed sequence Tags (EST) and computational biology, Microbial genomics, computational analysis of whole genomes, computational genome analysis, Genomic differences that affect the outcome of host pathogen interactions, Protein coding genes, repeat elements, genome duplication, analysis of proteome, DNA variation, Biological complexity. Single nucleotide polymorphisms (SNP's) in Pharmacogenomics - approaches, number and types of SNPs, Study design for analysis, Analytical issues, Development of markers. Role of SNP in Pharmacogenomics. Impact of SNPs on Translation.

UNIT III ASSOCIATION STUDIES IN PHARMACOGENOMICS

Viability and Adverse drug reaction in drug response-Multiple inherited genetic factors influence the outcome of drug treatments-Association studies in Pharmacogenomics-Strategies for pharmacogenomics Association studies- Benefits of Pharmacogenomics in Drug R & D.

UNIT IV DRUG DISCOVERY PROCESS

Platform technologies and Pharmaceutical process, its applications to the pharmaceutical industry, Understanding biology and diseases, Target identification and validation, Drug candidate identification and optimization, safety and toxicology studies. The need of protein structure information, protein structure and variation in drug targets-the scale of problem, Mutation of drug targets leading to change in the ligand binding pocket.

UNIT V PERSONALIZED MEDICINE

Personalized medicine approach for prescribing antipsychotics, antidepressants, antiepileptics, antidiabetics, cardiovascular drugs, NSAIDs, analgesic drugs, hypnotics , anxiolytics drugs, gastrointestinal drugs, immunosuppressants-Genetic counseling- Medical liability for Pharmacogenomics -Commercial and regulatory aspects of Pharmacogenomics:

Ethical issues of personal genetic information/ Individualized medicine-Economics of Pharmacogenomics testing in clinical practice-Regulatory guidelines involving Pharmacogenomics-Intellectual property and commercial aspects of Pharmacogenomics

MATERIALS FOR STUDY AND REFERENCE

1. Martin M. Zdanowicz, M.M. “Concepts in Pharmacogenomics” Second Edition, American Society of Health-System Pharmacists, 2017.
2. Licinio, J and Wong, Ma-Li. “Pharmacogenomics: The Search for the Individualized Therapies”, Wiley-Blackwell, 2009.
3. Yan Q, “Pharmacogenomics in Drug Discovery and Development” Humana Press, 2nd Edition, 2014.
4. Brazeau, D.A. and Brazeau, G.A. “Principles of the Human Genome and Pharmacogenomics” American Pharmacist Association, 2011
5. Werner, K., Meyer, U.A., Tyndale, R.F. “Pharmacogenomics”, Second Edition, Taylor and Francis, 2005.
6. Langman, L.J. and Dasgupta, A. "Pharmacogenomics in Clinical Therapeutics", Wiley – Blackwell, 2012

COURSE OUTCOMES:

- At the completion of course, the student will be able to
- Distinguish the effect of genetic differences between individuals in the outcome of drug therapy and in drug efficacy and toxicity.
- Describe the role of single nucleotide polymorphism as a biomarker for the prediction of risk, therapeutic response and prognosis of malignancies.
- Utilize and manage the new genomics based tools as they become available as well as make best treatment choices.

AGRICULTURE BIOINFORMATICS

COURSE CODE: 22BI9CO03.2 CREDIT: 5

COURSE OBJECTIVES

- To impart an introductory knowledge about the subject of Agriculture Bioinformatics to the students studying any discipline of science.
- To discuss the specialized topics and recent advances in the field of agriculture bioinformatics

UNIT-I BIOINFORMATICS AND NGS TECHNOLOGIES

Advances in agricultural bioinformatics: an outlook of multi "omics" approaches-Promises and benefits of omics approaches to data-driven science industries-Chloroplast genome and plant–virus interaction-Bioinformatics intervention in functional genomics: current status and future perspective-Genome informatics: present status and future prospects in agriculture-Genomics and its role in crop improvement

UNIT-I OMICS TECHNOLOGIES IN AGRICULTURE

Tools and Applications for Developing More Effective Immunotherapies - Bioinformatics Strategies Associated with Important Ethnic Medicinal Plants-Mining Knowledge from Omics Data-Bioinformatic Tools in the Analysis of Determinants of Pathogenicity and Ecology-Genome-wide predictions, structural and functional annotations of plant transcription factor gene families-Proteomics as a tool to understand the biology of agricultural crops-Metabolomics and sustainable agriculture

UNIT-III PLANT BREEDING

Omics approaches for biotic, abiotic, and quality traits improvement- Single-nucleotide polymorphism discovery and its applications in plant breeding-Whole transcriptomics-based marker prediction in agricultural crops-RNA-sequencing in crops responding to abiotic stress-small RNAs: a tiny silent tool against agriculture pest-Omics-assisted understanding of BPH resistance in rice

UNIT-IV ARTIFICIAL INTELLIGENCE AND AGRIBOTS

Cloud Computing in Agriculture-Deep Learning in agricultural sciences-Image processing–based artificial intelligence system for rapid detection of plant diseases-Next-generation farming: Role of artificial intelligence, sensor technology, big data in agriculture-Artificial intelligence: a way forward for agricultural sciences

UNIT-IV NEXT GENERATION FARMING

Concepts and applications of bioinformatics for sustainable agriculture-Next generation genomics: Decoding domestication history of crops-Molecular markers for crop improvement in postgenomic era- Structural and functional genomics technologies in crop nutrition- Plant metabolomics-Soil microbiota using metagenomic approach for sustainable agriculture-Computational analysis for plant virus and viroid analysis-Bioremediation of atrazine by following metabolic modeling

MATERIALS FOR STUDY AND REFERENCE

- Agricultural Bioinformatics (2021) by Kavi Kishor, Springer Nature
- Bioinformatics in Agriculture (2022) by Pradeep Sharma, Dinesh Yadav, R.K. Gaur. Elseivier
- Agriculture Bioinformatics (2021) By R. Keshavachandran, S. Raji Radhakrishnan. ISBN 9781032024585

COURSE OUTCOMES:

- At the completion of course, the student will be able to
- Understand the omics technologies in agriculture
- Gain the deep knowledge in plant breeding and artificial intelligence and agribots

NGS TECHNIQUES AND DATA ANALYSIS

COURSE CODE: 22BI9EC03.1 CREDIT: 4

COURSE OBJECTIVES

- To get acquainted with the high throughput sequencing data and its processing.
- Since these data often pose a problem of big data domain, the existing algorithm to tackle such problems will be discussed with the limits and lacunas of each such existing technique.
- This will enable the students to ponder more about the string processing techniques and to come with novel approach of genomic strings processing.

UNIT-I NGS PLATFORMS

NGS platforms-Roche 454-GS FLX Titanium-Illumina Genome Analyzer IIX-Life Technologies SOLiD4-Helicos Biosciences Heliscope-Pacific Biosciences SMRT-Template preparation methods for NGS-Emulsion PCR-Gridded rolling circle nanoballs-DNA colony generation-Single-molecule templates-Sequencing approaches-Pyrosequencing-Sequencing by reversible terminator chemistry-Sequencing-by-ligation mediated by ligase enzymes-Phospholinked Fluorescent Nucleotides or Real-time sequencing

UNIT-II DNA SEQUANCING

DNA sequencing, strings, and matching: DNA sequencers and working principle, DNA as a string-Parsing and manipulating real genome sequences and real DNA sequencing data-Naive exact matching, homology detection; optimal pair-wise sequence alignment, alignment score statistics, efficient database searches (BLAST), Data science of metabolomics, pathway models

UNIT-III DYNAMIC PROGRAMMING

Preprocessing, indexing and approximate matching: Improving on naïve exact matching with Boyer-Moore. Preprocessing and indexing-Indexing through grouping and ordering, k-mers and k-mer indexes-Approximate matching and the pigeonhole principle-Edit distance, assembly, overlaps: Hamming and edit distance-Algorithms for computing edit distance-Dynamic programming-Global and local alignment-De novo assembly-Overlaps and overlap graphs

UNIT-IV ALGORITHMS

Algorithms for assembly: Shortest common superstring and the greedy version-How repetitive DNA makes assembly difficult-De Bruijn graphs and Eulerian walks-How real assemblers work-The future of assembly.

UNIT-V DATA ANALYSIS

Data variability and replication-Data transforms, Clustering, Dimension reduction-Pre-processing and normalization-Linear models with categorical covariates-Logistic regression-Null and alternative hypotheses analysis-false discovery rate-permutation and bootstrapping-Gene expression repository (GEO)

MATERIALS FOR STUDY AND REFERENCE

1. Analytical Techniques In DNA Sequencing by Veena Kumari
2. DNA Sequencing From Experimental Methods To Bioinformatics by Alphey, Luke Next-Generation Sequencing Data Analysis by Xinkun Wang

COURSE OUTCOMES:

- Trained individuals with basic knowhow of the string processing techniques
- To good understanding about the tools for such data analytics.

DRUG AND PHARMACEUTICAL BIOTECHNOLOGY

COURSE CODE: 22BI9EC03 .2 CREDIT: 4

COURSE OBJECTIVES

- To know therapeutic categories such as vitamins, Drug and Pharmaceutical Industry
- To learn terapeutic agents, their use and economics

UNIT- I INTRODUCTION
Development of Drug and Pharmaceutical Industry: Therapeutic agents, their use and economicsRegulatory aspects.

UNIT- II DRUG METABOLISM AND PHARMACOKINETICS
Drug metabolism: physico chemical principles, radio activity-pharma kinetic action of drugs on human bodies.

UNIT- III IMPORTANT UNIT PROCESSES AND THEIR APPLICATIONS
Bulk drug manufacturers- Type of reactions in bulk drug manufacture and processes- Special requirement for bulk drug manufacture.

UNIT- IV MANUFACTURING PRINCIPLES
Compressed table- wet granulation-dry granulation or slugging-direct compression-tablet pressescoating of tablets, capsules-sustained action dosage forms-parental solution-oral liquids-injectionsointment-topical applications- Preservation, analytical methods and test for various drug and pharmaceuticals-packing: packing techniques, quality management, GMP.

UNIT- V PHARMACEUTICAL PRODUCT AND THEIR CONTROL
Therapeutic categories such as vitamins-laxatives- analgesics- nonsteroidal contraceptivesAntibiotics, biologicals- hormones.

UNIT -VI Current Contours: (For Continuous Internal Assessment only) Cutting edge research techniques in drug design and molecular pharmacology, and in evaluating mechanisms of drug action at the molecular level through to complex integrated systems

MATERIALS FOR STUDY AND REFERENCE

1. Leon Lachman et al, Theory and Practice of Industrial Pharmacy, 3 Edition, Lea and Febiger, 1986.

2. Remington‟s, Pharmaceutical Science, Mark Publishing and Co. WEB RESOURSE LINKS vle.du.ac.in/mod/book/view.php?id=12963&chapterid=27926 https://www.ck12.org/c/chemistry/amino-acids/?by=community www.bioinformatics.org/strap/createStrapLinks2.html

COURSE OUTCOMES

- After completion of this course student would be able to
- Justify the details about the pharma kinetic action of drugs on human bodies.

- Inspect the facts about the drug metabolism.
- Synthesize the details about the bulk drug manufacturers.
- Characterize the vitamins, laxatives and analgesics.
- Describe the details about the drug development and pharmaceutical industry.
- Explain the types of reactions in bulk drug manufacture and processes.
- Illustrate the facts about the hormones.
- Use the details about the analytical methods and test for various drug and pharmaceuticals.

FIFTH YEAR

SEMESTER X

Course Code	Name of the Course	Credits	Teaching Hours	Maximum Marks		
				CIA	ESE	Total
SEMESTER – X						
22 BI10CP02	Project	15	30	50	150	200
	Seminar, Library, Leveraging E-Resources	--	--	--	--	--
	Total	15 (230)	30	50	150	200 (6500)

Maximum marks for CIA = 50

Maximum marks for ESE = 150

Total = 200