VIVEKANANDHA
COLLEGE OF ARTS AND SCIENCES FOR WOMEN
[AUTONOMOUS]

An ISO 9001:2008 Certified Institution
Affiliated to Periyar University
(Approved by AICTE and Re-accredited with „A“ Grade by NAAC)
Recognized Under 2(f) and 12 (b) of UGC Act, 1956.
Elayampalayam, Tiruchengode-637 205, Namakkal Dt., Tamil Nadu, India

DEPARTMENT OF BIOTECHNOLOGY
Master of Science

M. Sc SYLLABUS

[For the Candidates admitted on 2018-2019 onwards under Autonomous, CBCS & OBE pattern]

SPONSORED BY
ANGAMMAL EDUCATIONAL TUST
ELAYAMPALAYAM – 637 205, TIRUCHENGODE Tk., Namakkal Dt., Tamil Nadu
VEERACHIPALAYAM – 637 303, SANKARI Tk., Salem Dt., Tamil Nadu
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College Vision & Mission

Vision

- To be an academic institution exclusively for women, in dynamic equilibrium with the social and economic environment, strive continuously for excellence in education, research and technological service to the nation.

Mission

- The mission of our institution is to discover, teach and apply knowledge for the intellectual, cultural, ethical, social and economic growth of women students.

DEPARTMENT OF BIOTECHNOLOGY

Vision

To be recognized as a centre for excellence in Biochemistry that provides an atmosphere to acquire skills in identifying the link between biological and human resources and transform it to enhance the quality of life.

Mission

- To help the students to gain more knowledge through visits to research Institutions, Industries, and hospitals through Job training and project work.
- To give an opportunity to students to meet eminent scientists working in various fields of Biochemistry by way of invited lectures, seminars & workshops
- Designing strategies and catalysts for making chemical bonds in new ways
- To provide opportunities to get hands on experience in –
  - Research oriented education in Biochemistry
  - Molecular Biology and Biotechnology
  - Apprenticeship in industries and service agencies
  - Entrepreneurship in Biochemistry-related areas.
- Promote research based projects/activities in the emerging areas of technology convergence.

Programme Educational Objectives

PEO 1: To The program has been designed to bridge the gap between industry requirements and the growing demand for skilled manpower in life science sector.

PEO 2: Hands on training in practical techniques, which are being, used commonly like culture methods, biochemical techniques etc. will be provided.

PEO 3: Students will examine a range of practical applications and at the end of the course they should carry out a project work in a selected sector of industry.

PEO 4: The selection of project work will reflect the areas of interest to the student and will provide an excellent opportunity for employment in that sector.

After completion of the program the Graduates will be able to

PO1: Have sound knowledge of fundamental biochemical principles in the area of biochemistry

PO2: To perform and design effective experimental and critical analysis of data..

PO3: To explore multi disciplinary academic endeavors

PO4: Acquire professional careers in different fields like clinical laboratories, food and pharmaceutical industries.

IV. ELIGIBILITY FOR ADMISSION

- M. Sc., Biotechnology- (2 years) - Bachelor degree in Physical (Physics and Chemistry), Biological (Botany and zoology). Biochemistry, Microbiology, Biotechnology, Agricultural, Veterinary, Fisheries Sciences, Pharmacy/ Engineering/ Technology or equivalent degree.

V. DURATION OF THE COURSE

- The course shall extend over a period of two academic years consisting of four semesters. Each academic year will be divided into two semesters. The First semester will consist of the period from July to November and the Second semester from December to March.

VI ASSESSMENT

Assessment of the students would be made through Continuous Internal Assessment (CIA) and External Assessment (EA) for passing each subject both theory and practical papers.

A candidate would be permitted to appear for the External Examination only on earning 75 % of attendance and only when his / her conduct has been satisfactory. It shall be open to grant exemption to a candidate for valid reasons subject to conditions prescribed.

A. CONTINUOUS INTERNAL ASSESSMENT (CIA)

The performance of the students will be assessed continuously by the teacher concern and the Internal Assessment Marks will be as follows:

Distribution Of Continuous Assesment Marks (25/40)

Activity	Period (WD)	Marks (25)	Activity	Marks (40)
Attendance	90	5	Attendance	5
CA Test I	30 to 35	2.5	CA Test I/Review	5
CA Test II	60 to 65	2.5	CA Test II/Review II	5
Model	After 90	10	Model/Model Presentation	10
Assignment	15 to 20	1	Observation note	10
Poster	30 to 35	1	Results in lab/Work	5
PowerPoint	45 to 50	1		
Skit	60 to 65	1		
Group discussion	65 to 70	1		
Total		**25**		**40**

Distribution of attendance mark

S. No.	Percentage	Marks	
		Theory	Practical
1	76-80	1	2
2	81-85	2	4
3	86-90	3	6
4	91-95	4	8
5	96-100	5	10

A. EXTERNAL ASSESSMENT (EA)

The performance of the students would be assessed by examination at the end of each semester with a written test for theory for three hours and practical examination at the end of even semesters for six hours. Question papers would be set by the selected external examiners in the prescribed format and valuated by the external examiners with the help of the teacher concern.

The pattern of assessment is as follows:

Distribution Of Final Assesment Marks (75/60)

Section	Activity	Marks (75)	Activity	Marks (60)
A	Five marks (Either or)	25	Record work	5
B	Ten marks (Either or)	50	Viva Voce	5
			Spotter	20
			Major (Performance)	5
			Major (Result)	5
			Major (Writeup)	10
			Minor (Performance)	2
			Minor (Result)	3
			Minor (Writeup)	5
Total		**75**	**Total**	**60**

VII. PASSING MINIMUM

INTERNAL

There is no passing minimum for CIA

EXTERNAL

In the EA, the passing minimum shall be 40% out of 75 Marks. (30 Marks)

VIII. CLASSIFICATION OF SUCCESSFUL CANDIDATES

Successful candidates passing the examination of Core Courses (main and allied subjects) and securing marks

a) 75 % and above shall be declared to have passed the examination in first class with Distinction provided they pass all the examinations prescribed for the course at first appearance itself.
b) 60% and above but below 75 % shall be declared to have passed the examinations in first class without Distinction.

c) 50%and above but below 60% shall be declared to have passed the examinations in second class.
d) All the remaining successful candidates shall be declared to have passed the examinations in third class.
e) Candidates who pass all the examinations prescribed for the course at the first appearance itself and within a period of three consecutive academic years from the year of admission only will be eligible for College rank.

IX. ELIGIBILITY FOR AWARD OF THE DEGREE

A candidate shall be eligible for the award of the degree only if she has undergone the above degree for a period of not less than three academic years comprising of six semesters and passed the examinations prescribed and fulfilled such conditions has have been prescribed therefore.

X. PROCEDURE IN THE EVENT OF FAILURE

Candidates fail in any subject would be permitted to appear for each failed subject or subjects in the subsequent EA. However, final year students failed in one or two subjects would be allowed to appear for a supplementary exam within a month of the final result.

XI. COMMENCEMENT OF THESE REGULATIONS

These regulations shall take effect from the academic year 2018-19(i.e.,) for the students who are to be admitted to the first year of the course during the academic year 2018-19 and thereafter.

XII. TRANSITORY PROVISIONS.

Candidates who have undergone the PG Course of study before 2018-19 shall be permitted to appear for the examinations under the regulations for a period 2 years i.e. upto and inclusive of the examination of April/May 2018-19. Thereafter, they will be permitted to appear for the examination only under the regulations then in force.

Supplementary examination will be conducted within a month. In case of failure she has to complete within 5 years. (2+5).

For the deserving candidates, if a student fails in a single subject she can be provided with 15 marks in the examination.

XIII. COURSE PATTERN

VIVEKANANDHA COLLEGE OF ARTS AND SCIENCES FOR WOMEN (AUTONOMOUS)
SYLLABUS FRAME WORK

Subjects	Inst. Hour/Week	Credit	Exam Hours	Internal	External	Total Marks	Subjects	Inst. Hour/Week	Credit	Exam Hours	Internal	External	Total Marks
YEAR I													
Semester I							**Semester II**						
Core I	5	5	3	25	75	100	Core III	5	5	3	25	75	100
Core I Practical	5	4	6	40	60	100	Core III Practical	5	4	6	40	60	100
Core II	5	5	3	25	75	100	Core IV	5	5	3	25	75	100
Core II Practical	5	4	6	40	60	100	Core IV Practical	5	4	6	40	60	100
Elective I	4	4	3	25	75	100	Elective II	4	4	3	25	75	100
Elective I Practical	5	3	6	40	60	100	Elective II Practical	5	3	6	40	60	100
Library	1	0	0	0	0	0	Library	1	0	0	0	0	0
Total	**30**	**25**	27	**195**	**405**	**600**	**Total**	**30**	**25**	27	**195**	**405**	**600**
I YEAR TOTAL									**50**	**54**	**390**	**810**	**1200**
YEAR II													
Semester III							**Semester IV**						
Core V	5	5	3	25	75	100	EDC	2	2	3	25	75	100
Core V Practical	5	4	6	40	60	100	Elective IV	4	4	3	25	75	100
Core VI	5	5	3	25	75	100	Elective IV Practical	5	3	6	40	60	100
Core VI Practical	5	4	6	40	60	100	Project work	19	5	6	40	60	100
Elective III	4	4	3	25	75	100							
Elective III Practical	5	3	6	40	60	100							
Value Education (HR)	1	1	3	25	60	100							
Total	**30**	**26**	30	**220**	**465**	**700**	**Total**	**30**	**14**	18	**130**	**270**	**400**
II YEAR TOTAL									**90**	**102**	**740**	**1545**	**2300**

Distribution Of Duration And Credit Under Different Papers

Paper	Hours/Week	Weeks/Semester	Hour/Paper	No. of Papers	Credit/Paper	Total Hours	Total credit
Core paper	5	15	75	6	5	600	30
Core practical	5	15	75	6	4	600	24
Elective paper	4	15	60	4	4	240	16
Elective practical	5	15	75	4	3	240	12
Value Education	1	15	15	1	1	30	1
EDC	2	15	30	1	2	120	2
Project	19	15	285	1	5	120	5
Total			**615**	**23**	**24**	**1950**	**90**

Distribution Of Duration And Content Under Different Papers

S. No.	Hours/Week	Duration/Unit	Topic/Unit
1	1	3	3
2	2	6	6
3	3	9	9
4	4	12	12
5	5	15	15

VIVEKANANDHA COLLEGE OF ARTS AND SCIENCES FOR WOMEN
(AUTONOMOUS)
DEPARTMENT OF BIOTECHNOLOGY
CBCS AND OBE PATTERN SYLLABUS - PG
(For candidates admitted from 2018-2019 onwards)

Paper Code	Papers	Paper Title	Inst. Hour/Week	Credit	Exam Hours	Internal	External	Total Marks
YEAR I		**Semester I**						
18P1BT01	Core I	Cell and Molecular Biology	5	5	3	25	75	100
18P1BT02	Core II	Biochemistry, Biophysics and Bioinstrumentation	5	5	3	25	75	100
18P1BTE01	Elective I	General Microbiology	4	4	3	25	75	100
18P1BTP01	Core I Practical	Lab in Cell and Molecular Biology	5	4	6	40	60	100
18P1BTP02	Core II Practical	Lab in Biochemistry Biophysics and Bioinstrumentation	5	4	6	40	60	100
18P1BTEP01	Elective I Practical	Lab in General Microbiology	5	3	6	40	60	100
	Library		1	0	0	0	0	0
Total			**30**	**25**	27	**195**	**405**	**600**
YEAR I		**Semester II**						
18P2BT03	Core III	Immunology and Immunotechnology	5	5	3	25	75	100
18P2BT04	Core IV	Genetic Engineering	5	4	6	40	60	100
18P2BTE02	Elective II	Bioprocess and Microbial Technology	4	4	3	25	75	100
18P2BTP03	Core III Practical	Lab in Immunology and Immunotechnology	5	5	3	25	75	100
18P2BTP04	Core IV Practical	Lab in Genetic Engineering	5	4	6	40	60	100
18P2BTEP02	Elective II Practical	Lab in Bioprocess and Microbial Technology	5	3	6	40	60	100
	Library		1	0	3	25	60	100
		Total	**30**	**25**	27	**195**	**405**	**600**
I YEAR TOTAL				**50**	**54**	**390**	**810**	**1200**

Paper Code	Papers	Paper Title	Inst. Hour/Week	Credit	Exam Hours	Internal	External	Total Marks
YEAR II		**Semester III**						
18P3BT05	Core V	Plant and Animal Biotechnology	5	5	3	25	75	100
18P3BT06	Core VI	Environmental Biotechnology	5	5	3	25	75	100
18P3BTE03	Elective IV	Genomics and proteomics	4	4	3	25	75	100
18P3BTP05	Core V Practical	Lab in Plant and Animal Biotechnology	5	4	6	40	60	100
18P3BTP06	Core VI Practical	Lab in Environmental Biotechnology	5	4	6	40	60	100
18P3BTEP03	Elective IV Practical	Lab in Genomics and proteomics	5	3	6	40	60	100
18P3BTV01	Value Education (HR)	Human Rights	1	1	3	25	60	100
Total			**30**	**25**	27	**195**	**405**	**600**
YEAR II		**Semester IV**						
18P4MBED1	EDC	Plant and Animal cell culture techniques	2	2	3	25	75	100
18P4BTE04	Elective III	Research Methodology and Bioinformatics	4	4	3	25	75	100
18P4BTEP04	Elective III Practical	Lab in Research Methodology and Bioinformatics	5	3	6	40	60	100
18P4BTPR01	Project work	Project &Viva voce	19	5	6	40	60	100
Total			**30**	**14**	18	**130**	**270**	**400**
II YEAR TOTAL				**90**	**102**	**740**	**1545**	**2300**

YEAR I – SEMESTER I
CELL AND MOLECULAR BIOLOGY

Paper	: Core I	Total Hours	: 75
Hours/Week	: 5	Exam Hours	: 03
Credit	: 5	Internal	: 25
Paper Code	: **18P1BT01**	External	: 75

Aim:

To get knowledge about structure and function of cells at molecular level like, cellular energetic, protein trafficking, bio molecules and cellular development.

Objective:

The objective of the paper is to make the students to understand the cell structure and its general function**,** nucleic acids and their function, transcription and translation, mutation, cell signaling and oncobiology.

OUTCOME:

CO1 Familiarize about the cell theory, cell structure and organelles.

CO2 To gain knowledge about nucleic acids and their structure, replication and DNA repair mechanisms.

CO3 Understanding the molecular mechanism behind the transcription and translation and regulation of gene expression.

CO4 Evolve the gene mutation and mechanisms, cell cycle and cell differentiation.

CO5 Exposure in signal transduction mechanisms and cancer biology and genetic mobile elements.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4
CO1	S	S	M	S
CO2	S	S	M	S
CO3	S	M	M	M
CO4	S	S	S	S
CO5	S	S	S	M

S- Strong; M-Medium; L-Low

CONTENT:

Unit I – (15 Hrs.): Cell: Cell theory - Ultra structure of prokaryotic and eukaryotic cells. cellular organelles – structure and functions of cell wall, Plasma membrane, Mitochondria, Chloroplast, Endoplasmic reticulum, Ribosomes, Golgi complex, Vacuoles, Peroxysomes, Lysosome, Nucleus, Chromosomes and their organization.

Unit II – (15 Hrs.): Introduction to Nucleic acid: Types and their structure – DNA and RNA as genetic material – Evidences. DNA Replication in Prokaryotes and Eukaryotes: Mechanism – Replication of RNA genome, Replicase and reverse transcriptase. DNA repair mechanisms- direct reversal; Excision repair (base excision, nucleotide excision and mismatch); re-combinational repair; SOS response and SOS bypass.

Unit III – (15 Hrs.): Transcription and translation: Transcription: initiation, elongation and termination (rho-dependent and independent) of RNA synthesis; eukaryotic promoters, enhancers, transcription factors, RNA polymerases; various protein motifs involved in DNA-protein interactions during transcription. Translation: Prokaryotes and eukaryotes translation and their regulation, processing of mRNA for translation (e.g. 5' capping and splicing) and involvement of different translational factors at different stages of the process. Regulation of gene expression (Lac and Trp operons).

Unit IV – (15 Hrs.): Mutation: Gene Mutation and its mechanism ; Types of mutation: Forward; Reverse; Intragenic suppressor; Extragenic suppressor; point mutations; Missense; Nonsense; mutation. Mutagenesis- spontaneous and induced. **Cell cycle:** Cell division (Mitosis and Meiosis), Apoptosis and its significance, cell differentiation.

Unit V – (15 Hrs.): Cell signaling: Signal Transduction. Role of CAM, Calmodulin as the second messenger. **OncoBiology:** Induction of Cancer: characteristics & causes, oncogenes and tumour suppressor genes. Recombination - Models; Rec A, RecBCD, Ruv ABC, and molecular mechanism of recombination. Transposons - simple and complex in prokaryotic and eukaryotic systems.

TEXT BOOKS:

- Paul, A. 2007. Text Book of Cell and Molecular Biology, Books and Allied (P) Ltd. 2nd edition, Kolkata 700 009, pp-1310.

REFERENCE BOOKS:

- Verma, P. S. and Agarwal, V. S. 2005. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology. S Chand and Company Ltd., New Delhi 110 055, pp-294.
- Malacinski, G. M. 2008. Freifelder's Essentials of Molecular Biology. 4th edition, Narosa Publishing House Private Ltd., Chennai 600 006, pp-491.
- Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., and Walter, P. 2002. Molecular biology of the cell (4th ed.): Garland Publishing, New York, pp-1462.
- Lodish, H., Berk, A., Zipursky, S. L., Matsudaira, P., Baltimore, D. Darnell, J. 2000. Molecular Cell Biology, 4th ed. W. H. Freeman and Company, New York 10010, pp-1084.
- Karp G. 2002. Cell and Molecular Biology, 3rd Edition. John Wiley and Sons Inc., United States, pp-785.

PEDOGOGY: CHALK and Talk , PPT, Seminar, Models

M.Sc., BIOTECHNOLOGY
QUESTION PAPER PATTERN
MAXIMUM MARKS – 75 marks
DURATION – 3 hours

PART – A (5 X 5 = 25 marks)

1. Either or Type

2. From each unit two questions

PART – B (5 X 10 = 50 marks)

3. Either or Type

4. From each unit two questions

VIVEKANANDHA COLLEGE OF ARTS AND SCIENCES FOR WOMEN
(AUTONOMOUS)
MODEL QUESTION PAPER M.Sc. BIOTECHNOLOGY
YEAR I – SEMESTER I (2018-19)

CELL AND MOLECULAR BIOLOGY

Paper	: Core I	Section - A (5X5)	: 25
Examination	: External	Section – B (10X5)	: 50
Time	: Three Hours		
Paper Code	: **18P1BT01**	Maximum Marks	: 75

Section-A (Answer All The Questions)

1. a) Explain about Cell theory **(or)**
   b) Write a brief note on Plasma memberane
2. a) Explain about DNA replication in prokaryotes **(or)**
   b) Explain briefly about the DNA and its types
3. a) Write a note on processing of mRNA **(or)**
   b) Write about the Trp operons
4. a) Write short notes on spontaneous mutations **(or)**
   b) Briefly explain about cell differentiation
5. a) Explain about the Role of Calmodulin as the second messenger **(or)**
   b) Write about Transposons

Section-B (Answer All The Questions)

6. a) Explain in detail about the Chromosomes and their organization. **(or)**
   b) Give a detailed account on Mitochondria, structure and functions.
7. a) Briefly explain about the DNA repair systems.**(or)**
   b)Give a detailed account on Replication of RNA.
8. a) Write a brief note on Transcription.**(or)**
   b) Give a detailed account on the Regulation of gene expression
9. a) Explain in detail about the cell cycle **(or)**
   b) Write an essay on Gene Mutation and its mechanism
10. a) Give a detailed account on tumour suppressor genes **(or)**
    b) Give a detailed account on Recombination and its models

YEAR I – SEMESTER I
LAB IN CELL AND MOLECULAR BIOLOGY

Paper	: Core Practical I	Total Hours	: 75
Hours/Week	: 5	Exam Hours	: 06
Credit	: 3	Internal	: 40
Paper Code	: **18P2BTPO1**	External	: 60

CO1	Learn and understand the principles of microscopy, DNA isolation and AGE
CO2	Demonstrate the mitosis and meiosis
CO3	Analyze, interpret and identify cell size by micrometry and heamocytometer

MAJOR PRACTICAL:

Lab 1 – (10 hrs.): Microscopy (Principles of microscopy, Simple, Compound and Electron microscopes).

Lab 2 – (10 hrs.): Salivary gland Chromosomes squash preparation from *Chironomous larvae.*

Lab 3 – (10 hrs.): Demonstration of various stages of mitosis using onion root tip.

Lab 4 – (10 hrs.): Demonstration of various stages of meiosis using grasshopper testis squash.

Lab 5 – (10 hrs.): Bacterial Transformation and Conjugation.

MINOR PRACTICAL:

Lab 1 – (4 hrs.): Mounting Buccal epithelium and observing the living cells.

Lab 2 – (4 hrs.): Measurement of cell size by Micrometry.

Lab 3 – (4 hrs.): Barr body identification.

Lab 4 – (4 hrs.): Isolation of Genomic DNA and visualization by AGE.

Lab 5 – (4 hrs.): Cell counting by Haemocytometer.

SPOTTERS (5 hrs.): SEM,TEM, Haemocytometer, Methhylene blue, Acetocarmine, Aceto-orcein, Polytene Chromosome, Lampbrush Chromosome, Chromosomes, Chloroplast, Photosystem I, Photosystem II, Barr body, Microtome, Xyelne, Ocular Microtometer, Stage Microtometer, Prophase, Metaphase, Anaphase, Telophase, Meosis I, Meosis II, Chlorophyll, Carotenoid, Spectrophotometer, Beer-Lamberts Law, Robert Hooke, Murray Barr, Compound microscope, Mitochondria.

REFRENCE BOOKS:

Sinha, J., Chatterjee, A. K. and Chattopadhyay, P. 2001. Advanced Practical Zoology, 2nd Edition, Books and Allied (P) Ltd., Kolkata, P-1038.

Swamy, P. M. 2009. Laboratory manual on Biotechnology, Ist Edition, Rastogi publications, India, P-618.

LAB IN CELL AND MOLECULAR BIOLOGY

Paper	: Core Practical I	Major (1X20)	: 20
Examination	: External	Minor (1X10)	: 10
Time	: Six Hours	Spotters (5X4)	: 20
Paper Code	: **18P1BTPO1**	Record (1X5)	: 5
Batch	:	Viva Voce	: 5
Date	:	Maximum Marks	: 60

MAJOR (Answer All the Questions)

a. Perform the identification of various stages of mitosis using onion root tip. **(or)**

b. Perform Isolation of Plant Genomic DNA and visualization by AGE

MINOR (Answer All the Questions)

a. Measure the size of given cell samples by Micrometry. **(or)**

b. Perform the Barr body identification

SPOTTERS (Answer All the Questions)

Identify the given spotters and discuss (A, B, C and D,E.).

VIVEKANANDHA COLLEGE OF ARTS AND SCIENCES FOR WOMEN
(AUTONOMOUS)
MODEL QUESTION PAPER M.Sc. BIOTECHNOLOGY
YEAR I – SEMESTER I (2018-19)

LAB IN CELL AND MOLECULAR BIOLOGY

Paper	: Core Practical I	Major (1X20)	: 20
Examination	: External	Minor (1X10)	: 10
Time	: Six Hours	Spotters (5X4)	: 20
Paper Code	: **18P1BTPO1**	Record (1X5)	: 5
Batch	:	Viva Voce	: 5
Date	:	Maximum Marks	: 60

KEY

MAJOR

Onion root tip, glass wares, chemicals Bacterial broth, Microscope, Electrophoresis tank, UV- transilluminator.

MINOR

Glass slide, microscope, Haemocytometer, Metheylene Blue and necessary glassware's are to be provided.

SPOTTERS

1.Meiosis,

2. Methhylene blue,

3. Microtome

4. Mitochondria

5. Robert Hooke.

RECORD

VIVA-VOCE

YEAR I – SEMESTER I
BIOCHEMISTRY, BIOPHYSICS AND BIOINSTRUMENTATION

Paper	: Core II	Total Hours	: 75
Hours/Week	: 5	Exam Hours	: 03
Credit	: 5	Internal	: 25
Paper Code	: **18P1BT02**	External	: 75

Aim:

To provides information about structure and functions of cellular components such as proteins, carbohydrates, lipid, nucleic acids and other biomolecules along with techniques of physical science to study biological systems.

Objective:

The objective of the paper is to make the students to understand the structure and classification of Carbohydrates and proteins, biosynthesis and metabolism of lipids and vitamins, enzyme kinetics and nucleic acid metabolism, importance of electrophoresis and centrifugation, basic principles of various spectroscopy and chromatography

OUTCOME:

CO1	Familiarize about the carbohydrate classification and carbohydrate metabolism, protein structure and aminoacid metabolism.
CO2	Getting knowledge about structure, function, classification and metabolism of lipids, vitamin deficiencies.
CO3	Understanding the definition, classification, mechanism of action of enzymes and chemical properties of nucleic acids.
CO4	Learning about biophysics and its techniques, structural understanding of nucleic acids and proteins, electrophoresis and centrifugation techniques.
CO5	Exposure in spectroscopy principle and types, chromatography techniques and classification.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4
CO1	S	S	S	M
CO2	S	S	M	S
CO3	S	M	S	S
CO4	S	S	S	S
CO5	M	S	S	M

S- Strong; M-Medium; L-Low

CONTENT:

Unit I – (15 Hrs.): Carbohydrates and Proteins: Definition and classification of carbohydrates. Concepts of isomerism and epimers. Mono, Di and Polysaccharides. Clinical significance of carbohydrate deficiencies. Carbohydrate metabolism-Glycolysis, Gluconeogenesis, Glycogenesis, Glycogenolysis, HMP shunt, TCA cycle. Definition, classification, structure and functions of aminoacids and proteins. Protein architecture. Clinical significance of proteins deficiencies. Amino acid metabolism: Transamination and deamination reactions. Urea cycle and its clinical significance.

Unit II – (15 Hrs.): Lipids and Vitamins: Definition, structure, functions and reactions of lipids. Fatty acids (saturated and unsaturated - Essential and non-essential). Sterols and its significance. Clinical significance of lipid deficiencies. Lipid metabolism: Biosynthesis of saturated and unsaturated fatty acids, sterols and phospholipids. Beta-oxidation of fatty acids. Definition, structure, classification and functions of fat and water soluble vitamins. Clinical significance of vitamin deficiencies-Hypervitaminosis.

Unit III – (15 Hrs.): Enzymes and Nucleic Acids: Definition, classification, properties of enzymes. Mechanism of enzyme action (Lock & Key model, induced fit hypothesis). Enzyme kinetics: MM equation and LB plot) and enzyme inhibition (Reversible & Irreversible). Coenzymes (FAD & NAD) and Isoenzymes (LDH & ALP). Chemical structure, composition and functions of DNA and RNA. Biological types of nucleic acids. Nucleic acid metabolism: Biosynthesis of purines and pyrimidines - Denovo and salvage pathways. Degradation purines and pyrimidines.

Unit IV – (15 Hrs.): Biophysics: Introduction and scope of biophysics. Nucleic acid and protein structural studies: Transition angle of nucleic acids, sugar puckering model and pseudorotation cycle. Syn-anti orientation of glycosyl bond. Geometry of Watson – Crick and Hoogsteen base pairs. Amino acid confirmations (Phi & Psi angles), Ramachandran plot. **Electrophoresis and Centrifugation:** Principles and applications of Moving boundary, zone, Low and high voltage electrophoresis, gel electrophoresis, SDS-PAGE, isoelectric focusing and continuous flow electrophoresis. Principles and types of centrifugation (Differential, rate-zonal and isopycnic).

Unit V – (15 Hrs.): Spectroscopy and Chromatography: Basic principles of spectroscopy. Laws of absorption. Instrumentation, applications, advantages and disadvantages of UV-VIS, IR, Raman, FTIR, NMR and AAS, Fluorescence spectroscopy. Principle and applications of paper, thin layer, column, GC, HPLC and ion-exchange and size exclusion chromatographic techniques. Potentiometry

PEDOGOGY: CHALK and Talk , PPT, Seminar, Models

REFERENCE BOOKS:

- Sathyanarayana, U. and Chakrapani, U. 2005. Biochemistry, Books and Allied (P) Ltd. Kolkata, p-792.
- Wilson, K. and Walker, W. 2005. Practical Biochemistry – Principles and Techniques, 5th Edition, Cambridge University Press. UK, p-784.
- Rajeswari, M. R. 2013. An introduction to Biophysics, Rastoji publications, Meerut, India, p-368.

REFERENCE BOOKS:

- Lehninger, A. L. 2015. Biochemistry, Kalyani Publishers, New Delhi, p-1104.
- Fersht, A. 1995. Enzyme structure and mechanism, 2nd edition, W.H. Freeman and Company, New York, p-475.
- Boyer, R. 2008. Modern Experimental Biochemistry, 3rd edition, Dorling Kindersley (India) Pvt. Ltd.p-447.
- Garrett R. H. and Grisham C.M. 1999. Biochemistry, 2nd edition, Thompson Brooks, USA, p-1126 – S-0 to S-66.
- Robert, K. M, Daryl, K. G, Peter, A.M, Victor, W. R. 2013. Harper's Illustrated Biochemistry, 26th edition, The Mc Graw Hill, Asia, p-693.

M.Sc., BIOTECHNOLOGY
QUESTION PAPER PATTERN
MAXIMUM MARKS – 75 marks
DURATION – 3 hours

PART – A (5 X 5 = 25 marks)

1. Either or Type

2. From each unit two questions

PART – B (5 X 10 = 50 marks)

3. Either or Type

4. From each unit two questions

VIVEKANANDHA COLLEGE OF ARTS AND SCIENCES FOR WOMEN (AUTONOMOUS)
MODEL QUESTION PAPER M.Sc. BIOTECHNOLOGY
YEAR I – SEMESTER I (2018-19)

BIOCHEMISTRY, BIOPHYSICS AND BIOINSTRUMENTATION

Paper	: Core Paper II	Section - A (5X5)	: 25
Examination	: External	Section – B (10X5)	: 50
Time	: Three Hours		
Paper Code	: **18P1BT02**	Maximum Marks	: 75

Section-A (Answer All the questions)

1. a) Explain the clinical significance of carbohydrate deficiency disorders **(or)**
   b) Write short notes on Urea cycle. Add a note on its clinical significance.
2. a) Explain about sterols and its clinical significance **(or)**
   b) Write about deficiency symptoms of fat soluble vitamins
3. a) Explain the mechanism of enzyme action **(or)**
   b) Explain the adenine synthesis pathway
4. a) Explain the sugar puckering model and pseudorotation cycle of nucleic acids **(or)**
   b) Explain the principle of differential centrifugation
5. a) What are the applications of FTIP spectroscopy **(or)**
   b) Explain the principle of size exclusion chromatography

Section-C (Answer All the questions)

1. a) Give a detailed account on TCA cycle. Add a note on its regulation **(or)**
   b) Write an essay on Transamination and deamination reactions of proteins
2. a) Give a detailed account on beta oxidation of saturated fatty acids **(or)**
   b) Explain the structure, functions, daily requirements, deficiency symptoms of 'B' complex vitamins
3. a) Give a detailed account on Enzyme kinetics with special reference to MM equation and LB plot **(or)**
   b) Give a detailed account on chemical structure, composition and biological functions of DNA
4. a) Write an essay on Ramachandran plot **(or)**
   b) Give a detailed account on SDS-PAGE
5. a) Explain in detail about the principle, instrumentation, applications advantages and disadvantages of Gas chromatography **(or)**
   b) Explain in detail about the principle, instrumentation, applications advantages and disadvantages of Atomic absorption spectroscopy

YEAR I – SEMESTER I
LAB IN BIOCHEMISTRY, BIOPHYSICS AND BIOINSTRUMENTATION

Paper	: Core Practical II	Total Hours	: 75
Hours/Week	: 5	Exam Hours	: 03
Credit	: 3	Internal	: 40
Paper Code	: **18P1BTPO2**	External	: 60

CO1	Understand the qualitative and estimation analysis of carbohydrate, amino acids, DNA and RNA.
CO2	Demonstrate the centrifugation and chromatography techniques.
CO3	To get knowledge in handling pH meter and conductivity meter.

MAJOR PRACTICAL:

Lab 1 – (10 hrs.): Qualitative analysis of carbohydrates (glucose, fructose, lactose, maltose, sucrose & starch).

Lab 2 – (10 hrs.): Qualitative analysis of amino acids (histidine, tyrosine, tryptophan, methionine, arginine), saturated and unsaturated fattyacids

Lab 3 – (10 hrs.): Estimation of glucose by Anthrone method and protein by Lowry's method.

Lab 4 – (10 hrs.): Estimation of DNA by diphenylamine method

Lab 5 – (10 hrs.): Estimation of RNA by Orcinol method

MINOR PRACTICAL:

Lab 1 – (4 hrs.): Solid liquid separation – centrifugation.

Lab 2 – (4 hrs.): Precision and validity in an experiment using absorption spectroscopy and Validating Lambert-Beer's law using KMn O_4

Lab 3 – (4 hrs.): Separation of amino-acids by paper and thin layer chromatography.

Lab 4 – (4 hrs.): Separation of plant pigments by column chromatography.

Lab 5 – (4 hrs.): Calibration of pH meter & conductivity meter.

SPOTTERS (5 hrs.):

Ninhydrin, Anthrone, Folins reagent, Calculation (Molar, normality solution preparation), Diphenylamine, Cholesterol, Orcinol, pH meter, TLC, Conductivity meter, DNA, RNA, MM equation (graph), LB plot, Colorimeter SDS – PAGE, AGE, Electron transport chain,Buffers (Acetate, Tris), etc.

VIVEKANANDHA COLLEGE OF ARTS AND SCIENCES FOR WOMEN (AUTONOMOUS)
MODEL QUESTION PAPER M.Sc. BIOTECHNOLOGY
YEAR I – SEMESTER I (2018-19)

LAB IN BIOCHEMISTRY, BIOPHYSICS AND BIOINSTRUMENTATION

Paper	: Core Practical II	Major (1X20)	: 20
Examination	: External	Minor (1X10)	: 10
Time	: Six Hours	Spotters (5X4)	: 20
Paper Code	: **18P1BTPO2**	Record (1X5)	: 5
Batch	:	Viva Voce	: 5
Date	:	Maximum Marks	: 60

MAJOR (Answer All the Questions)

a. Qualitatively analyse the given sugar sample and interprete the results. **(or)**

b. Estimate the amount of DNA present in the given sample

MINOR (Answer All the Questions)

a. Separate the given amino acids sample by paper chromatography.

b. Separate the plant pigments by column chromatgraphy.

SPOTTERS (Answer All the Questions)

Identify the given spotters and discuss (A, B, C, D and E).

VIVEKANANDHA COLLEGE OF ARTS AND SCIENCES FOR WOMEN (AUTONOMOUS)
MODEL QUESTION PAPER M.Sc. BIOTECHNOLOGY
YEAR I – SEMESTER I (2018-18)

LAB IN BIOCHEMISTRY, BIOPHYSICS AND BIOINSTRUMENTATION

Paper	: Core Practical II	Major (1X20)	: 20
Examination	: External	Minor (1X10)	: 10
Time	: Six Hours	Spotters (5X4)	: 20
Paper Code	: **18P1BTPO2**	Record (1X5)	: 5
Batch	:	Viva Voce	: 5
Date	:	Maximum Marks	: 60

KEY

MAJOR

Sugars (Glucose/sucrose/fructose/lactose/maltose/starch), reagents, test tubes, water bath, microscope etc. **(OR)**

Test tubes, standard DNA (1 mg/ml), Un known sample (0.8mg/ml) (Diphenylamine reagent, Spectrophotometer/Colorimeter, Cuvettes, Wash bottle, blotting tissue paper etc.

MINOR

Amino acid sample (histidine, tyrosine, histidine, proline), Ethanol, Acetic acid, Distilled water, Whatmann filter paper, Glass chamber / Beaker, cover plate, Sprayer etc. **(OR)**

Homogenised leaf suspension, Required solvent system, Chromatographic column, Silica gel.

SPOTTERS

a) Anthrone
b) How much amount of NaOH is required to prepare 0.25N solution in 350ml volume
c) Thin layer chromatography
d) Cholesterol
e) Lineviewer – Burk plot (Graph)

RECORD

VIVA-VOCE

YEAR I – SEMESTER I
GENERAL MICROBIOLOGY

Paper	: Elective I	Total Hours	: 75
Hours/Week	: 4	Exam Hours	: 03
Credit	: 4	Internal	: 25
Paper Code	: **18P1BTE01**	External	: 75

Aim:

To provides information about basic Principles underlying Microbiology its scope, the tools and techniques for better understanding and its interdisciplinary nature.

Objective:

The objective of the paper is to make the students to understand the Microscopic technique, Classification of micro organism, Culture Process, Pathogenic organism & symptoms and Resolution of biogeocycles.

OUTCOME:

CO1	Knowing about scope and history of microbiology, types of microscopy and staining techniques.
CO2	Getting knowledge about microorganism classification, structure and function of bacterial cell.
CO3	Understanding the microbial culture techniques, culture media composition and preparations and bacterial growth curve.
CO4	Getting awareness about bacterial and viral diseases and examination of microbial specimens.
CO5	Exposure in understanding biogeochemical cycles, microflora in soil, microbial interaction with water and soil.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4
CO1	S	S	S	M
CO2	S	M	M	S
CO3	M	S	S	S
CO4	S	S	S	M
CO5	S	M	S	S

S- Strong; M-Medium; L-Low

CONTENT:

Unit I – (15 Hrs.): Introduction to Microbiology: Scope, history of microbiology, Applications. Microscopy: Light Microscope – Bright- field, Dark field, phase contrast, fluorescent. Electron Microscope: TEM and SEM. Staining – simple, Differential stain: Gram's, Acid fast. Special stain – capsule, spore. Fungal stain-KOH, LCB, Hanging drop technique.

Unit II – (15 Hrs.): Classification of microorganisms: Actinomycetes; Fungi, Protozoa & Virus. Bacterial Anatomy-Structure and functions of bacterial cell. Haeckels, Whittaker's, Bergey's system (Prokaryotes) Carl Weese classification, General features and classification of Rickettsiae, Mycoplasma, Archaebacteria, and Prochlorates

Unit III – (15 Hrs.): Microbial culture Techniques: Isolation & maintenance of purecultures. Cultivation of bacteria-aerobes & anaerobes, Culture media-Preparation & Types. Identification of Bacteria-culture characteristics. Microbial growth-Growth curve & Measurement of growth, Nutritional types of microorganism. sterilization & disinfection.

Unit IV – (15 Hrs.): Microorganisms and Disease: Normal microflora, Host Microbe interaction, Immunity-Types. Bacterial diseases (Tuberculosis, Cholera, Typhoid), Viral diseases HIV/ AIDS, Dengue fever, Hepatitis, Protozoan –*Entamoeba histolytica*, Malaria, Fungal- Dermatophytosis, Candidiasis, Collection and examination of Microbiological specimens.

Unit V – (15 Hrs.): Microbial Ecology: Biogeochemical cycles – Carbon, Nitrogen, Phosphorous and Sulphur. Nitrogen fixation. Microflora of soil-Enumeration of bacteria from soil. Microbial decomposition of organic matter. Microbial interaction-Morphology of water-Microbial analysis of Water-Purification &disinfection of water. Microbiology of Air-Enumeration of bacteria in Air-Air sampling methods-Air sanitation.

PEDOGOGY: CHALK and Talk , PPT, Seminar, Models

TEXT BOOK:

- Dubey, R. C. and Maheswari, D. K. 2010. A Text book of Microbiology, S. Chand Publications, New Delhi, p-134.

REFERENCE BOOKS:

- Ananthanarayan, R. and Paniker, C. K. J. 2009. Text book of Microbiology, 8th Edition,Universities Press (India) Private Limited, p-746..
- Purohit, S. S. 2006. Microbiology Fundamentals and Applications, 7th Edition, Agrobios (India), p-1008.
- Prescott, L. M., Harley, J. P. and Klein, D. A. 2002. Microbiology. 5th edition. McGraw Hill Company Inc. p-1026.
- Pelczar JR, M. J. Chan, E. C. S. and Krieg, N. R. 1993. Microbiology,5th edition, McGraw Hill Education (India) Private Limited, p-918.

M.Sc., BIOTECHNOLOGY
QUESTION PAPER PATTERN
MAXIMUM MARKS – 75 marks
DURATION – 3 hours

PART – A (5 X 5 = 25 marks)

1. Either or Type

2. From each unit two questions

PART – B (5 X 10 = 50 marks)

3. Either or Type

4. From each unit two questions

VIVEKANANDHA COLLEGE OF ARTS AND SCIENCES FOR WOMEN
(AUTONOMOUS)
MODEL QUESTION PAPER M.Sc. BIOTECHNOLOGY
YEAR I – SEMESTER I (2018-19)

GENERAL MICROBIOLOGY

Paper	: Elective I	Section - A (5X5)	: 25
Examination	: External	Section – B (10X5)	: 50
Time	: Three Hours		
Paper Code	: **18P1BTE01**	Maximum Marks	: 75

Section-A (Answer All the questions)

1. a) Discuss fluorescent Microscope. **(or)**
   b) Mention briefly about the applications of Microbiology.
2. a) Explain five kingdom concept of classification. **(or)**
   b) Draw a neat sketch on prokaryotic cell.
3. a) Write briefly about the nutritional classification of bacteria. **(or)**
   b) Explain Growth curve with a neat sketch.
4. a) Mention the pathogenesis and diagnosis of Typhoid. **(or)**
   b) Write a note on Candidiasis.
5. a) Write briefly about Carbon cycle. **(or)**
   b) Explain Enumeration of soil bacteria.

Section-B (Answer All the questions)

1. a) Write an essay on the history of Microbiology. **(or)**
   b) Mention the principle and applications of TEM.
2. a) Describe Bergey's system of prokaryote. **(or)**
   b) Write a detailed account on Fluid Mosaic model.
3. a) Give a detailed account on growth of bacteria. **(or)**
   b) Write about physical method of sterilization.
4. a) Write an essay on Tuberculosis. **(or)**
   b) Discuss about Hepatitis – B.
5. a) Explain in detail about Nitrogen fixation. **(or)**
   b) Describe in detail about microbial Interaction.

YEAR I – SEMESTER II
LAB IN GENERAL MICROBIOLOGY

Paper	: Elective I	Total Hours	: 75
Hours/Week	: 5	Exam Hours	: 03
Credit	: 3	Internal	: 40
Paper Code	: **18P1BTEO1**	External	: 60

CO1	Understand the biochemical test principles and procedures, antibiotic sensitivity test, motility test.
CO2	Demonstrate the enumeration of microbes from soil by plate method and water MPN tests and plating techniques.
CO3	To get knowledge in steriluzation techniques, staining procedures.

MAJOR PRACTICAL:

Lab 1 – (10 hrs.): Biochemical tests-IMViC, Grams, Acid fast bacilli,LCB and KOH.

Lab 2 – (10 hrs.): Antibiotic Sensitivity test-Kirby Bauer Method.

Lab 3 – (10 hrs.): Enumeration of microbes from air by settle Plate Method.

Lab 4 – (10 hrs.): Enumeration of bacteria from Soil.

Lab 5 – (10 hrs.): Examination of Water-MPN

MINOR PRACTICAL:

Lab 1 – (4 hrs.): Principles of sterilization techniques Staining Procedure-Simple,fungal stain.

Lab 2 – (4 hrs.): Media preparation (solid ,Liquid,Agar Slant,Agar Deep &Selective Media).

Lab 3 – (4 hrs.): Determination of Motility.

Lab 4 – (4 hrs.): Streak Plate, Pour Plate, Spread Plate Techniques

Lab 5 – (4 hrs.): Biochemical Tests-Catalase, Oxidase, TSI,Urease, Simple staining.

SPOTTERS (5 hrs.):

Antony van leeuwen hoek, Louis Pasteur, Edward Jenner, Robert Koch, Robert hook, Gram positive cell structure, Gram negative cell wall structure, EMB Agar, MacConkey Agar, XLD Agar, Nutrient Agar, Nutrient broth, Bacterial growth curve, Simple stain, Gram staining, Spore structure, Flagella structure, Antibiotic, Capsule stain, Tuberculosis, Selective medium, Blood agar, Bacterial Nutrition, Whittaker classification, Morphology of bacteria, AIDS, Oxidase enzyme, Fungal structure, Autoclave, Laminar air flow, Incubator, Hot air oven, PH meter.

VIVEKANANDHA COLLEGE OF ARTS AND SCIENCES FOR WOMEN (AUTONOMOUS)
MODEL QUESTION PAPER M.Sc. BIOTECHNOLOGY
YEAR I – SEMESTER I (2018-19)

LAB IN GENERAL MICROBIOLOGY

Paper	: Elective Practical I	Major (1X20)	: 20
Examination	: External	Minor (1X10)	: 10
Time	: Six Hours	Spotters (5X4)	: 20
Paper Code	: **18P1BTEPO1**	Record (1X5)	: 5
Batch	:	Viva Voce	: 5
Date	:	Maximum Marks	: 60

MAJOR (Answer All the Questions)

a. Perform Gram staining to differentiate bacterial cell. **(or)**

b. Perform antibiotic Sensitivity test (Kirby Bauer Method).

MINOR (Answer All the Questions)

a. Perform hanging drop method to identify motile cells.

b.Identify Catalase producing organism from the given culture

SPOTTERS (Answer All the Questions)

Identify the given spotters and discuss (A, B, C , D and E.).

VIVEKANANDHA COLLEGE OF ARTS AND SCIENCES FOR WOMEN (AUTONOMOUS)
MODEL QUESTION PAPER M.Sc. BIOTECHNOLOGY
YEAR I – SEMESTER I (2018-19)

LAB IN GENERAL MICROBIOLOGY

Paper	: Elective Practical I	Major (1X20)	: 20
Examination	: External	Minor (1X10)	: 10
Time	: Six Hours	Spotters (5X4)	: 20
Paper Code	: **18P1BTEPO1**	Record (1X5)	: 5
Batch	:	Viva Voce	: 5
Date	:	Maximum Marks	: 60

KEY

MAJOR

Gram staining kit, Bacterial culture, Microscopic slide and Microscope.

Muller hinton agar, antibiotic disc, cotton swab, culture, petriplate.

MINOR

Microscopic cavity slide, bacterial culture, inoculation loop, cover slip, Vaseline, Spirit and microscope are to be issued.

Slant culture, hydrogen peroxide, pasture pipette, etc.

SPOTTERS

1. Louis Pasteur
2. Autoclave
3. MacConkey agar
4. Antibiotic
5. Bacterial growth curve

RECORD

VIVA-VOCE

YEAR I – SEMESTER I
IMMUNOLOGY AND IMMUNOTECHNOLOGY

Paper	: Core III	Total Hours	: 75
Hours/Week	: 5	Exam Hours	: 03
Credit	: 5	Internal	: 25
Paper Code	: **18P2BT03**	External	: 75

Aim:

To provides information about a fundamental knowledge on principle and concepts in immunology.

.**Objective:**

To enable the students to understand the basic concepts of immunology and molecular mechanism behind immunological reactions that enables them to apply them to develop methods for diagnostic assays, treatment strategies, vaccine production, therapeutical drugs and Monoclonal antibody production.

OUTCOME:

CO1	Knowing about scope and history of immunology, primary and secondary lymphoid organs.
CO2	Getting knowledge about antigen and immunogen properties, immune responses and lymphocytes.
CO3	Understanding the antigen antibody interaction and biological significance of cytokines.
CO4	Getting awareness about hypersensitivity reactions and grafting, autoimmune diseases.
CO5	Exposure in vaccination principle and types for infectious diseases and edible vaccines.

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4
CO1	S	S	S	M
CO2	S	M	S	S
CO3	S	S	M	S
CO4	M	S	S	M
CO5	S	S	M	S

S- Strong; M-Medium; L-Low

CONTENT:

Unit I – (15 Hrs.): History and scope of immunology: Infection & Immunity – types and mechanisms; Haematopoiesis and cells of the immune system. Organs of immune system – Primary and secondary lymphoid organs – structure and functions

Unit II – (15 Hrs.): Antigen and immunogen – Properties: Haptens, mitogens, adjuvants, epitopes. Immunoglobulin – Basic structure, classes, function, Generation of antibody diversity. Immune responses – Humoral & Cell mediated immune responses & antigen recognition. Generation of lymphocyte specificity and clonal selection of lymphocytes. MHC – types, organization and its role in antigen processing and presentation.

Unit III – (15 Hrs.): Antigen- antibody interactions: Principle and applications of Precipitation & Agglutination reactions; Complement – components, properties and activation of pathways (Classical, alternative and lectin), biological significance of complements; Cytokines- properties, structure and function.

Unit IV – (15 Hrs.): Hypersensitivity reactions: Types and mechanisms; Mechanism of transplantation and graft rejection; Immunosuppressive therapy; Autoimmune diseases; Immunodeficiency diseases.

Unit V – (15 Hrs.): Principles of vaccination: Passive & active immunization, immunization programs & role of WHO in immunization programs. Vaccines types – Live and attenuated vaccines, inactivated vaccines, Polysaccharide capsular vaccine, peptide vaccine, DNA vaccines, recombinant vaccines, multivalent subunit vaccines to other infectious agents, edible vaccines.

PEDOGOGY: CHALK and Talk , PPT, Seminar, Models

TEXT BOOKS:

- Goldsby, R. A. Kindt, T. J. Osborne, B. A. and Kuby, J. 2003. Immunology 6th Edition. WH Freeman & Co. New York.
- Kuby, J. 2000. Immunology 4 th Edition. WH Freeman & Co. New York.

REFFERENCE BOOKS:

- Benjamini, E., Coico, R. and Sunshine, G. 2000. Immunology 4th Edition. A John Wiley & Sons, Inc. Publications.
- Roitt, I., Brostoff, J. and Male, D. 1993. Immunology 3 rd Edition. Mosby
- Tizard IR (1995). Immunology 4th Edition. Saunders College Publishing Harcourt. Brace College Publishers.
- Darnell, J., Lodish H. and Baltimore, D. 1994. Molecular Biology 2nd Edition. Scientific American Book, USA.

M.Sc., BIOTECHNOLOGY
QUESTION PAPER PATTERN
MAXIMUM MARKS – 75 marks
DURATION – 3 hours

PART – A (5 X 5 = 25 marks)

1. Either or Type

2. From each unit two questions

PART – B (5 X 10 = 50 marks)

3. Either or Type

4. From each unit two questions

VIVEKANANDHA COLLEGE OF ARTS AND SCIENCES FOR WOMEN (AUTONOMOUS)
MODEL QUESTION PAPER M.Sc. BIOTECHNOLOGY
YEAR I – SEMESTER II (2018-19)

IMMUNOLOGY AND IMMUNOTECHNOLOGY

Paper	: Elective I	Section - A (5X5)	: 25
Examination	: External	Section – B (10X5)	: 50
Time	: Three Hours		
Paper Code	: **18P2BT03**	Maximum Marks	: 75

Section-A (Answer All the questions)

1. a) Describe the contribution of Edward jenner and Louis pasteur to immunology. (or)
   b) What is immunity? Discuss about innate immunity.
2. a) What is immunogen? Discuss the properties of immunogen **(or)**
   b) Draw and describe structure of Immunoglobulin.
3. a) Discuss the biological functions of complement system. **(or)**
   b) What are cytokines? Explain about its properties.
4. a) Describe the mechanism of graft reaction. **(or)**
   b) What is autoimmunity? Mention any two organ specific auto immune diseases.
5. a) Describe the steps involved in the production of DNA vaccine. **(or)**
   b) What are edible vaccines? How are they produced?

Section-B (Answer All the questions)

1. a) What are primary lymphoid organs? Discuss in detail about its structures and functions. **(or)**
   b) Give an elaborate note on structure and functions of class I and class II MHC molecules.
2. a) Illustrate the Classical pathway of complement system. **(or)**
   b) What is hypersensitivity? Discuss in detail about the mechanism of Type I reaction.
3. a) What are vaccines? Describe the production of recombinant vaccine using rDNA technology. **(or)**
   b) Write about physical method of sterilization.
4. a) Write an essay on Tuberculosis. **(or)**
   b) Discuss about Hepatitis – B.
5. a) Explain in detail about Nitrogen fixation. **(or)**
   b) Describe in detail about microbial Interaction.

YEAR I – SEMESTER II

LAB IN IMMUNOLOGY AND IMMUNOTECHNOLOGY

Paper	: CORE PRACTICAL III	Total Hours	: 75
Hours/Week	: 5	Exam Hours	: 06
Credit	: 3	Internal	: 25
Paper Code	: **18P2BTP03**	External	: 75

CO1	Understand the immunodiffussion techniques, widal test and blood grouping
CO2	Demonstrate theELISA and wastern blooting techniques.
CO3	To get knowledge in blood cell counting and serum, plasma separation.

MAJOR PRACTICAL:

Lab 1 – (10 hrs.): Ouchterclony double immune diffusion technique (ODD)

Lab 2 – (10 hrs.): Radial immune diffusion (RID); Rocket immune electrophoresis.

Lab 3 – (10 hrs.): ELISA Test.

Lab 4 – (10 hrs.): Western blotting.

Lab 5 – (10 hrs.): Widal Test.

MINOR PRACTICAL:

Lab 1 – (4 hrs.): Determination of blood grouping and Rh typing in human beings

Lab 2 – (4 hrs.): Preparation of serum and plasma.

Lab 3 – (4 hrs.): Total count of WBC.

Lab 4 – (4 hrs.): Total count of RBC.

Lab 5 – (4 hrs.): Differential count of WBC.

SPOTTERS (5 hrs.):

Antisera A, Antisera B, Lancet, Picture of grouping reactions, serum, plasma, *Salmonella typhi* and *S. paratyphi* O and H antigens, Picture of radial immune diffusion, picture of double immune diffusion, ELISA plate and ELISA reader, Horseradesh peroxidase, Haemocytometer, RBC diluting fluid, WBC diluting fluid, Blood smear, Leishman's stain, Neutrophils, Lymphocytes, Eosinophils.

TEXT BOOKS:

- Rajan, S. and Selvi Christy, R. 2010. Experimental procedures in Life Sciences. Anjanaa Book House, Chennai.
- Arti Nigam, 2007. Lab Manual in Biochemistry, Immunology and Biotechnology. Tata Mc Graw Hill, New Delhi.

VIVEKANANDHA COLLEGE OF ARTS AND SCIENCES FOR WOMEN (AUTONOMOUS)
MODEL QUESTION PAPER M.Sc. BIOTECHNOLOGY
YEAR I – SEMESTER I (2018-19)

LAB IN IMMUNOLOGY AND IMMUNOTECHNOLOGY

Paper	: Elective Practical I	Major (1X20)	: 20
Examination	: External	Minor (1X10)	: 10
Time	: Six Hours	Spotters (5X4)	: 20
Paper Code	: **18P2BTP03**	Record (1X5)	: 5
		Viva Voce	: 5
		Maximum Marks	: 60

MAJOR (Answer All the Questions)

a. Perform ELISA Test. **(or)**

b. Perform Western blotting.

MINOR (Answer All the Questions)

a. Determination of blood grouping and Rh typing in human beings.

b. Differential count of WBC.

SPOTTERS (Answer All the Questions)

Identify the given spotters and discuss (A, B, C, D and E.).

VIVEKANANDHA COLLEGE OF ARTS AND SCIENCES FOR WOMEN (AUTONOMOUS)
MODEL QUESTION PAPER M.Sc. BIOTECHNOLOGY
YEAR I – SEMESTER II (2018-19)

LAB IN IMMUNOLOGY AND IMMUNOTECHNOLOGY

Paper	: Elective Practical I	Major (1X20)	: 20
Examination	: External	Minor (1X10)	: 10
Time	: Six Hours	Spotters (5X4)	: 20
Paper Code	: **18P2BTP03**	Record (1X5)	: 5
Batch	:	Viva Voce	: 5
Date	:	Maximum Marks	: 60

KEY

MAJOR

ELISA Kit.

Western blotting Kit.

MINOR

Glass slide, blood sample, Blood grouping kit.

Blood sample.

SPOTTERS

1. Antisera A
2. *S. paratyphi* O
3. Haemocytometer
4. Leishman's stain
5. Lymphocytes

RECORD

VIVA-VOCE

YEAR I – SEMESTER II

GENETIC ENGINEERING

Paper	: Core IV	Total Hours	: 75
Hours/Week	: 5	Exam Hours	: 03
Credit	: 4	Internal	: 25
Paper Code	: **18P2BT04**	External	: 75

Aim:

To provides information about the recombinant DNA Technology and importance of Bioethics and IPR in Bioresearch.

Objective:

To impart knowledge of genetic engineering, different types of products produced by recombinant DNA Technology and importance of research in genetic engineering.

OUTCOME:

CO1 Knowing about role of genes and its expression.

CO2 Getting knowledge about genes and genome mapping and its importance.

CO3 Understanding the cloning strategies, gene transfer techniques and DNA library preparation.

CO4 Getting exposure about blotting techniques, DNA sequencing techniques and microarray technology.

CO5 Exposure in recombinant DNA technology and transgenic animals.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4
CO1	S	M	S	S
CO2	S	S	S	S
CO3	S	S	S	S
CO4	S	S	M	M
CO5	M	S	M	M

S- Strong; M-Medium; L-Low

CONTENT:

Unit I – (15 Hrs.): Role of genes within cells - genetic elements that control gene expression in prokaryotes and eukaryotes – Repressors and Promoters – Methods of creating recombinant molecules - Restriction and modifying enzymes - safety guidelines of recombinant DNA research.

Unit II – (15 Hrs.): Restriction mapping, design of linkers and adaptors. Characteristics of plasmid and phage vectors, prokaryotic and eukaryotic expression vectors. Insect, Yeast and Mammalian vectors.

Unit III – (15 Hrs.): Cloning strategies and DNA libraries, cDNA libraries, cDNA cloning & Screening of libraries and recombinant clone selection, Gene transfer to Bacterial, animal and plant cells, Stability of transgene, inheritance, patterns of integration, Advances and applications of Transgenic and Recombinant DNA Technology.

Unit IV – (15 Hrs.): Principles of Blotting & Amplification techniques, Gene expression analysis & Polymerase Chain Reaction (PCR)-Types, Micro Array and Analysis, Gene Chip, Labeling & Hybridization, Basic DNA Sequencing, Whole genome sequencing, Shotgun sequencing

Unit V – (15 Hrs): Applications of recombinant technology in agriculture, pharmaceutical industry and medicine – knockout animals, Productionof novel products, Antisense technology - Transgenic animals – embryo transfer.

PEDOGOGY: CHALK and Talk , PPT, Seminar, Models

TEXT BOOK:

- Joshi, P. 2005. Genetic Engineering and its applications, Student Edition, Jodhpur, p-194.

REFERENCE BOOKS:

- Winnacker, E. L. 2003, From Genes to Clones, Introduction to Gene Technology, Panima Publishing corporation, New Delhi. P-634.
- Gupta, P. K. 2013. Biotechnology and Genomics, Rastogi Publication, Meerut, p-796.
- Primrose, S. B. and Twyman, R. M. 2009. Principles of Gene manipulation and Genomics, 7th Edition, Blackwell Scientific publications, USA. P-644.

M.Sc., BIOTECHNOLOGY
QUESTION PAPER PATTERN
MAXIMUM MARKS – 75 marks
DURATION – 3 hours

PART – A (5 X 5 = 25 marks)

1. Either or Type

2. From each unit two questions

PART – B (5 X 10 = 50 marks)

3. Either or Type

4. From each unit two questions

VIVEKANANDHA COLLEGE OF ARTS AND SCIENCES FOR WOMEN (AUTONOMOUS)
MODEL QUESTION PAPER M.Sc. BIOTECHNOLOGY
YEAR I – SEMESTER II (2018-19)

GENETIC ENGINEERING

Paper	: Core I	Section - A (5X5)	: 25
Examination	: External	Section – B (10X5)	: 50
Time	: Three Hours		
Paper Code	: **18P2BT04**	Maximum Marks	: 75

Section-A (Answer All The Questions)

1. a) Explain about Cell theory **(or)**
   b) Write a brief note on Plasma memberane
2. a) Explain about DNA replication in prokaryotes **(or)**
   b) Explain briefly about the DNA and its types
3. a) Write a note on processing of mRNA **(or)**
   b) Write about the Trp operons
4. a) Write short notes on spontaneous mutations **(or)**
   b) Briefly explain about cell differentiation
5. a) Explain about the Role of Calmodulin as the second messenger **(or)**
   b) Write about Transposons

Section-B (Answer All The Questions)

6. a) Explain in detail about the Chromosomes and their organization. **(or)**
   b) Give a detailed account on Mitochondria, structure and functions.
7. a) Briefly explain about the DNA repair systems.**(or)**
   b)Give a detailed account on Replication of RNA.
8. a) Write a brief note on Transcription.**(or)**
   b) Give a detailed account on the Regulation of gene expression
9. a) Explain in detail about the cell cycle **(or)**
   b) Write an essay on Gene Mutation and its mechanism
10. a) Give a detailed account on tumour suppressor genes **(or)**
    b) Give a detailed account on Recombination and its models

YEAR I – SEMESTER II

LAB IN GENETIC ENGINEERING

Paper	: CORE PRACTICAL IV	Total Hours	: 75
Hours/Week	: 5	Exam Hours	: 06
Credit	: 4	Internal	: 40
Paper Code	: **18P2BTP04**	External	: 60

CO1 Understand the nucleic acid isolation techniques.

CO2 Demonstrate protein purification and expression techniques by SDS PAGE.

CO3 To get knowledge in cloning techniques and PCR.

MAJOR PRACTICAL:

Lab 1 – (10 hrs.): Isolation of DNA from plant/animal/bacterial cell.

Lab 2 – (10 hrs.): Isolation of RNA from the given bacterial cell.

Lab 3 – (10 hrs.): Isolation of plasmid DNA from the given bacterial cell.

Lab 4 – (10 hrs.): Separation and characterization of proteins by SDS-PAGE

MINOR PRACTICAL:

Lab 1-(5 hrs.): Induction and expression recombinant protein

Lab 2-(5 hrs.): Cloning using restriction enzymes

Lab 3-(5 hrs.): Cloning of PCR products

Lab 4-(5 hrs.): Purification of recombinant proteins using His tag

SPOTTERS (5 hrs.): PCR machine, AGE setup, PAGE setup, His tag, EC0R1, BAM HI, Hind III, Sma I, Taq - polymerase, Ethidium bromide, Acrylamide-Bisacrylamide mix, TEMED, beta mercapto ethanol, SDS, Saturated Phenol, Karry Mullis, Karl Erky, Bolivar-Rodriguez, Werner Arber, PUC 18/19 vector, PBS vector, PBR 322 vector, IPTG, X-gal

REFRENCE BOOKS:

Sambrook, J., and Russell, D. W. 2001. Molecular Cloning: A Laboratory Manual (Volume 1- 3) 3rd edition, Cold Spring horbor laboratory Press, New York.

VIVEKANANDHA COLLEGE OF ARTS AND SCIENCES FOR WOMEN (AUTONOMOUS)
MODEL QUESTION PAPER B.Sc. BIOTECHNOLOGY
YEAR I – SEMESTER II (2018-19)

LAB IN GENETIC ENGINEERING

Paper	: Core Practical IV	Major (1X20)	: 20
Examination	: External	Minor (1X10)	: 10
Time	: Six Hours	Spotters (5X4)	: 20
Paper Code	: **18P2BTPO4**	Record (1X5)	: 5
Batch	:	Viva Voce	: 5
Date	:	Maximum Marks	: 60

MAJOR (Answer All the Questions)

a. Isolate plasmid DNA from the given bacterial sample. **(or)**

b. Separate the given protein sample by SDS-PAGE

MINOR (Answer All the Questions)

a. Perform restriction digestion from the given vector and restriction enzyme. **(or)**

b. Amplify the given DNA sample by PCR

SPOTTERS (Answer All the Questions)

Identify the given spotters and discuss (A, B, C, D, and E.).

VIVEKANANDHA COLLEGE OF ARTS AND SCIENCES FOR WOMEN (AUTONOMOUS)
MODEL QUESTION PAPER B.Sc. BIOTECHNOLOGY
YEAR I – SEMESTER II (2018-19)

LAB IN GENETIC ENGINEERING

Paper	: Core Practical I	Major (1X20)	: 20
Examination	: External	Minor (1X10)	: 10
Time	: Six Hours	Spotters (5X4)	: 20
Paper Code	: **18P2BTPO4**	Record (1X5)	: 5
Batch	:	Viva Voce	: 5
Date	:	Maximum Marks	: 60

KEY

MAJOR

a. Plasmid bearing bacterial culture, glass wares, chemicals, Microscope, Electrophoresis tank, Power pack and UV- transilluminator etc.
b. SDS PAGE apparatus, Protein sample, Power pack, Reagents etc.

MINOR

a. Restriction enzymes, given bacterial DNA, AGE electrophoresis tank, Power pack and UV-transilluminator etc.
b. PCR machine, Primers (Forward & Reverse), Magnesium chloride, Taq- polymerase, AGE electrophoresis tank, power pack and UV-transilluminator etc.

SPOTTERS

1. PCR, 2. TEMED, 3. Karl Erky, 4. PBS, 5. Bam HI

RECORD

VIVA-VOCE

YEAR I – SEMESTER II

BIOPROCESS AND MICROBIAL TECHNOLOGY

Paper	: Elective II	Total Hours	: 75
Hours/Week	: 4	Exam Hours	: 03
Credit	: 4	Internal	: 25
Paper Code	: **18P2BTE02**	External	: 75

Aim:

To provides information about basic science and communication skills, manufacturing technologies, and good manufacturing practices and applications of microorganism for the production of useful biological materials.

Objective:

To impart knowledge of fermentation process, formulating the nutrients for growth of microbes, downstream processing, production of aminoacids, organic solvents and vitamins.

OUTCOME:

CO1 Knowing about fermentation types and techniques and immobilization techniques..

CO2 Getting knowledge about media formulation for fermentor and scale up of antibiotic production.

CO3 Understanding the downstream processing and chromatography techniques.

CO4 Getting awareness about production of industrially important products and biofertilizer production.

CO5 Exposure in industrial biotechnology to produce secondary metabolite production.

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4
CO1	S	M	S	S
CO2	M	S	S	M
CO3	S	S	S	S
CO4	S	S	M	S
CO5	S	S	M	M

S- Strong; M-Medium; L-Low

CONTENT:

Unit I – (15 Hrs.): An introduction to fermentation process: Isolation of industrial important micro organisms- direct isolation method, enrichment culture method-general and special enrichment system. Screening of industrial important microorganisms-primary screening, secondary screening, Strain improvement-physical, chemical, biological method. Immobilization techniques-cell and enzyme.

Unit II – (15 Hrs.): Media formulation: nutritional requirement of microorganisms, Types of fermentation – Batch, Fed batch and Continuous. Sterilization of fermentation media - Batch and Continuous. Inocula development-criteria, development of abiotic component for bacterial process. Types and Designing of fermentor and Scale-up, Instrumentation for Monitoring and Controlling Bioreactors-Computer aided control and Monitoring, Photo bioreactors.

Unit III – (15 Hrs.): Downstream Processing: Disruption of Microbial Cells, Centrifugation, Filtration of Fermentation Broths, Cell Processing & Cell separations, Ultrafilteration, Liquid-Liquid Extraction, Chromatography - Ion Exchange, Molecular Sieve, Affinity, HPLC. Distillation, Fluid Extraction & Electrodialysis.

Unit IV – (15 Hrs.): Production of industrially important products: Enzymes – Amylase, Lipase and Cellulase. Beverages – Wine, Beer and Whisky. Dairy products – Cheese and yogurt. Production of SCP. Mushroom –types and cultivation. Spirullina- Production and cultivation. Biofertilizer- Rhizobium and Azolla.

Unit V – (15 Hrs): Industrial Biotechnology – Microbial synthesis of commercial products – Amino acids – Lysine, Glutamic acid. Vitamins – B_2 and B_{12}. Antibiotics – Penicillin, Tetracycline and Streptomycin. Organic acids – Acidic acid and citric acid, Organic Solvents- Methanol and Ethanol.

PEDOGOGY: CHALK and Talk , PPT, Seminar, Models

TEXT BOOKS:

- Sathyanarayana, U. 2010. Biotechnology. Books and Allied (Pvt) Ltd.
- Moo-Young, M. 2011. Comprehensive Biotechnology. 1-4 Volumes, Pergamon Press Ltd.

REFFERENCE BOOKS:

- Glazer et al., 1995. Microbial Bitechnology. W.H. Freeman and Co., New York.
- Srivastava, M. L. 2008. Fermentation technology, Narosa Publishing House Pvt Ltd.
- Casida. 2006. Industrial Microbiology, New age Publishers
- Stanbury, P. F. Whitaker, A. and Hall, S.J. 2005. Principles of fermentation technology,Second Edition,NarosaPublishing House.
- Crueger, W. and Cruger, A. 1990. Biotechnology: A Text Book of Industrial Microbiology. Science Tech Publishers,USA.

M.Sc., BIOTECHNOLOGY
QUESTION PAPER PATTERN
MAXIMUM MARKS – 75 marks
DURATION – 3 hours

PART – A (5 X 5 = 25 marks)

1. Either or Type

2. From each unit two questions

PART – B (5 X 10 = 50 marks)

3. Either or Type

4. From each unit two questions

VIVEKANANDHA COLLEGE OF ARTS AND SCIENCES FOR WOMEN
(AUTONOMOUS)
MODEL QUESTION PAPER M.Sc. BIOTECHNOLOGY
YEAR I – SEMESTER II (2018-19)

BIOPROCESS AND MICROBIAL TECHNOLOGY

Paper	: Elective II	Section - A (5X5)	: 25
Examination	: External	Section – B (10X5)	: 50
Time	: Three Hours		
Paper Code	: **18P1BTE02**	Maximum Marks	: 75

Section-A (Answer All the questions)

1. a) Explain about strain improvement methods **(or)**
   b) Write a brief note on immobilization techniques
2. a) Explain about batch and continuous sterilization **(or)**
   b) Explain briefly about the monitoring and controlling bioreactors.
3. a) Write a note on Penicillin. **(or)**
   b) Write about the production of process of Wine.
4. a) Write short notes on centrifugation. **(or)**
   b) Briefly explain about ultrafilteration techniques.
5. a) Explain about the vitamin B2 production. **(or)**
   b) Write about acetic acid production?

Section-B (Answer All the questions)

1. a) Explain in detail about the screening of industrially important microorganisms **(or)**
   b) Give a detailed account on Preservation of industrially important microorganisms.
2. a) Briefly explain about the designing of fermentor. **(or)**
   b) Give a detailed account on tower fermentor and airlift fermentor .
3. a) Write a brief note on fermented dairy product. **(or)**
   b) Give a detailed account on the industrial production of organis acid with respect to citric acid.
4. a) Explain in detail about the cell disruption process and cell processing and separations. **(or)**
   b) Write an essay on down-stream processing, recovery and purification processes of industrially important biomolecules.
5. a) Give a detailed account on methanol production. **(or)**
   b) Give a detailed account on industrially important enzymes

YEAR I – SEMESTER II

LAB IN BIOPROCESS AND MICROBIAL TECHNOLOGY

Paper	: Elective Practical II	Total Hours	: 75
Hours/Week	: 5	Exam Hours	: 06
Credit	: 3	Internal	: 40
Paper Code	: 18P2BTEP02	External	: 60

CO1 Understand the microbial fermentation techniques.

CO2 Demonstrate the fermentor and immobilization techniques..

CO3 To get knowledge in antibiotic production and azolla, spirulina production..

MAJOR PRACTICAL:

Lab 1 – (10 hrs.): Microbial production and estimation of Acetic acid and Citric acid

Lab 2 – (10 hrs.): Batch fermentation and Continuous fermentation

Lab 3 – (10 hrs.): Production of Saurkraut, Wine production and Yoghurt

Lab 4 – (10 hrs.): Production and estimation of nutrients of Azolla and Spirulina

MINOR PRACTICAL:

Lab 1-(5 hrs.): Media sterilization and Fermentor –parts and its function

Lab 2-(5 hrs.): Immobilization of Yeast cell using by Sodium alginate method

Lab 3-(5 hrs.): Penicillium production

Lab 4-(5 hrs.): Silage production using Molasses

SPOTTERS (5 hrs.): Fermentor, Centrifuge, Chromatography, SCP, Mushroom, HPLC, Vitamin B2, Vitamin B12, Penicillin, Tetracycline, Streptomycin, Immobilized cells, Cheese, Yoghurt, Azolla, Spirullina, Citric Acid, Acetic Acid, Auxanography, Sparger, Baffles, Electrophoresis, Antifoaming Agents, Corn steep Liquor, Weizmann, Cryopreservation, DMSO, Wine, Paper Chromatography and Amylase.

VIVEKANANDHA COLLEGE OF ARTS AND SCIENCES FOR WOMEN (AUTONOMOUS)
MODEL QUESTION PAPER B.Sc. BIOTECHNOLOGY
YEAR I – SEMESTER II (2018-19)

LAB IN BIOPROCESS AND MICROBIAL TECHNOLOGY

Paper	: Core Practical II	Major (1X20)	: 20
Examination	: External	Minor (1X10)	: 10
Time	: Six Hours	Spotters (5X4)	: 20
Paper Code	: **18P2BTEPO2**	Record (1X5)	: 5
Batch	:	Viva Voce	: 5
Date	:	Maximum Marks	: 60

MAJOR (Answer All the Questions)

a. Microbial production and estimation of Acetic acid. **(or)**

b. Production and estimation of nutrients of Azolla.

MINOR (Answer All the Questions)

a. Media sterilization and Fermentor –parts and its function. **(or)**

b. Penicillium production

SPOTTERS (Answer All the Questions)

Identify the given spotters and discuss (A, B, C, D, and E.).

VIVEKANANDHA COLLEGE OF ARTS AND SCIENCES FOR WOMEN (AUTONOMOUS)
MODEL QUESTION PAPER B.Sc. BIOTECHNOLOGY
YEAR I – SEMESTER II (2018-19)

LAB IN BIOPROCESS AND MICROBIAL TECHNOLOGY

Paper	: Core Practical I	Major (1X20)	: 20
Examination	: External	Minor (1X10)	: 10
Time	: Six Hours	Spotters (5X4)	: 20
Paper Code	: **18P2BTEPO2**	Record (1X5)	: 5
Batch	:	Viva Voce	: 5
Date	:	Maximum Marks	: 60

KEY

MAJOR

a. Media, Laminar air flow, test tubes.

b. Nutrient media, Azolla.

MINOR

c. Agar, Nutrients, Fermentor etc.

d. Penecillium notatum, Incubator, Nutrient agar medium, etc.

SPOTTERS

1. Chromatography
2. Spirullina
3. Penicillin
4. Electrophoresis
5. Amylase

RECORD

VIVA-VOCE

YEAR II – SEMESTER III
PLANT AND ANIMAL BIOTECHNOLOGY

Paper	: Core V	Total Hours	: 75
Hours/Week	: 5	Exam Hours	: 03
Credit	: 5	Internal	: 25
Paper Code	: 17P3BT05	External	: 75

Subject description

This course introduces the principles and applications of plant tissue culture, animal tissue as well as the biology of cultured plant cells. Later through the course, Students will be exposed to the molecular techniques using plant systems. The designed experiments will illustrate the principles and ideas discussed in the plant biotechnology, animal biotechnology.

Goal

This paper will help students interested in careers as laboratory, plant and animal care technicians in the fields of agriculture, veterinary and human health or biotechnology.

Course outcome

- To impart basic knowledge about plant tissue culture.
- To promote knowledge on transformation methods in plants.
- To produce transgenic plants.
- To impart basic knowledge on Animal biotechnology.
- To impart practical knowledge on animal biotechnology.

UNIT	CONTENT	HOURS
I	**Tissues culture**: Media - Composition and preparation MS & B5; Cell and tissue culture techniques for plants - Micro propagation, Callus culture, somatic embryogenesis, suspension culture, embryo culture, haploid culture, protoplast culture, protoplast fusion; Somaclonal variation; Artificial seeds; hardening. Germ plasm and Cryopreservation.	**15**
II	**Plant transformation technology**: Ti and Ri plasmids, binary & co-integrated vector systems; viral vectors and their applications; 35S and other promoters; genetic markers; reporter genes; virulence genes; Cloning Strategies; Gene transfer methods in plants – Direct DNA transfer methods, Agrobacterium mediated nuclear transformation, Chloroplast transformation.	**15**
III	**Genetic engineering**: Pest, herbicides, virus, fungal and bacterial resistance. Induction of stress tolerance in plants (Salt and drought). Edible vaccines, Plantibodies, therapeutic proteins, long shelf life of fruits and flowers.	**15**
IV	**Equipments and materials used in animal cell culture:** Media used for ATC, Primary culture	15

	Isolation of explants, Disaggregation of explants, Primary explant techniques - Slide or cover slip cultures, flask cultures, test tube cultures. Organ culture and whole embryo culture. Measurement of cell viability and cytotoxicity, maintenance of cell culture; cell separation.	
V	**Transgenic plants and animals** : Animal viral vectors, Transgenic animals – Transgenic sheep, mice, cattle, bird and fish. Biotechnology of silkworm – Silkworm as bioreactor. Biotechnology in aquaculture (Ploidy induction, Gynogenesis, Androgenesis) Ethical issues in animal biotechnology.	**15**

Text books:

1. Bernad, R. G. and John, E.T. (1993). Methods in plant Molecular Biology and Biotechnology. CRC press.
2. Satyanarayana, U. (2008). Biotechnology. Allied (P) Ltd.
3. Chawla. Introduction toPlant Biotechnology. 2nd edition, Oxford Publishers.(2002)
4. Dubey, R. C. A text book of Biotechnology. S. Chand and Company Ltd,(1993)
5. Iorn, F. Culture of animal cells. 3rd edition, Wiley-liss.
6. Jenni, P. M. and David, B. Methods in cell biology, animal cell culture methods. Vol. 57, Academic Press.
7. Ranga, M. M. (2000). Animal Biotechnology. Agrobios, India.
8. Roberta, S. (2000). Plant tissue culture- Techniques and experiments. 2nd edition, Academic press.

YEAR II – SEMESTER III			
LAB IN PLANT AND ANIMAL BIOTECHNOLOGY			
Paper	: Core Practical V	Total Hours	: 75
Hours/Week	: 5	Exam Hours	: 06
Credit	: 4	Internal	: 40
Paper Code	: 17P3BTP05	External	: 60

Subject description

This lab provides the basic knowledge in plant tissue culture and about the transgenic plant production. Further the lab work provides the skill in micropropagation techniques and also it provides the basic knowledge in animal cell lines.

Goal

Goal of the present lab is to provide knowledge about the production of plants through tissue culture. This provides basic skill in the preparation of cell lines

Course outcome

- To impart skill in plant tissue culture, media formulation and sterilization
- To impart knowledge about different tissue culturing methods
- To impart skill in the production fodder by hydrophonics
- To impart skill in animal tissue culturing methods
- To promote knowledge about the cell viability checking by haemocytometer.

Experiment No.	Content	Hours
PLANT BIOTECHNOLOGY		
1	Media preparation and sterilization	5 Hrs
2	Micropropagation – Nodal and apical meristems.	5 Hrs
3	Callus induction	5 Hrs
4	Somatic embryogenesis and preparation of synthetic seeds.	5 Hrs
5	Embryo culture	5 Hrs
6	Protoplast isolation.	5 Hrs
7	Determination of protoplast viability by Evan's blue staining method.	5 Hrs
8	Pollen culture.	5 Hrs
9	Anther culture.	5 Hrs
10	Hydrophonics	5 Hrs
ANIMAL BIOTECHNOLOGY		
11	Sterilization techniques	5 Hrs
12	Preparation of culture media and sera	5 Hrs
13	Preparation of primary cell culture	5 Hrs
14	Trypsinization and subculturing cells from a monolayer	5 Hrs
15	Determining cell umber and viability with a haemocytometer and Trypan blue staining	5 Hrs

Manuals

- Ian Freshney,R., 2016, Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications, 7th Edition, Wiley-Blackwell
- John H. Dodds, Lorin W. Roberts, 1985, Experiments in Plant Tissue Culture, Cambridge University Press,New York.
- Bhojwani , S.S., Razdan, M.K., 1996, Plant Tissue Culture: Theory and Practice, Elsevier Science

YEAR II – SEMESTER III

ENVIRONMENTAL BIOTECHNOLOGY

Paper	: Core VI	Total Hours	: 75
Hours/Week	: 5	Exam Hours	: 03
Credit	: 5	Internal	: 25
Paper Code	: 17P3BT06	External	: 75

Subject description:

This course presents the basic or research, research purpose, problem solving in research, statistical methods used in research, data description, waste water treatments and alternative source of energy.

Goal

Course outcome

- To equip the students with basic knowledge of how to do research, problem solving in research
- To know about the different waste water treatments and different energy sources and to familiarize with biofuel technology.

UNIT	CONTENT	HOURS
I	**Environmental issues:** Climate change, Conservation Energy, Environmental degradation, Environmental Health Genetic engineering Intensive farming Land degradation soil, Land use. Nanotechnology Nuclear issues Over population, Burial, Ozone depletion-CFCP pollution, Water pollution, Air pollution, Reservoirs Resources depletion Consumerism-Fishing, Logging, Mining Toxins, Waste.	15
II	**Bioremediation and Bio-leaching:** Environmental impact of pollution and measurement methods- Composting of organic wastes, microbial bioremediation of oil spills; Waste water treatment- sewage treatment and common industrial effluent treatment; Concepts of bioremediation (in-situ and ex-situ), Bioremediation of toxic metal ions-biosorption and bio accumulation principles. Concepts of phytoremediation; Microbial biotransformation of pesticides and xenobiotics: Microbial leaching of ores- direct and indirect mechanisms.	10
III	**Biofuel technology:** Classification of biofuel, First generation biofuels, Bioalcohols, Biodiesel, Green diesel, Vegetable oil, Bioethers, Biogas, Syngas, Solid biofuels, Second generation biofuels (advanced biofuels), Biofuels by region, Issues with biofuel production and use.	15
IV	**Waste Water treatment**: Definition, source, types and composition of waste water, domestic sewage and industrial waste water. Methods of analysis of waste water- Std. parameters for physical, chemical and biological analysis, microbiological analysis, rationales	10

	and methods, their significance and limitations. Primary treatment: (Chemical/Physical) sedimentation, screening, coagulation, flocculation, dilution, neutralization, equalization etc. Secondary treatment: (Biological/ biochemical) Activated sludge process, Trickling filters, anaerobic filters, sludge digestion, Aerated lagoons, Algal ponds, Evapo- transpiration system.	
V	**Alternate Source of Energy**, Biomass as a source of energy. Biocomposting, Vermiculture, Biofertilizers, Organic farming, Biomass project, Biomass centre & Species used for Biomass production.s Biomineralization, Bioelectricity through microbial fuel cell. Energy management and safety.	**10**

REFERENCE

Text Books

1. Alan, S. (1999). Environmental Biotechnology. Pearson Education Limited, England.
2. Allsopp, D. and Seal, K.J. (1986). Introduction to Biodeterioration. ELBS/Edward Arnold, London.
3. Athie, D and Ceri, C.C. (1990). The use of Macrophytes in Water Pollution Control. Pergamon Press, Oxford.
4. Chin, K.K. and Kumarasivam, K. (1986). Industrial Water Technology Treatment- Reuse and Recycling. Pergamon Press, Oxford.
5. Dart, R.K. and Stretton, R.J. (1994). Microbiological aspects of pollution control. Elsevier Pub. Co., Amsterdam, New York.
6. Fry, F.C. and Gadd, G.M. Herbert, R.A. Jones, C.W. and Watson-Crick, J.A. (1982). Microbial Control of Pollution. Cambridge University Press, New York.
7. Henze, M and Gujer, W. (1992). Interactions of waste water: Biomat and Reactor Configurations in Biological Treatment Plan. Pergamon Press, Oxford.
8. Jenkins, D. and Olson, B. H. (1989). Water and Waste water Microbiology. Pergamon Press, Oxford.
9. John, C. and Todd, V.C. (1990). Integrated environmetal Management. Lewis Publishers Inc., Chel.
10. Kaul, T.N. and Trrivedy, R.K. (1993). Pollution Control in Distilleries. Enviromedia, Karad, India.
11. McEldowney, Sharon, Hardman, David, J. and Waite, S. (1993). Pollution, Ecology Biotreatment. Longman Scientific and Technical, Harlow, England.
12. Technoglous, G. Burton, F.L. and Stensel, H.D. (2004). Wastewater Engineering-Treatment, Disposal and Reuse. Metcalf and Eddy Inc., TataMcGraw Hill, New Delhi.

Publications

1. De, A. K. (2004). Environmental Chemistry . Wiley Eastern Ltd., New Delhi.
2. Jogdand, S.N. (1995). Environmental Biotechnology. Himalaya Publishing House, Bombay.
3. Sastry, C.A. Hashim, M.A. and Angamuthu, P. (1995). Waste Treatment Plants. Narosa Publishing House, New Delhi, India.

LAB IN ENVIRONMENTAL BIOTECHNOLOGY

Experiment No.	Content	Hours
1	Isolation of Air Borne Bioparticles	5 Hrs
2	Effect of high salt concentration on microbial growth	5 Hrs
3	Oligodynamic action heavy metals on microbes	5 Hrs
4	Isolation of Coliforms from sewage	5 Hrs
5	Estimation of total solids in effluent sample	5 Hrs
6	Analysis of TDS of effluent	5 Hrs
7	Estimation of total suspended solids of effluent sample	5 Hrs
8	Determination of Biological demand	5 Hrs
9	Determination of chemical oxygen demand	5 Hrs
10	Microbial degradation of cellulose	5 Hrs

REFERENCE

1. Rajan S. and Selvi Christy R. (2015). Experimental Procedures in Life Sciences. 4th Edition. Anjana Book House, PSR Associates. Chennai.

YEAR II – SEMESTER III
GENOMICS AND PROTEOMICS

Paper	: Elective III	Total Hours	: 75
Hours/Week	: 4	Exam Hours	: 03
Credit	: 4	Internal	: 25
Paper Code	: 17P3BTE03	External	: 75

Subject Description

The students are able to understand the fundamental principle and techniques in genomics and proteomics which will enable them to sequence and analyze the gene and unlock potential candidate gene that may help to discovery new drugs and therapeutics, to establish evolutionary relationship, study and analyze gene and protein expressions.

Goal

The enable the students to understand the concepts and applications of genomics and proteomics

Course outcome

- To understand the basic concepts in genomics and various techniques applied to enumerate genome sequences and its functions
- To understand the fundamentals of proteomics and various techniques supporting the protein sequence and functional analysis

UNIT	CONTENTS	HOURS
I	Genomics- Prokaryotic &Eukaryotic Genomes Organization- Nuclear Genomes- - Organelle genomes-origin- Repetitive DNA contents- Tandem repeats – DNA transposons- Comparative genomics and application of genomics in understanding genetic disease of humans	15
II	Traditional approaches to expression profiling to study genes- SAGE for large scale gene expression and analysis- DNA sequencing- shot gun sequencing – Contig assembly-techniques for gene location – ORF- Next generation sequencing (NGS)- RT-PCR-RACE-S1nuclease mapping – exon trapping- transcriptome analysis-DNA chips and Microarrays, Real time PCR	15
III	Genome Mapping – Human genome project Genetic Mapping –SNP-AFLP-Human pedigree analysis–FISH – STS mapping –Gene therapy for inherited disorders and infectious diseases.	15
IV	Proteomics: Definition, Characterization of proteins using 2-D gel electrophoresis, Multidimensional liquid chromatography and	15

	Mass spectrometry Tools of Proteomics- MALDI-TOF-ESI – tandem Mass analyzers-peptide Mass finger printing-protein identification with MS data.	
V	Metabolomics & Global biochemical networks, different levels of metabolite analysis, basic mass spectrometery metabolomics analysis, sample selection and handling for analysis of metabolites, methodology to construct global biochemical network.Protein mining - SALSA algorithm for mining specific features- protein microarraysprotein expression profiling –	**15**

Text book

- Old and Primrose, 2006, Principles of Gene manipulation and genomics.

Reference book

1. Terence A Brown, 2002, Genomes, 2nd Edition, Bios Scientific Publishers.
2. Tom Strachan and Andrew P Read, 1999, Human Molecular Genetics, 2nd edition, Bios Scientific Publishers.
3. Daniel C. Liebler, 2002, Introduction to Proteomics, tools for the New biology- Humana press. Totowa,NJ.
4. Pennington.S, M. Dunn, 2001, Proteomics: From Protein Sequence to Function, 1st edition, Bios Scientific Publishers.

YEAR II – SEMESTER III			
LAB IN GENOMICS AND PROTEOMICS			
Paper	Elective III Practical	Total Hours	: 75
Hours/Week	: 5	Exam Hours	: 06
Credit	: 3	Internal	: 40
Paper Code	: 17P3BTEP03	External	: 60

Experiment No.	**Content**	**Hours**
1	Online and offline tools for analysis of genomics and proteomic information	
2	16 s rRNA sequence amplification	
3	Phylogenetic Analysis of gene sequence using MEGA4 software	
4	Random amplified polymorphic DNA analysis	
5	Single nucleotide polymorphism	
6	Chromatographic techniques for proteins separation	
7	Characterization of proteins & protein profiling	

References

1. R. Simpson (2003). Proteins and Proteomics: A Laboratory Manual. Cold Spring Harbor Laboratory Press, 2003
2. J.F. Sambrook and D.W. Russell, ed., (2001).Molecular Cloning: A Laboratory Manual, 3rd ed., Vols 1,2 and 3. Cold Spring Harbor Laboratory Press

YEAR II – SEMESTER IV			
DEPARTMENT OF BIOTECHNOLOGY **PLANT AND ANIMAL CELL CULTURE TECHNIQUES**			
Paper	: Extra Disciplinary Course I	Total Hours	: 75
Hours/Week	: 4	Exam Hours	: 06
Credit	: 4	Internal	: 40
Paper Code	: 17P4BTED1	External	: 60

Subject Description:
This course aims to introduce the principles and applications of plant tissue culture, animal tissue as well as the biology of cultured plant cells. Later through the course, Students will be exposed to some molecular techniques using plant systems. The designed experiments will illustrate the principles and ideas discussed in the plant biotechnology, animal biotechnology.

Goal
This paper helps the students to learn about the basics of plant and animal cell culture techniques.

Course outcome
This course was designed to acquaint the students to:

- Work under aseptic conditions to cultivate different plant species and/or parts in vitro. Learn how to subculture and follow the growth pattern of the cultures.
- Practice scientific thinking in analyzing the experiments, keeping records, and presenting results.
- Practice and learn some techniques in plant biochemistry, molecular biology, animal biotechnology.

UNIT	CONTENT	HOURS
I	**Introduction to plant tissue culture:** Structure and organization of plant cell. Establishment of plant tissue culture laboratory. Preparation of explants. Sterilization techniques. Preparation and composition of Plant tissue culture media. Growth regulators - auxin, cytokinin and other hormones.	**15**
II	**Tissue culture techniques:** Callus culture - initiation and maintenance of callus. Suspension culture, Meristem tip culture, Anther culture, Embryo and ovule culture Principles of Micropropagation: Direct and indirect morphogenesis, somatic embryogenesis. Synthetic seed production. Protoplast isolation, culture & fusion, somaclonal variations.	**15**
III	**Gene transfer methods in plants**: Agrobacterium mediated transformation (Ti plasmid & Ri plasmid). Particle bombardment, Electrophoration. Selectable marker, promoter and reporter genes used in plant transgenesis- Genetic engineering for Pest, Herbicide Viral, fungal and Bacterial resistance.	**15**

IV	**Introduction to animal cell culture:** ATC Laboratory design- Equipments and materials used in animal cell culture -Balanced salt solutions and Complete medium; Constituents of animal cell culture media and role of serum containing and serum free media and their applications. Primary and established cell line cultures. Applications of animal cell culture.	**15**
V	**Animal cell culture techniques:** Primary culture Isolation of explants, Disaggregation of explants, Primary explantation techniques - Slide or cover slip cultures, flask cultures, test tube cultures. Organ culture and whole embryo culture. Measurement of cell viability and cytotoxicity, maintenance of cell culture; cell separation. Cryopreservation. Large scale culture of cell lines.	**15**

REFERENCE

1. Bernad, R. G. and John, E.T. (1993). Methods in plant Molecular Biology and Biotechnology. CRC press.
2. Bhowjwani, S. S, (2004). Plant tissue culture- Theory and practice.
3. Chawla. Introduction toPlant Biotechnology. 2nd edition, Oxford Publishers.
4. Dubey, R. C. A text book of Biotechnology. S. Chand and Company Ltd.
5. Iorn, F. Culture of animal cells. 3rd edition, Wiley-liss.
6. Jenni, P. M. and David, B. Methods in cell biology, animal cell culture methods. Vol. 57, Academic Press.
7. John, R.W.M. Animal cell culture. Raifica approach, OXFORD.
8. Martin, C. Animal Cell culture techniques. Springer.
9. Ranga, M. M. (2000). Animal Biotechnology. Agrobios, India.
10. Roberta, S. (2000). Plant tissue culture- Techniques and experiments. 2nd edition, Academic press.
11. Satyanarayana, U. (2008). Biotechnology. Allied (P) Ltd.

YEAR II – SEMESTER IV

RESEARCH METHODOLOGY,BIOSTSTISTICS AND BIOINFORMATICS

Paper	: Elective IV	Total Hours	: 75
Hours/Week	: 4	Exam Hours	: 03
Credit	: 4	Internal	: 25
Paper Code	: 17P4BTE04	External	: 75

Aim: To enable the students to learn about the basics of research and application of Bioinformatics

Objectives:

To equip the students with basic knowledge of how to do research, problem solving in research and to know about the biological database and tools and its application

UNIT	CONTENT	HOURS
I	Research definition, Types of Research: Descriptive vs. Analytical Research, Applied vs. Fundamental Research, Quantitative vs. Qualitative Research, Conceptual vs. Empirical Research, Formulating the Research Problem, Research Methods vs. Research Methodology, Literature Review, Review Concepts and Theories, Current trends in Research, Mono,Trans, Inter- disciplinary Research, Computer & Internet: Its Role in Research, Threats and Challenges to Good Research	**15**
II	Hypothesis: Formulation, Sources, Characteristics, Role, Test, Research Design, Legal Research, Clinical Trials, Evolutive and Evaluative, Identificatory and Impact studies, Projective and Predictive, Writing an: Article, Essay, Research Paper, Research Project, Legislation Drafting, Judgment Writing, Thesis, Dissertation, Book, Reviews - Book Review; Case Review, Criteria of Good Research, Research Ethics, Citation Methods: Foot Note, Text Note, End Note, Bibliography, Citation Rules	**15**
III	Statistics in Research: Sampling Design, Data Collection- Primary and Secondary data, Processing and Analysis of Data, Limitation and uses of Statistics, Graphs, mean, Median, Mode, Standard deviation, Standard error	**15**
IV	Biological Data Acquisition: Access, Retrieval and Submission methods for DNA sequence, protein sequence and protein structure information; Databases –Annotated sequence databases, Organism specific databases; Sequence Similarity Searches: Local versus global. Distance metrics, Scoring matrices, Dynamic programming algorithms, Needleman-wunsch and Smith-waterman.	15

V	Genome Analysis: Whole genome analysis, existing software tools; Genome Annotation and Gene Prediction; Structure Prediction, ORF finding, Primer Designing, Phylogenetic Analysis, Gene Disease Associations Database: DisGeNET, GWAS, Open-source Bioinformatics software : Bioconductor, BioPerl, Biopython, BioJava, BioJS, BioRuby, Bioclipse, EMBOSS, .NET Bio, Orange	**15**

TEXTBOOKS

1. Research Methodology: A Step-by-Step Guide for Beginners–by Ranjit Kumar
2. Practical Research: Planning and Design (10th Edition) 10th Edition by Paul D. Leedy, Jeanne Ellis Ormrod
3. Developing Research Proposals (Success in Research) by Pam Denicolo, Lucinda Becker
4. Research Methodology – C.R.Kothari
5. 1.B.K. Mahajan, (1997)Methods in Biostatistics, Sixth Edition, Jaypee Brothers Medical Publishers(p)Ltd
6. 2.S.P. Gupta, (2011)Statistical Methods (41th edition),Sultan Chand & sons, New Delhi
7. Bioinformatics: Databases and Systems, by Stanley I. Letovsky
8. Bioinformatics Databases: Design, Implementation, and Usage (Chapman & Hall/ CRC Mathematical Biology & Medicine), by SorinDraghici
9. Data base annotation in molecular biology, principles and practices, Arthur M.Lesk
10. Current topics in computational molecular biology, Tao, Jiang, Ying Xu, Michael Q.Zang

STUDENT LEARNING OUTCOMES:

This course gives an idea about the basics of research, research purpose, problem solving in research, writing research articles, essay, review the paper, statistical methods used in research, data description, Bioinformatics tools and its application

YEAR II – SEMESTER IV			
LAB IN RESEARCH METHODOLOGY AND BIOINFORMATICS			
Paper	Elective IV Practical	Total Hours	: 75
Hours/Week	: 5	Exam Hours	: 06
Credit	: 3	Internal	: 40
Paper Code	: 17P4BTEP04	External	: 60

Experiment No.	**Content**	**Hours**
1	Retrieving the data and Blast analysis of the sequence data from Entrez	5
2	Locating the chromosome of a Gene	10
3	Retrieve gene expression data from GEO	5
4	Finding ORF of a Given Sequence	10
5	Retrieving structural data of a protein using PDB database	10
6	Retrieving Motif Information of a Protein Using Prosite	10
7	Retrieving Gene Information from TAIR database	10
8	Designing a primer	5
9	Retrieving genes and variants associated with human diseases from DisGeNET	5
10	Research paper - Review ,Synapsis,summary	5