

**VINOBA BHAVE UNIVERSITY**  
**SYLLABUS FOR THE**  
**DEGREE OF THE MASTER OF SCIENCE IN BIOTECHNOLOGY**  
**[UNDER CHOICE BASED CREDIT SYSTEM,**  
**SEMESTER EXAMINATION AT P.G.LEVEL]**  
**(Academic Session 2016-2018 onwards)**

The brochure of the programme of study in Biotechnology is broadly divided into three parts. (A) General Information (B) Scheme of Examination and (C) Course of Study.

**(A)General Information**

**1. Duration of the Course:** This will be a full time programme to be covered in four semesters in two academic sessions. The first part of the course shall be called M.Sc previous consisting of 1<sup>st</sup> and 2<sup>nd</sup> semesters and second part as M.Sc final, consisting of 3<sup>rd</sup> and 4<sup>th</sup> semesters. At the end of each Semester/Academic year, there shall be university examination.

**2. Eligibility for admission:** A candidate who has passed one of the following examination from Vinoba Bhave University or an examination recognized by the university as equivalent thereto shall be eligible to join M.Sc course in Biotechnology.

i) B.Sc (Honours) or equivalent examination under 10+2+3 pattern of education in Biotechnology, Biochemistry, Microbiology, Botany, Zoology & Chemistry.

ii) First class B.Sc (General) with Botany, Zoology, Chemistry or Physics and Mathematics (having biology at +2<sup>level</sup>).

iii) Graduate in Agriculture/Veterinary/Forestry/Medical Sciences with a minimum of 45% marks in aggregate. Reservation rules of Govt.of Jharkhand would be followed in the admission.

After completion of one semester, students will be admitted provisionally to the next semester, which will commence after a gap of not more than 10 days from the completion of semester examination.

The number of seats will be 25.Number of seats can be increased from time to time on the approval of the Vice Chancellor. Admission to the course will be done through a National Written Entrance Test followed by personal interview counseling to be conducted at Hazaribag by the University preferably in the month of June each year.

**Method of Admission:** The admission to the 1<sup>st</sup> Semester of Master's Course will be made in general on the basis of a merit list of the application prepared on the basis of marks obtained in the last qualifying examination or on the basis of the written entrance test conducted by the university for the purpose.

**Reservation and Weightage:**

(i)The reservation rules of the Jharkhand state government framed for the purpose of admission shall be applicable to different caste categories of the candidates provided that 15% of the total seat of the department shall be reserved for students passing outside the Jharkhand state, out of which 5% seats will be reserved for NRI categories. In case candidate of a particular category are not available adequately, the vacant seats will be treated as general seats.

(ii)The following categories of candidates will be provided weightage of marks obtained against each category for preparing merit list.

**Category: - Weightage (percent of marks to be added in the relevant Marks obtained by the candidate in the subject concerned for preparing merit list)**

- |                                  |    |
|----------------------------------|----|
| (i)Girl Student                  | 3% |
| (ii) Department of Ex Serviceman | 2% |

a. Ward of Teaching and Non-teaching Staff of the University/College under Privilege of the University	7%
(iv) N.C.C	
(a) N.C.C. Cadet having camp certificate	1%
(b) N.C.C. Cadet having state comp certificate	2%
© N.C.C. CADET having National Camp Certificate	3%
(d) N.C.C. C- Certificate	5%
(e) N.C.C. B-Certificate	4%
(v) N.S.S	
(a) N.S.S. Special Camp Certificate (unit level)	1%
(b) N.S.S. Zonal Level	2%
© PRD- Camp N.S.S National Level Camp	3%
(d) R.D.Parade/National award	5%
(vi) Sports/Cultural Activities/Fine Art and Music/Drama	
(a) International Level Representation	
(i) Olympic or Equivalent	20%
(ii) Asian Level	15%
(b) National Level	10%
© Representation of the college at State/Zonal Level	5%

**Provided that no candidate shall be allowed two benefits at the same time.**

**The Total number of seats allotted to the University Department shall be fixed by the Syndicate on the recommendation of the Academic Council.**

**Provided that if the Academic Council does not ratify the increase in the number of seats, the increase will be reverted back only in next academic session.**

3. **Course Fee per Semester:** This course will be totally operated under Self –Finance Scheme of the University. Candidates admitted to this course will pay for his/her seats Rs 25,000 for General/OBC category and Rs 20,000 for SC/ST category along with other fees of the University every semester. Fee may be increased as and when required after due consideration.

4. **Selection Procedure:** The admission to first semester/year of M.Sc Biotechnology course shall be made on the basis of performance of the candidate at the **Entrance Aptitude test (EAT)** followed by **counseling** and **interview**. For admission against NRI/NRI sponsored seats, EAT is not required but the sponsored candidates shall be required to appear at **Special test** including Viva-voce on a date to be decided by the department.

5, **Nature of test:** The entrance test will be conducted to test the knowledge of the candidates from various disciplines of Biotechnology ( Covering 80% questions of Degree level) & Mathematics including Statistics, Physics & Computer(covering 20% questions of + level).Questions will be of Objective/.Multiple choice/Fill in the blank type. There shall be **Negative Marking** and half of the total marks of each question will be deduced for wrong answer.

6. **Scope of students (Structure of Programme):** There will be four papers along with practical in each semester, except in fourth semester. Every student of fourth semester will submit a dissertation *in lieu* of four theory papers. The course of studies in different papers and in practicals will be as per syllabus prescribed by the Board of Studies in Biotechnology, Vinoba Bhave University, and Hazaribag.

## Course Structure

The Course structure of Semester I-IV shall be as under.  
(Total Credits: 74)

### FIRST SEMESTER (18 Credits)

Paper	Subject Code	No. of Credits per week	Teaching (in hours ) per week	Minimum Teaching required in Hrs
I	BTM-101	3(3x1=3)	3	45
II	BTM-102	3(3x1=3)	3	45
III	BTM-103	3(3x1=3)	3	45
IV	BTM-104	3(3x1=3)	3	45
V	BTM-105	3(3x1=3)	3	45
VI	BTM-106	3(3x1=3)	3	45/90

### SECOND SEMESTER (18 Credits)

Paper	Subject Code	No. of Credits	Teaching (in hours ) per week	Minimum Teaching required in Hrs
VII	BTM-201	3(3x1=3)	3	45
VIII	BTM-202	3(3x1=3)	3	45
IX	BTM-203	3(3x1=3)	3	45
X	BTM-204	3(3x1=3)	3	45
XI	BTM-205	3(3x1=3)	3	45
XII	BTM-206	3(3x1=3)	3	45/90

### THIRD SEMESTER (18 Credits)

Paper	Subject Code	No. of Credits	Teaching (in hours ) per week	Minimum Teaching required in Hrs
XIII	BTM-301	3(3x1=3)	3	45
XIV	BTM-302	3(3x1=3)	3	45
XV	BTM-303	3(3x1=3)	3	45
XVI	BTM-304	3(3x1=3)	3	45
XVII	BTM-305	3(3x1=3)	3	45
XVIII	BTM-306	3(3x1=3)	3	45/90

### FOURTH SEMESTER

Subject Code: BT-M-401  
Paper: XIX

*Fundamentals of Research Methodology* (Course based on project and its seminar).  
(=02 credits)

Subject Code: BTM-402  
Paper: XX  
Dissertation/Project Work  
(=20 credits)

[Total=02+18=20 Credits]

Paper	Subject Code	No. of Credits	Teaching(in hours ) per week	Minimum Teaching required in Hrs
XIX	BTM-401	2(2X1=2)	1	12
XX	BTM-402	18	1	12

[Total = 1<sup>st</sup> + 2<sup>nd</sup> + 3<sup>rd</sup> + 4<sup>th</sup> Semesters]

[Total=18+18+18+20=74 Credits]

## [OPEN ELECTIVE]

**Only for disciplines other than Biotechnology**

**(1) FUNDAMENTALS OF BIOTECHNOLOGY**

**Practical**

**(2) WASTE MANAGEMENT**

**Practical**

**Credit System:** Each course shall have a specified number of credits. These credits describe the weightages of concerned courses. The number of credits that a student has satisfactorily completed measures the performance of the student. Satisfactory progress of a student is subject to his/her maintaining a minimum Cumulative Grade Point Average (CGPA). A certain minimum number of credits as specified in the syllabus must be earned by the student to qualify for the degree. One theory paper shall contain teaching content of minimum of 60 hours.

**Assignment of credits:**

Credits of a course shall be assigned in the following manner.

- (a) For all theory (Lecture) courses one credit shall be assigned for one hour lecture per day in a semester.
- (b) Two laboratory hours per week in a semester shall be assigned one credit.
- (c) Credits shall be in whole numbers.
- (d) There shall be 16-30 credits per semester.

The performance of a candidate in a semester or upto a semester shall be measured by SGPA and CGPA.

The grading system, as detailed hereunder in table below (as per UGC rule) shall be applicable for each course

**Table: Award of Grades Based on Absolute Marks:**

Marks Range (Out of 100)	Grade	Grade Point
91-100	O	10
81-90	A+	9
71-80	A	8
61-70	B+	7
51-60	B	6
41-50	C	5
Passed with Grace	P	4
00-40	F	0
Non appearance in examination(Incomplete)	I	0
Incomplete	X	0
Dissertation/Training		

**Grace Rule:** Grace rules shall be awarded as per the following guidelines.

- (1) A student who fails in not more than 3 theory courses by total marks of not more than  $\frac{1}{2}$  the number of total theory courses of the semester (any) fraction is rounded off to the next higher number, shall be awarded grace "P" (in place of grade "F") of grade point 4 in the concerned courses.
- (2) Grace mark will not be awarded for making up shortfall in minimum SGPA/CGPA or improving the grade.

7. **Internal (Continuous) Assessment:** Apart from the semester (term) examination, every student of first, second and third semesters will be assessed in (i) Written tests (ii) Assignments. (iii) Seminars (iv) Attendance

(i) **Written tests:** In I, II and III semesters, every student will have to appear in two written test at least.

(a) **The assessment (sessional) in theory courses shall comprise a class test of 1.5 hour duration for 20 marks and 10 marks for regularity/viva/quiz/ or any other similar test.**

**The 30 marks of sessional for courses of laboratory exercises shall be based on completion of the laboratory exercise in due course of time/keeping up of practical record book / punctuality in class/viva to the practical/ any other relevant judgment.**

(b) **At the discretion of the concerned Head, a student who could not appear in the internal test(s) already conducted on account of some cogent reasons, such as late admission, illness, etc., may be allowed to appear in the internal assignment/test held for such a student.**

© **The class tests shall be conducted by the teacher (or group of teachers) teaching the course and the marks shall be displayed on the Notice Board and the student must be allowed to see their evaluated answer books based on their desire.**

(d) **Head of The Department shall ensure that all internal assessment marks of the sessional are sent to Controller of Examination prior to the commencement of End Semester Examination.**

(e) **Sessional marks of a course shall be carried over for failed students in the course.**

(ii) **Assignments:** Regular assignments will be given to each student during 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> semester in each course. Assignments should be relevant to course content. Credit for assignments in each semester shall be included along with internal assessment marks.

(iii) **Seminars:** Students in I, II and III semesters will be required to deliver one seminar of 30 minute duration followed by discussion. The performance of the student will be judged by two teachers of the department. The credit for seminar in each semester shall be included along with internal assessment exam marks.

(iv) **Attendance:** - Each student shall attend at least 75% of the classes (Theory / Practical/ Library/ Seminar) held in the department, failing which He/ She shall be debarred from filling up the University Examination form/appearing at the University Examination. Internal evaluations will also be done for the above.

**Absence during the Semester-**

- (a) **A student must inform the HOD concerned immediately of any instance of continuous absence from classes.**
- (b) **A student who is absent due to illness should approach the teachers concerned for make-up test immediately on return to class. The request should be supported with a medical certificate issued by a registered medical practitioner.**
- (c) **In case of period of absence on medical grounds is more than 20 days during the Semester a student may apply for withdrawal from the semester. Such**

**application must be made as early as possible. No applications for semester withdrawal will be considered after External examination have commenced. Partial withdrawn in a semester is not allowed.**

- (d) If a student is continuously absent from the institute for more than four weeks without permission of the Head of the Department concerned, his/her name will be removed from institute rolls.**

**8. Eligibility for taking examination:** Students Participation in the Course (Attendance): No student admitted to M.Sc. course in Biotechnology, shall be considered to have completed the course and be eligible for taking the concerned examination unless he/she has attended at least 75% of lectures and practicals and has completed his/her project work. The H.O.D. concerned/Principal can act at his/her discretion to exempt 5% attendance under special condition only on production of medical certificate. The student(s) **will be declared failed in that subject/course/semester.**

**9. Term (Semester) Examination:** There shall be term (semester) examination at the end of each semester. The semester examination will be held every year normally in the month of December and June or on dates declared in the academic calendar of the Department/University. A student seeking admission to a semester examination will submit through the Head of the Department his/her application on prescribed form along with required examination fee, etc to the Registrar of the University. Every student will appear in five respective theory papers and one combined practical examination of 6 hour duration in every semester except for the fourth semester. In the fourth semester, every student will be allotted dissertation work in lieu of 4 theory papers and 1 practical paper. Also the students have to study one theory paper and appear in exam. Allotment of dissertation will be done by a committee comprising of the Head of the Department of Biotechnology and other faculties of the Department, preferably in a National Laboratory/ Institute e.t.c. However if it is not arranged in these institutions, the students however may be permitted to pursue their dissertation work in the department or other Universities/ Private Universities or to a government recognized Laboratory or any institution duly recognized by a statutory body.

The dissertation evaluation will be evaluated by the external examiner(s) who has expertise in the concerned subject. For the purpose of holding viva-voce 2 external examiners will be appointed so. The scheme of marks for evaluating the various components of dissertation will be followed as given in the syllabus. **The dissertation evaluation will be purely external in nature.**

**10. Condition for Pass:** For passing the examination in each semester, a candidate must have secured a minimum of 45% marks in aggregate in theory, practical, dissertation and internal assessment separately. The students who do not pass a semester examination shall get an opportunity in the subsequent examination of that semester in the papers in which they have failed in the next academic session. Provided any student who fails in two consecutive semesters will not be given privileges of this clause.

**Eligibility criteria for taking admission in 2<sup>nd</sup>/3<sup>rd</sup>/4<sup>th</sup> Semester:**

**All Candidates who have passed or promoted in the previous semester may take admission in next semester.**

**11. Result:** The result of the candidate will be declared on the basis of aggregate marks obtained by him/her in all semester examination taken together. The division shall be awarded on the following basis *viz*

- |                              |                                 |
|------------------------------|---------------------------------|
| <b>(i) First Division:</b>   | 60% and above                   |
| <b>(ii) Second Division:</b> | 45% and above but less than 60% |
| <b>(iii) Failed:</b>         | Less than 45%                   |

The result of an examination shall be published as per the provisions of the concerned Ordinance.

**Examination:**

**There shall be the following four examinations comprising the course.**

**1<sup>st</sup> Examination: On completion of the courses for the period prescribed therein in November/December**

**2<sup>nd</sup> Examination: On completion of the courses for the period prescribed therein in April/May/June.**

**Scheme of Examination of a Semester: The examination of each paper shall have two components- written examination at the end of each semester carrying 70% marks to be conducted by the University and Sessional work of 30% to be evaluated by the Departmental Council. Sessional work shall comprise the written component Seminars/Cultural Activities/NCC/NSS/Sports and day to day assessment. The written component shall carry 20% marks of a paper Seminars/Cultural Activities/Sports/NCC/NSS be 5% and day to day assessment 5% of a paper. The sessional work shall be evaluated which will comprise the candidate by the Departmental Council on the basis of his/her performance in various extra curricular activities, general behavior, performance at seminar, etc.**

**12. Scheme of Examination:**

As and when required, the Board of Studies in Biotechnology, Vinoba Bhave University, Hazaribag, will be empowered to change the scheme of examination.

**13.Others:** Moderation of Results, Award of Degrees and other provisions not covered under the present regulation shall be governed by the regulation for Masters examination in Arts, Science and Commerce of Vinoba Bhave University, Hazaribag and may, if needed be reviewed.

**14. Course of Study:** The courses of the studies in different papers and in practicals will be as per syllabus prescribed by the Board of Studies in Biotechnology, Vinoba Bhave University, Hazaribag. The syllabus of M.Sc. Biotechnology shall be demarcated in to well defined units/areas of content along with a topic wise break up in each paper as per UGC/Biotechnology guidelines. The syllabus may be revised as per discretion of the university.

There shall be twenty papers, among which fifteen papers will be of 100 marks each. Dissertation paper in 4<sup>th</sup> semester will be of 600 marks and Research Methodology will be of 100 marks. The duration of test of theory papers will be of 3 hours and that of practical papers will be of 6 hours.

Teaching in Biotechnology subject shall follow the Semester pattern with a minimum of 90 days covered in 15-16 weeks per semester as provided in the relevant summary chart.

Invited lectures from eminent Researchers, Industrialists and others, on recent issues related to Biodiversity, Ethics, Biosafety, Intellectual Property Rights and Patent Issues, and Good Laboratory and Manufacturing practices shall be organized.

**Note: The Departmental council shall be responsible for conduct of sessional examination. Normally the test of a portion shall be conducted by the teacher who had imparted the teaching of the relevant portion and shall evaluate the answer paper and submit the result to the HOD within a week of the test conducted.**

The following are the detailed schemes of examination of a semester.

## Marking Scheme of the Examination

### FIRST SEMESTER

Paper (Theory & Practical)	External Exam	Internal Exam	Pass Marks (External)	Pass Marks (Internal)	Total Marks	Pass Marks
I. Cell Biology	70	30	28	12	100	40
II. Microbial Physiology & Genetics	70	30	28	12	100	40
III. Biostatistics, & Computer Applications in Biology	70	30	28	12	100	40
IV. Biochemistry	70	30	28	12	100	40
V. Practical	70	30	28	12	100	40
VI. Communicative English (Elective from other Department)	70	30	28	12	100	40
<b>TOTAL</b>	<b>420</b>	<b>180</b>	<b>168</b>	<b>72</b>	<b>600</b>	<b>240</b>

### SECOND SEMESTER

Paper (Theory & Practical)	External Exam	Internal Exam	Pass Marks (External)	Pass Marks (Internal)	Total Marks	Pass Marks
VII. Genetic Engineering	70	30	28	12	100	40
VIII. Methods in Molecular Diagnostics/ In Silico Drug Designing	70	30	28	12	100	40
IX. Molecular Biology & Biophysics	70	30	28	12	100	40
X. Biology of The Immune System	70	30	28	12	100	40
XI. Practical	70	30	28	12	100	40
XII Fundamentals of Economics (Elective from other Department)	70	30	28	12	100	40
<b>TOTAL</b>	<b>420</b>	<b>180</b>	<b>168</b>	<b>72</b>	<b>600</b>	<b>240</b>

### THIRD SEMESTER

Paper (Theory & Practical)	External Exam	Internal Exam	Pass Marks (External)	Pass Marks (Internal)	Total Marks	Pass Marks
XIII. Animal Cell Sciences & Techniques	70	30	28	12	100	40
XIV Bioprocess Engineering & Technology (Elective)	70	30	28	12	100	40
XV. Plant Biotechnology	70	30	28	12	100	40
XVI. Environmental Biotechnology	70	30	28	12	100	40
XVII. Practical	70	30	28	12	100	40
XVIII. IPR & Patenting/Entrepreneurship Development/Marketing Management (Elective from other Department)	70	30	28	12	100	40
<b>TOTAL</b>	<b>420</b>	<b>180</b>	<b>168</b>	<b>72</b>	<b>600</b>	<b>240</b>

### FOURTH SEMESTER

<b>XIX. RESEARCH METHODOLOGY</b>	<b>Max. Marks 100</b>	<b>Min. Aggr. Marks for Passing = 40</b>
----------------------------------	---------------------------	--



<b>XX. DISSERTATION /PROJECT WORK (Six Months)</b>		
Objective	100	
Review of Literature	100	
Methodology	100	=240
Analysis & Interpretation of Result	100	
Language & Presentation	100	
Viva voce	100	
<b>TOTAL MARKS</b>	<b>700</b>	<b>=280</b>

<b>AGGREGATE OF 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup> &amp; 4<sup>th</sup> Semesters</b>	
<b>Total Marks =2500</b>	<b>Pass Marks=(720+280)=1000</b>

**[OPEN ELECTIVE]**

**Only for disciplines other than Biotechnology**

- (3) **FUNDAMENTALS OF BIOTECHNOLOGY**  
**Practical**
- (4) **WASTE MANAGEMENT**  
**Practical**

# COURSES OF STUDY (M. Sc. in Biotechnology)

## FIRST SEMESTER

### Paper: BTM -101

### Cell Biology

#### Unit I

Diversity of Cell size and shape, Cell theory, Structure of Prokaryotic and eukaryotic cells, Isolation of cells, Principles of microscopy, light microscopy, resolving power of a microscope, SEM and TEM, Freeze etch and image processing; Cellular organelles, Structural complexity of chromosomes.

#### Unit II

Plasma membrane structure, function and transport mechanisms, transport of nutrients, ions and macromolecules across membranes. Cellular energy transactions- role of mitochondria and chloroplast.

#### Unit III

Cell cycle- molecular events and model systems; Cell signaling in plants & animals, mechanisms of signal transduction, quorum sensing. Cilia and flagella of eukaryotes & prokaryotes; Biology of cancer; Cellular basis of differentiation and development: mitosis, meiosis, gametogenesis & fertilization.

#### Unit IV

Biosynthesis of proteins in eukaryotic cell, protein localization, synthesis and secretion of membrane proteins, intracellular protein trafficking. Cell Junctions, Development in *Drosophila* and *Arabidopsis*.

### Recommended Books

1. Molecular Biology of the Cell, B. Alberts, 6<sup>th</sup> Edition, Garland Science
2. Molecular Cell Biology, Lodish et al., 5<sup>th</sup> Edition, Free Man
3. Developmental Biology, SF Gilbert, Sinauer Associates Inc., 7<sup>th</sup> Edition
4. The Cell – A Molecular Approach, 6<sup>th</sup> Edition, Geoffrey M.Copper, Sinauer Associates
5. Molecular Biology, Friedfelder D, Jones and Bartlett Publication, (1998).
6. Principles of Biochemistry, Lehninger, Freeman, 5<sup>th</sup> Edition
7. Cell Biology: T.devasena
8. Chordate Embryology: Veer Bala Rastogi, S.Chand Publication

**Unit I**

History and scope of microbiology, Sterilization techniques, Pure culture methods enrichment culture technique, Isolation, staining techniques and preservation of microorganisms. Kinetics of growth, curve & mathematical expression of growth.

**Unit II**

Metabolic diversity among microorganisms, photosynthesis in microorganisms, chemolithotrophy; hydrogen-iron nitrite oxidizing bacteria; nitrate and sulfate reduction; Methane fermentation-diversity, syntrophy, role of anoxic decomposition, methanogenesis and acetogenesis; hydrocarbon transformation.

**Unit III**

Structural diversity of bacteria, purple and green bacteria, cyanobacteria, spirilla, spirocheaetes, lactic and propionic acid bacteria, rods and cocci, mycobacteria, rickettsias, chlamydias and mycoplasma methanogens.

Structural diversity of viruses; bacterial, plant, animal and tumor viruses, discovery, classification and structure of viruses, positive and negative strand viruses, lytic and lysogenic cycle, examples of herpes, pox, adenoviruses, retrovirus, Ø X 174, viroids and prions.

**Unit IV**

Prokaryotic cells structure and functions, cell walls of eubacteria, peptidoglycan and related molecules, biosynthesis of cell wall; outer membrane of gram negative bacteria, cell membrane synthesis, gram +ve and gram -ve flagella, cell inclusions like endospores, gas vesicles. Host parasite relationship; entry of pathogens into host; toxins and their mode of action. Elementary idea of broad spectrum antibiotics

**Recommended Books**

1. General Microbiology, Stanier, R.Y. Ingraham, J.L. Wheelis, M.L. and Painter, P.R. The Macmillan press Ltd. 5<sup>th</sup> edition (2000).
2. Brock Biology of Microorganisms, Madigan M.T. Martinko, J.M. and Parker, J. Prentice- Hall NY, USA (6<sup>th</sup> edition).
3. Microbiology, Pelczar, M.J. Jr. Chan E.C.S. and Kreig, N.R. Tata McGraw Hill, NY, USA (5<sup>th</sup> edition).
5. Microbiology- A Laboratory Manual, Cappuccino, J.G. and Sherman N. Addison Wesley, UK, (10<sup>th</sup> edition).
6. Microbiological Application: A Laboratory Manual in General Microbiology Benson, H.J, Alfred Brown, McGraw Hill, NY, USA (10<sup>th</sup> edition).

**Unit I**

Importance and scope of statistics in biological experimentation; Elements of probability; Mathematical and statistical definitions; Addition and Multiplication theorems; Probability distribution functions-Binomial, Poisson and Normal; Area under normal distribution curve. Measures of central tendency: Arithmetic, geometric & harmonic means: Measures of dispersion: range, quartile deviation, variance, standard deviation, coefficient of variation, confidence limits of population mean.

**Unit II**

Tests of significance, hypothesis and errors; student t statistics-population means equals a specified value; equality of 2 independent means (equal and unequal variance), equality of 2 means (paired samples). Analysis of variance: one way analysis (sample sizes equal and unequal), completely randomized design; two way analysis (one observation per cell).

**Unit III**

Linear regression: regression diagram and equation, regression coefficient, standard error, significance tests, prediction of dependent variable from the independent variable; linear correlation-scatter diagram , correlation coefficient, standard error, significance tests; relationship between regression and correlation coefficients, Non parametric tests: Chi square statistics, tests of goodness of fit, test of independence of attributes, standard line interpolation.

**Unit IV**

Introduction to computers: Basic Architecture, generations of computer hardware and software; operating systems-WINDOWS system and application software; introduction to internet-LAN, MAN,WAN, Programming language C (Introduction) and presentation software, Flow charts & Programming techniques.

**Recommended Books: -**

1. Fundamentals of Biostatistics and Bioinformatics– B.L.Agarwal, New Age International Publishers, Daryaganj, New Delhi
2. Bioinformatics- Sharma, Shankar, Rastogi Publication, Merrut,
3. Principles of Bioinformatics- Shanmughawel, Pointer Publishers, Jaipur,
4. Biostatistics-A foundation for Health Science, Daniel WW, John Wiley (1983).
5. Statistical Methods, Medhi J, Willey Eastern Limited, (1992).

**Unit I**

Structure of water and its solvent properties, acid, base, pH and buffers, free energy and spontaneity of reactions; ATP and other phosphorylated compound with their free energy of hydrolysis, biological oxidation reduction reactions, coupled reactions and oxidative phosphorylation. Intra and inter molecular forces, electrostatic interactions, hydrogen bonding, weak interactions and Vander Waals forces, disulphide bridges.

**Unit II**

Enzyme classification, specificity, active site, Enzyme kinetics- Michaelis & Menton equation, determination of kinetic parameters, bi-substrate reactions and their kinetics, enzyme inhibition and kinetics, allosteric enzymes, ribozymes, isozymes. Enzyme catalysis in solutions, Applications of enzymes in industries.

**Unit III**

Structure and chemistry of macromolecules: Carbohydrates, Proteins, Lipids and Vitamins. Biochemical tests for carbohydrates, proteins & lipids. Kinetics of protein folding, protein sequencing & protein denaturation. Metabolism of carbohydrates, lipids, amino acids, nucleotides and vitamins.

**Unit IV**

Chromatographic technique- paper and TLC, gel filtration, column chromatography, ion-exchange, affinity column, HPLC, GLC, SDS-PAGE, Agarose electrophoresis; isoelectric focusing & 2D-PAGE, Western blotting, Differential, density gradient, rate zonal & isopycnic centrifugation.

**Recommended Books: -**

1. Biochemical Calculations, Irwin H. Segal, John Wiley and Sons Inc, 2<sup>nd</sup> Edition.
2. Biochemistry, Stryer I., H.Freeman and Company, (2000).
3. Understanding Chemistry CNR Rao, Universities. Press Hyderabad (1999).
4. A Biologist's Guide to Principals and Techniques of Practical Biochemistry. K Wilson & KH Goulding, ELBS Edition, 1986.
5. Principles of Biochemistry, Lehninger, Freeman, 5<sup>th</sup> Edition
6. Biochemistry, Jermey M. Berg, John L. Tymcozko. 7<sup>th</sup> Edition
7. Harper's Biochemistry, Murray RK et al., Prentice Hall International (1999).

**List of Practicals:**

1. Microscopy : bright field
2. To study instrumental methods for cell biology
3. To study mitosis & meiosis
4. 'C' programming language
  - a. if-else, nested if-else, ladder if-else related programs
  - b. looping
  - c. arrays
5. MS- Office
  - a. MS-Word
  - b. MS-Excel
  - c. MS-Power Point
6. MS-DOS
7. Basic Practicals of Bioinformatics
8. To prepare NA media for routine cultivation of bacteria.
9. To prepare Czapek-Dox Agar media for routine cultivation of fungi.
10. To prepare PDA media for routine cultivation of fungi.
11. To prepare LB broth for enteric bacteria culture
12. To study various methods of sterilization, Isolation and maintenance of micro-organisms by plating, streaking and serial dilution methods of slants and stab cultures, storage of micro-organisms.
13. To isolate pure cultures from soil and water.
14. To study growth curve, measurement of bacterial population by turbidometry and serial dilution methods; effects of temperature, pH, carbon and nitrogen sources on growth.
15. Microscopic examination of bacteria and yeast study of micro-organism by Gram's staining, and staining for spores.
16. Assay of antibiotics and demonstration of antibiotics resistance.
17. Titration of amino acids.
18. Colorimetric determination of pK.
19. Estimation of DNA by DPA method.
20. Estimation of RNA by Orcinol method.
21. Estimation of glucose by DNS method.
22. Estimation of protein by FC method.
23. To separate the plant pigments by paper chromatography.
24. To separate the lipids from doob grass by TLC

Unit-1

**Introduction, Business Correspondence**

Definition, Objectives, Stages of Communication, Essentials of Good/Effective Communication, Benefits of Good communication, Gaps in Communication, Communication and Information Technology. Structure of a Letter, Inquiry Letter, Sales Letter, Order Letter, Complaints, Complaint Handling, Telemarketing.

Unit-2

**Government Correspondence, Writing Skills**

Noting, Routine Letter, Official Letter, Memorandum, Circular, Telegrams, Newsletter, Report Writing, Scientific Paper Writing, Writing small Paragraphs & Essays, Composition.

Unit-3

**Grammar**

Sentence Structure, Idiomatic Usages of Language, Tense, Direct and Indirect Speech, Active and Passive Voice, Vocabulary

Unit-4

**Short Stories**

The following short stories are prescribed for study:

R K Narayan	- The Axe
Maugham	- The Necklace
Khuswant Singh	- The Portrait of a Lady
O'Henry	- The Gift of the magi
Leo Tolstoy	- Three Questions

Unit- 5

**Preparation for Job**

Writing Applications for Jobs, Preparing Curriculum Vitae, Preparing for Interviews, Preparing for Group Discussions.

## SECOND SEMESTER

**Paper: BTM-201**

**Genetic Engineering**

### **Unit I**

Scope of genetic engineering, milestones in genetic engineering; genetic engineering guidelines, DNA- synthesis and mutation, sequencing, Gene cloning and patenting; Molecular tools and their applications: restriction enzymes, modification enzymes, nucleic acid purification. PCR, its types and applications. Vectors- plasmids, bacteriophage, phagemids, cosmids, artificial chromosomes (YAC & BAC). Restriction digestion & Restriction mapping cDNA synthesis and cloning; mRNA enrichment, reverse transcription, DNA primers, linkers, adaptors and their chemical synthesis; library construction and screening.

### **Unit II**

Alternative strategies of gene cloning; Cloning interacting genes-Two and Three hybrid systems, Cloning differentially expressed genes, DNA micro array; Site Directed Mutagenesis and Protein Engineering ; How to study gene regulation- DNA transfection, northern blot, primer extension, SI mapping , RNase protection assay, reporter assays.

### **Unit III**

Expression strategies for heterologous genes: vector engineering and codon optimization, host engineering; in vitro transcription and translation, expression in bacteria, yeast, insect cells, mammalian cells, plants.

### **Unit IV**

T-DNA and transposon tagging; role of gene tagging in gene analysis, identification and isolation of genes through T-DNA or transposon; Transgenic and Gene Knockout technologies–Targeted gene transfer, Chromosome Engineering; Gene Therapy-Strategies of gene delivery, Gene replacement/ augmentation, Gene correction, Gene editing.

### **Recommended Books**

1. Molecular cloning: A Laboratory Manual, J. Sambrook , E.F. Fritsch and T. Maniatis, Cold Spring Harbor Laboratory Press, New York, 2000.
2. DNA Cloning: A practical Approach, D.M. Glover and B.D. Hames, IRL Press,Oxford, 1995.
3. Methods in Enzymology Vol. 152, Guide to Molecular Cloning Techniques, S.L.Berger and A.R. Kimmel, Academic Press, Inc. San Diego, 1998.
4. Molecular Biotechnology (2nd Edn.) S.B. Primrose, Blackwell Scientific Publishers,Oxford, 1994.
5. Gene cloning and DNA analysis: An Introduction- T.A Brown 6<sup>th</sup> edition Willey Publisher (2010).



**UNIT-I**

Isolation and Purification of Nucleic acids- Principles and Methods. Molecular cloning, labeling of nucleic acids, hybridization. Protein- protein and protein- ligand interactions, physical and chemical methods for their study. Nucleic acid amplification methods and types of PCR: Reverse Transcriptase-PCR, Real-Time PCR, Inverse PCR, Multiplex PCR, Nested PCR, Alu-PCR, Hot-start, *In situ* PCR, Long-PCR, PCR-ELISA, Arbitrarily primed PCR, Ligase Chain Reaction.

**UNIT-II**

Applications of PCR- PCR based microbial typing: Eubacterial identification based on 16S rRNA sequences- Amplified Ribosomal DNA Restriction analysis. (ARDRA). Culture independent analysis of bacteria- DGGE and TRFLP. Molecular diagnosis of fungal pathogens based on 18S rRNA sequences- Detection of viral pathogens through PCR. RAPD for animal and plants- PCR in forensic science- AmpFLP, STR, Multiplex PCR- Determination of Paternity- Human identification and sex determination.

**UNIT-III**

Automated DNA sequencing- Principles, Methods and Instrumentation- Advances in DNA sequencing- Pyrosequencing- Microarrays- Personalized Medicine Pharmacogenomics.

**UNIT-IV**

Proteomics- Clinical Proteomics, Good Laboratory Practices. Different Levels of Biosafety, Containment Levels for rDNA experiments. Biosafety aspects of transgenic plants and germplasm.

**Recommended Books-**

1. Clinical Chemistry and Molecular diagnostic- Carl A Burtis, Edward R. Ashwood David E. Boons, Elsevier publication, USA, 5<sup>th</sup> edition (2012).
2. Molecular Diagnostic for the clinical laboratorian, William B. Coleman, Gregory J. Tsongalis, Humana Press, USA, 2<sup>nd</sup> edition,.

**Unit I**

Bioinformatics-Introduction; NCBI, MEDLINE, PubMed, Gen Bank, Entrez Protein database: Swiss Prot, PIR, BLOCKS, Human Genome Database, Dynamic Programming, BLAST, FASTA, Clustal, HMM, Phylogenetic analysis, Applications of bioinformatics in biotechnology

**Unit II**

Discovery & Development of Drug: History of drug discovery, strategies in drug discoveries, lead discoveries, pharmacophore identification, lead development, screening of compounds, toxicological evaluation of new drugs, Pre-Clinical testing, Clinical trials, Bioavailability of the drug, Pharmacokinetics. Rational Drug Design-Structure, Activity, Relationships in Drug Design, Molecular Modeling, Molecular Docking & Dynamics, Electronic Structure, Methods & Quantum Chemical Methods, De novo Drug Design techniques & informatics methods in drug design.

**Unit III**

Fundamental of Drug Action: Inter & Intra Molecular Interaction; Weak interaction in drug molecule, chirality and drug action, covalent ion, ion dipole, hydrogen bonding, C-H hydrogen bonding, dihydrogen bonding, Vander Waals interactions & associated energies. Cation and OH interactions.

**Unit IV**

Receptrology: Drug Receptor Interaction, Receptor Theories and Drug Action, Occupancy theory, Rate theory, Induced Fit Theory, Macromolecular Perturbation Theory, Activation-Aggregation theory. Pharmacological Screening & Assays: General principle of screening, Correlation between various animal models & human situation.

**Recommended Books-**

1. The organic chemistry of drug design and drug action-Richard B. Silverman, Academic press, Cambridge, (2<sup>nd</sup> edition), 2004.
2. Drug Design- Kenneth M Merz Jr, Dagmar Ringe, Charles M. Renyolds, Cambridge University Press, (2010 edition).

**Unit I**

Introduction to Molecular Biology and Genetics; Double helix: Physico-chemical considerations. DNA replication, mechanism of DNA replication in prokaryotes and eukaryotes, enzymes and accessory proteins involved in DNA replication. DNA repair and recombination- methyl directed mismatch repair, very short patch repair, nucleotide and base excision repair, SOS system, Holliday junction, FLP/FRT Cre/Lox recombination, RecA and other recombinases. Antisense: Molecular mechanism of antisense molecules, disruption of RNA structure; applications of antisense.

**Unit II**

Transcription and modifications in RNA/protein; prokaryotic and eukaryotic transcription, RNA polymerases, general and specific transcription factors, regulatory elements and mechanisms of transcription regulation, 5-Cap formation, transcription termination, 3' end processing and polyadenylation, splicing, editing, stability and nuclear export of mRNA; post transcriptional gene silencing. Translation in prokaryotes and eucaryotes, machinery, mechanism and regulation of translation

**Unit III**

Physical techniques in protein, nucleic acids and polysaccharide: structural analysis X-ray crystallography, UV-Vis, Fluorescence, IR, CD, NMR, ESR and Raman spectroscopy; Differential colorimetry, Scanning Tunneling microscopy, MALDI –TOF-MS, Atomic Absorption Spectroscopy & Flame Photometry.

**Unit IV**

Radiolabeling techniques, properties of different types of radioisotopes normally used in biology, their detection and measurement, incorporation of radioisotopes in biological tissues and cells, molecular imaging of radioactive material, safety guidelines.

**Recommended Books-**

1. Molecular cloning : A Laboratory Manual , J. Sambrook & Russeel, 3<sup>rd</sup> Edition, CSHL Press
2. Molecular Biology LabFax, T.A. Brown (Ed) Bios Scientific Publishers Ltd. Oxford, 1991
3. Molecular Biology of the Gene (6th edition ), J.D. Watson, Pearson
4. Molecular Cell Biology 5<sup>th</sup> Edition) J. Darnell, H. Lodish and D. Baltimore, , Freeman American Books, Inc., USA, 1994.
5. Molecular Biology of the Cell (4<sup>th</sup> Edition) B. Alberts, Garland Science
6. Gene VI (6th Edition) Benjamin Lewin, Oxford University press, U.K., 1998.
7. Molecular Biology- David Freifelder, 2<sup>nd</sup> Edition, Narosa Publishing House.
8. Molecular Cell Biology-6<sup>th</sup> Edition, Lodish, Berk, Kaiser, Krieger, Scott, Bretscher, Ploegh, Matsudaira, 6<sup>th</sup> Edition- Free Man Publishing.

**Unit I**

Introduction: innate and acquired immunity, organization and structure of lymphoid organs, nature and biology of antigens and super antigens. Antibody structure and function; antigen antibody interactions; major histocompatibility complex, BCR & TCR; Generation of diversity, complement system.

**Unit II**

Cells of the immune system; hematopoiesis and differentiation, lymphocyte trafficking; B-lymphocytes, T-lymphocytes, macrophages, dendritic cells, natural killer and lymphokine activated killer cells, eosinophil, neutrophils and mast cells.

**Unit III**

Antigen processing and presentation, Generation of humoral and cell mediated immune responses; activation of B and T –lymphocytes; cytokines and their role in immune regulation; MHC restriction; Immunological tolerance.

**Unit IV**

Cell-mediated cytotoxicity: mechanism of T cell and NK cell mediated lysis; antibody dependent cell mediated cytotoxicity, macrophage mediated cytotoxicity; hypersensitivity, autoimmunity; AIDS and other immunodeficiencies, Vaccines-different types.

**Recommended Books**

1. Kuby immunology, 4th Edition, R.A. Goldsby, Thomas J. Kindt, Barbara, A. Osbarne. (Freedom)
2. Immunology-A short Course, 4th Edition- Ell Benjamin, Richard Coico, Geoffrey Sunshine (Wiley-Liss).
3. Fundamentals of immunology, William Paul, 7<sup>th</sup> edition, Lippincotts Williams and wilkins (2012).
4. Roitt's essential Immunology, Roitt I.M. and Delves P.J., Blackwell Science Ltd., (2001).

**List of Practicals:**

1. To preparation competent cells.
2. To isolate plasmid DNA.
3. To quantitate nucleic acids.
4. To study agarose gel electrophoresis and restriction mapping of DNA.
5. To construct restriction map of plasmid DNA.
6. To perform PCR
7. To perform Restriction Digestion
8. To perform Southern blotting.
9. To isolate genomic DNA from moong seeds.
10. To isolate genomic DNA from *E-coli*.
11. To isolate DNA from germinating gram seeds.
12. To determine molecular weight of given DNA sample by agarose gel electrophoresis.
13. To isolate DNA from cauliflower and show the bands.
14. Blood film preparation and identification of cells.
15. Immunization, collection of serum.
16. Double diffusion and immuno-eletrophoresis.
17. Western –blotting.
18. ELISA
19. To assay T<sub>3</sub> in a given serum sample.
20. To assay T<sub>4</sub> in a given serum sample
21. To assay TSH in a given sample.
22. To perform affinity chromatography.
23. To. perform SDS-PAGE of protein
24. To perform Gel Filtration chromatography using kit

**Micro Economics**

**Module -1- Consumer Behaviour**

Consumer's Behaviour-Law of Demand. Marshallian and Hicksian theory of consumer's equilibrium. Elasticity of Demand- Kinds and measurement of elasticity of demand. Marshallian theory of consumer's surplus.

**Module -II- Production Function**

Law of variable proportions. Returns to scale. Least cost combination of factors. Different concepts of costs: Short run and long run cost curves.

**Module -III-Market**

Market- Meaning and classification. Relationship between average revenue, marginal revenue and elasticity of demand. Relationship between average cost and marginal cost. Pricing under perfect competition and monopoly.

**Module- IV-Distribution**

Marginal productivity theory of distribution. Ricardian theory of rent, Liquidity preference theory of interest. Knight's and Schumpeters theory of profit.

**Macro Economics**

**Module V-** National income- concepts and methods of measurement. Fisherian version of quantity theory of money. Central and commercial banks: Credit creation and methods of credit control.

## THIRD SEMESTER

**Paper: BTM-301**

**Animal Cell Science and Techniques**

### **Unit I**

Structure and organization of animal cell, equipments and materials for animal cell culture technology; primary and established cell line cultures, introduction to the balance salt solutions and simple growth medium, brief account of chemical, physical and metabolic functions of different constituents of culture medium, role of carbon di-oxide, serum and supplements.

### **Unit II**

Serum and protein free defined media and their application, measurement of viability and cytotoxicity, biology and characterization of the cultured cells, measuring parameters of growth, basic techniques of mammalian cell culture *in vitro*; disaggregation of tissue and primary culture; maintenance of cell culture; cell separation.

### **Unit III**

Cell synchronization, cell cloning and micro-manipulation, cell transformation. Applications of animal cell cultures, stem cell cultures, embryonic stem cells and their applications.

### **Unit IV**

Cell culture based vaccines, somatic cell genetics, hybridoma technology and production of monoclonal antibodies. Organ and histotypic culture, measurement of cell death, apoptosis, three dimensional culture and tissue engineering.

### **Recommended Books**

1. Culture of Animal Cells (3rd Edition), R. Ian Freshmney. Wiley-Liss.
2. Animal Cell Culture – Practical Approach, Ed . John R W Masters. Oxford Univ Press. 2000
3. Animal Cell Culture Techniques, Ed Martin Clynes, Springer. 1998
4. Methods in Cell Biology, Vol. 57, Animal Cell Culture Methods, (Ed.) Jenni P.Mather and David Barnes, Academic Press

**Unit I**

Bio fermentation: designing and application, principles of bio fermentation, monitoring and control parameters (pH, oxygen, agitation, temperature, foam, etc), batch and continuous; production medium, raw materials, isolation, maintenance, preservation & improvement of industrial strains, computer control of fermentation processes.

**Unit II**

Downstream processing: Filtration of fermentation broths, ultra centrifugation, recovery of biological products by distillation, superficial fluid extraction. Removal of microbial cells and solid matter, foam separation, centrifugation, cell disruption, liquid-liquid extraction, chromatography, drying and crystallization, D.O.C. and C.O.D. treatment and disposal of effluents.

**Unit III**

Industrial production of solvents: Ethyl alcohol, citric and acetic acids; enzymes; amylases, proteases, cellulases; vitamin B<sub>12</sub>, vitamin C, antibiotics (penicillin, streptomycin,). Microbes in mineral beneficiation & petroleum industry (MEOR). Immobilization.

**Unit IV**

Elementary idea of Dairy & Food Microbiology, bread, cheees, idli & yoghurt. Canning and packing, technology of typical food products.

**Recommended Books**

1. Biochemical Engineering, S Aiba, AE Humphrey and NF Millis, Academic Press. New York 1973
2. Biochemical Reactors, B Atkinson, Pion Ltd., London. 1974
3. Biochemical Engineering Fundamentals (2nd edition), JE Baily and DF Ollis, McGraw Hill BookCo. New York. 1986
4. Bioprocess Engineering: Basic Concepts (2nd edition), ML Shuler, and F Kargi, Prentice Hall,Engelwood Cliffs. 2003
5. Principles of Fermentation Technology (2nd edition), PF Stanbury, A Whittaker and SJ Hall,Pergamon Press, Oxford. 1995
6. Chemical Engineering Problems in Biotechnology, M L Shuler, (Ed) AICE. 1989
7. Biochemical Engineering, J M Lee, Prentice Hall Inc. 1991



**Unit I**

Introduction of plant cell and tissue culture: tissue culture media Single and suspension culture, Organogenesis & Embryogenesis, embryo culture and embryo rescue; haploid production and homozygous diploid lines; cryopreservation and germplasm conservation; protoplast isolation, culture and fusion; selection of hybrid cells and regeneration of hybrid plant; symmetric and asymmetric cybrids, production of virus free plants.

**Unit II**

Cloning vector for higher plant transformation: *Agrobacterium tumefaciens* Ti and Ri plasmids, basis of tumor formation, hairy root, mechanisms of DNA transfer, role of virulence genes. Viral vectors. Direct gene transfer. Transformation of monocots; transgene stability and gene silencing, selection of clones. Expression of cloned genes: genetic markers, reporter genes, Gus assay

**Unit III**

Application of plant transformation for productivity and performance: herbicide resistance, insect resistance, virus resistance, disease resistance, nematode resistance, abiotic stress post harvest losses, long shelf life of fruits and flowers, carbohydrate composition and concentration during storage.

**Unit IV**

Chloroplast transformation: vectors, mechanisms, advantages and limitations, homoplasmic line development. Metabolic engineering and industrial products; plant secondary metabolites, control mechanisms and applications of industrially important secondary metabolites. Marker-aided breeding RFLP maps; Linkage analysis; RAPD markers; STS, SSCP, SCAR, AFLP, QTL and microsatellites; Molecular assisted selection.

**Recommended Books**

1. T, J. Fu, G. Singh and W.R. Curtis (Eds): Plant Cell and Tissue Culture for the Production of Food Ingredients. Kluwer Academic/Plenum Press. 1999.
2. H.S. Chawla: Plant Biotechnology, 2<sup>nd</sup> Edition, Oxford & IBH publishing co.pvt.ltd
3. R.J. Henry: Practical Application of Plant Molecular Biotechnology. Chapman and Hall. 1997.
4. P.K. Gupta Elements of Biotechnology. Rastogi and Co. Meerut. 1996
5. Plant Biotechnology, M.K. Razdan, 2<sup>nd</sup> Edition, Oxford & IBH publishing co.pvt.ltd
6. Plant Biotechnology: J. Hammond, P. McGarvey and V Yusibov (Eds):, Springer Verlag, 2000

**Unit -I**

Environment: Basic concepts and issues. Global environmental problems-ozone depletion, UV-B green house effect and acid rain, their impact and biotechnology approaches for management. Air pollution and its control through biotechnology, *Biodiversity*: conservation and management

**Unit II**

Water pollution and its control through biotechnology. Waste water treatment-physical, chemical and biological treatment processes; algal blooms and human health. Microbiology of waste water treatment: Aerobic processes & Anaerobic processes.

**Unit III**

Treatment schemes for waste waters of dairy, distillery & tannery industries; extremophiles. Xenobiotics & Bioremediation.

**Unit IV**

Biological N<sub>2</sub> fixation, biofertilizers and biopesticides; solid wastes; sources and management (composting, vermiculture and methane production); Single cell protein (*Spirulina*, yeast, mushroom); Biosensors, Biomass Energy, Biofuels.

**Recommended Books**

1. Wastewater Engineering – Treatment, Disposal and Reuse, Metcalf and Eddy. Inc. Tata McGrawHill, New Delhi. 1991
2. Environmental Science (5th Edition) by WP Cunningham & BW Saigo., Mc Graw Hill. 1999.
3. Environmental Chemistry, A.K. De. Wiley Eastern Ltd. New Delhi(1996).+
4. Introduction to Biodeterioration , D Allsopp and K J Seal, ELBS/Edward Arnold. Cambridge UnivPress. 2004.
5. Ecology & Environment,P.D.Sharma.,11<sup>th</sup> edition, Rastogi publication.
- 6.Microbial Ecology,Ronald M. Atlas & Richarad Bartha, Pearson publication,4<sup>th</sup> edition

1. To prepare tissue culture medium, and membrane filtration
2. To prepare single cell suspension from spleen and thymus.
3. To study cell counting and cell viability.
4. Trypsinization of monolayer and sub-culturing
5. Cryopreservation and thawing
6. Measurement of doubling time
7. Role of serum in cell culture
8. Cell fusion with PEG.
9. To determine dissolved oxygen (DO) concentration of water sample.
10. To determine biological oxygen demand (BOD) of a sewage sample.
11. To estimate nitrate, nitrite and chlorine in drinking water sample.
12. To determine the Chemical Oxygen Demand (COD) of water sample.
13. To determine the Total Dissolved Solids (TDS) of water sample
14. To prepare MS media.
15. To study the effect of solidification on media.
16. To study Surface sterilization & Seed Inoculation
17. To develop RFLP and RAPD maps
18. To isolate industrially important microorganisms for microbial processes.
19. To determine thermal death point (TDP) and thermal death time (TDT) of microorganisms.
20. To immobilize the seeds.
21. Microbial production of citric acid using *Aspergillus niger*.
22. Microbial production of antibiotic (penicillin).

**Paper: BTM-306**

**IPR & Patenting / Marketing Management/ Entrepreneurship Development**

**Paper: BTM-306**

**IPR & Patenting**

**UNIT I**

Introduction to IPR & Patents: Understanding of Intellectual Property Rights, Introduction of IPR, History of Patent Protection, Rationale behind Patent System, WTO, TRIPS and WIPO

**UNIT II**

Overview of Biotechnology and Intellectual Property, Biotechnology Research and Intellectual Property Rights, Management, Licensing and Enforcing Intellectual Property, Commercializing Biotechnology Invention, Case studies of Biotechnology

**UNIT III**

Patents, Copyrights and Trademark: Economic impact of the patent system, Patent and kind of inventions protected by a patent, Granting of patent, Rights of a patent, Searching a patent, Drafting of a patent, Filing of a patent, The different layers of the international patent system (National, and International options), Copyright and related rights, trademark, Rights of trademark, types of trademark, function does a trademark perform, protection, trademark registration,

**UNIT IV**

Legislations and Salient Features of Patent Act: History of Indian Patent Act, Indian Patents Act 1970, Patent Amendment Act 2005, WTO-TRIPS – Key effect on Indian Legislation, Organization of Patent System in India.

## **Marketing Management**

### **Objective:**

The objective of this paper is to develop an understanding of the basic concepts of marketing and acquire skill to develop necessary product, pricing, distribution and promotion strategies for marketing of bio product and services.

### **UNIT I :**

Introduction , Definition, Importance and Scope of Marketing, Elements of Marketing Needs, Wants, Demands, Customer, Consumer, Markets and Marketers; Marketing vs Selling, Consumer Markets and Industrial Markets. Concept of Marketing Management, Marketing –Mix, Functions of Marketing Management ,Marketing Organizations, Qualities of Marketing Manager, Marketing Environment, Factors Affecting Marketing Environment, Marketing Research , Strategic Marketing Planning.

### **UNIT II :**

Market Segmentation, Segmenting the Market, Benefits/ Purpose and Limitations of Market Segmentations, Market Segmentation Procedure, Basis for Consumer / Industrial Market Segmentation. Market Targeting – Introduction, Procedure, Product Positioning – Introduction, Objective, Usefulness, Differentiating the Product, Product Positioning Strategy, Consumer Behavior- Introduction, Importance & Process.

### **UNIT III:**

Marketing – Mix Decisions, Product Decisions, New Product Development – Concept and Necessity for Development, Failure of New Products, New Product Planning and Development Process, Product-Mix, Branding and Packaging Decisions, Product Life Cycle- Stages and Strategies for Different Stages of PLC.

### **UNIT IV:**

Pricing Decisions, Pricing Objective, Policies Methods of Setting Price, Pricing Strategies, Channels of Distribution for Consumer/ Industrial Products, Factors Affecting Channel Distribution, Management of Channels: Current Trends in Wholesaling and Retailing, Retail Distribution System in India.

### **UNIT V:**

Promotion: Promotion-mix, Advertising, Sales Promotion, Personal Selling, Publicity and Public Relations. A Brief Account of Marketing of Services, Rural Marketing, CRM, Electronic Marketing; B2C,B2B and C2C, Direct Marketing through Internet, International Marketing etc.

### **Recommended Books :**

1. Kotler, Philip –Marketing Management, Analysis, Planning, Implementation and Control (Pearson 12<sup>th</sup> Edition).
2. Stanton William J-Fundamentals of Marketing (Mc Graw Hill)
3. Kotler, Philip and Armstrong Graw- Principles of Marketing (Pearson Education, 11<sup>th</sup> Edition).

4. Kotler, Philip, Keller Kevin Lane, Koshy Abraham and Jha Mithileshwar- Marketing Management: A south. Asian Perspective (Pearson Education 12<sup>th</sup> Edition)
5. Ramaswamy V.S. and Namakumari S.-Marketing Management : Planning, Implementation and Control(Mac Millan, 3<sup>rd</sup> Edition)
6. Etzel M.J., Walker B.J. and Stanton William J- Marketing concept & Cases special Indian Edition. (Tata Mc Graw Hill, 13<sup>th</sup> Edition)
7. Mc. Carthy and Perreault- Bsic Marketing: A global Marketting Approach (Tata Mc Graw Hill, 15<sup>th</sup> Edition).
8. Kurtz and Boone- Principles of Marketing (Thomson India Edition)

**Paper: BTM-306**

**Entrepreneurship Development**

Objective: The objective of this paper is to acquaint the students with entrepreneurship development management, the another important objective of this paper is importance of diversified technological innovation methodologies in entrepreneurship in relation to success and growth of business firm and over all development of Indian economy as well as overall development of self employment.

**UNIT I :**

**Entrepreneurship:**

Definition of Entrepreneur, Role of entrepreneurs in economic growth, Functions of an Entrepreneur, Entrepreneurial motivation and Barriers, Classification of Entrepreneurship, Theory of Entrepreneurship, Concept of Entrepreneurship, Development of Entrepreneurship, Culture, Stages in Entrepreneurial process.

**Unit II:**

**Creativity and Entrepreneurial Plan:**

Steps to reach Goal, Idea, Generation, Screening and Project Identification, Creative Performance, Feasibility Analysis: Economic Marketing Financial and Technical: Project Planning: Evaluation, Monitoring and Control segmentation. Creative Problem Solving: Heuristics, Brainstorming, Synectics, Analysis, Innovation.

**Unit III:**

**International Entrepreneurship Opportunities:**

The nature of International Entrepreneurship, Importance of international business to the form, International versus domestic's entrepreneurship, Stages of economic development. Institutional support for new ventures: Supporting Organizations: Incentives & facilities; Financial Institutions and Small Scale Industries, Govt. Policies for SSIs.

**Unit IV**

**Family and Non Family Entrepreneur:**

Role of Professionals, Professionalisms vs family entrepreneurs, Role of Woman entrepreneur. Venture Capital: Nature and Overview, Venture capital process, locating venture capitalists.

## **Unit V**

### **Information Technology for Entrepreneurs:**

Concept of Information Technology uses of Information Technology, Information Technology tools: The Fax, personal computer email connection, printer, photocopier, scanner, Digital camera, Smart Mobile Phones, MIS

### **Recommended Books :**

1. Couger,C- Creativity and Innovation (IPP,1999)
2. Nina Jacob- Creativity in Organizations (Wheeler,1998)
3. Jonne & Ceserani- Innovation and Creativity (Crest,2001)
4. Bridge S et al- Understanding Enterprise: Entrepreneurship and Small Business(Palgrave,2003)
5. Holt-Entrepreneurship: New Venture Creation (Prentice Hall,1998)
6. Hunger J.D. and Wheelen T.L.- Strategic Management (Addison-Wesley,1999)\
7. Dollinger M.J.- Entrepreneurship (Prentice Hall,1999)

## **FOURTH SEMESTER**

### **Paper: BTM-401**

## **RESEARCH METHODOLOGY**

### **Unit I**

Research- Purpose, Types & Characteristics. Process of Research. Formulation of objectives, Hypothesis- Types of Hypothesis. Methods of testing Hypothesis. Research plan and its components. Survey, Observation, Case Study.

### **Unit II**

Research problem: Identification and formation of research problem. Elements in research methodology. Research Design, components of research.

### **Unit III**

Role of IPR and patenting in Research and Development. Ethical, legal, social and scientific issues in research.

### **Unit IV**

Data Collection, Sources of Data, Primary Data, Secondary Data. Procedure Questionnaire. Sampling, merits & demerits. Experiments; kinds and procedure. Control Observation- Merits & Demerits. Kinds. Procedure, Brief idea of Sampling errors.



**Paper: BTM-402**

**DISSERTATION/PROJECT VIVA**

Course based on project and its seminar.

<b>DISSERTATION/PROJECT WORK</b>
<p><i>(a) Objective</i> <i>(b) Review of Literature</i> <i>© Methodology</i> <i>(d) Analysis &amp; Interpretation of Result</i> <i>(e) Language &amp; Presentation</i> <i>(f) Viva voce</i></p>

## **[OPEN ELECTIVE]**

**Only for disciplines other than Biotechnology**

### **FUNDAMENTALS OF BIOTECHNOLOGY**

#### **Unit I**

Cell Size, Shape, Diversity, Prokaryotic & Eucaryotic cells. Cell Division. Microscopy; resolving power & types of microscopes. History & scope of microbiology, sterilization techniques, isolation and staining techniques, microbiological media; their composition and roles. Immunology & The Immune System, Antigens, Antibodies, Organs and cells, Vaccines.

#### **Unit II**

Water and its solvent properties. Acids, bases, pH, buffers, ATP and other bioenergetics related compounds. Redox reactions, Biological interactions. General idea of biomolecules such as carbohydrates, proteins, lipids, nucleotides, vitamins & hormones. Biophysical Techniques: X-ray crystallography, UV-VIS Spectroscopy, Radioactivity. Structure of Animal Cell, materials & equipments for animal cell technology, growth medium, cell line & cell strain, Apoptosis & applications of Animal Cell Sciences & Techniques.

#### **Unit III**

Structure of DNA & RNA. Genetic Engineering-Scope, History, Restriction Enzymes, Vectors, PCR, Patenting of life forms. Amino Acids & Nucleic Acid sequencing. Bioinformatics; Introduction,NCBI, Pub Med, Protein & Nucleic Acid databases, Human Genome Projects, Applications of Bioinformatics in Biotechnology. A brief idea of Drug Design & Molecular Modelling.

#### **Unit IV**

Biofermentor; Design, applications, principles, monitoring & control parameters, Downstream Processing. Microbial Enhanced Oil & Petroleum Recovery. Elementary idea of Dairy & Food Microbiology. Tissue Culture Medium: composition, production of haploids, Agrobacterium mediated transformation. Environment; Basic concepts & issues, Biotic and Abiotic factors. Air and Water pollution; methodology of environmental management, problems and its controls. Biodiversity, Nitrogen fixation, Bio fertilizers, SCP, Mushroom and Methane production, Biofuels and Biosensors.'

Books:

1. Biotechnology Expanding Horizons,,B.D.Singh,Kalyanai Publishers
2. A Text Book of Biotechnology,R.C.Dubey,S.Chand Publications
3. Cell and Molecular Biology- S.C. Rastogi, New Age International Publishers

**[OPEN ELECTIVE]**

**Only for disciplines other than Biotechnology**

**[Practical]**

**TECHNIQUES IN BIOTECHNOLOGY**

1. Study of Equipments required in a Biotechnology Laboratory
2. Microscopy : bright field
3. To prepare NA media for routine cultivation of bacteria; To prepare Czapek-Dox Agar media for routine cultivation of fungi; To prepare PDA media for routine cultivation of fungi.
4. To study various methods of sterilization, Isolation and maintenance of micro-organisms by plating, streaking and serial dilution methods of slants and stab cultures, storage of micro-organisms.
5. To isolate pure cultures from soil and water.
6. To classify bacteria in a given sample using Gram's staining.
7. Estimation of DNA by DPA method
8. Estimation of RNA by Orcinol method.
9. Estimation of Glucose by DNS method.
10. Estimation of Protein by FC method.
11. Paper chromatography; TLC.
12. Antigen and antibody interaction based techniques Double diffusion and immuno-electrophoresis; ELISA
13. To prepare animal based tissue culture medium.
14. To study cell counting and cell viability.
15. Dissolved Oxygen concentration of water sample.; Biological Oxygen Demand (BOD) of a sewage sample; Chemical Oxygen Demand of water sample.
16. To prepare MS media & To study Surface sterilization
17. Immobilization techniques

**[OPEN ELECTIVE]**

**Only for disciplines other than Biotechnology**

**SOLID WASTE MANAGEMENT**

**Unit I**

**Source and Composition of Municipal Solid Waste:** Introduction, sources, types State Municipal solid waste sources and its composition. Advantages of determining the composition of Municipal solid waste. Types of solid waste. Types of materials recovered from MSW. Handling and separation of solid waste at site. Material separation by pick in, screens, float and separator magnets and electromechanical separator and other latest devices for material separation. Waste handling and separation at Commercial and industrial facilities. Storage of solid waste at the sources.

**Unit II**

**Processing of Solid Waste:** Processing of solid waste at residence e.g. Storage, conveying, compacting, Shredding, pulping, granulating etc. Processing of solid waste at Commercial and industrial sites

**Unit III**

**Disposal of Municipal Solid Waste:** Combustion and energy recovery of municipal solid waste, effects of combustion, undesirable effects of Combustion.Landfill: Classification, planning, siting, permitting, landfill processes, landfill design, landfill operation, use of old landfill. Differences between sanitary land fill and incineration as final disposal system for solid waste .Biochemical processes: Methane generation by anaerobic digestion, composting and other biochemical Processes.

**Unit IV**

**Hazardous Solid Waste:**

Definition, identification and classification of hazardous solid waste. Characteristics Hazardous waste toxicity, reactivity, infectiousness, flammability, radioactivity, corrosiveness, irritation, bio-concentration, genetic activity, explosiveness. Bio-medical waste, its sources, generation, storage, transportation and Disposal.

Books:

- 1.Solid Waste Management, K.Sasikumar,Sanoop Gopikrishna, PHI publishers
- 2.Solid Waste Management, Jagbir Singh, A.L.Ramanathan, I.K.International Publishing House

## **[OPEN ELECTIVE]**

**Only for disciplines other than Biotechnology**

### **TECHNIQUES BASED ON SOLID WASTE MANAGEMENT**

#### **PRACTICAL**

1. Carry out sample survey of different localities in groups listing properties of municipal solid waste.
2. Survey the MSW of your locality and Identify its sources and write composition of MSW.
3. Survey your locality and based on it suggest methods of solid waste collection
4. Survey your locality and based on it suggest suitable methods of handling, separation and storage of solid waste.
5. Identify& discuss the methods of processing different types of solid waste (search internet for latest methods).
6. Compare different methods of disposal of MSW. (search internet for latest methods)
7. Identify methods of hazardous waste disposal during a site visit. and follow safety precautions
8. Demonstration on disease epidemiology by various charts and CD.
9. Estimating various items of waste management Practice in maintenance of records.
10. Study of pathological, microbiological and radiological waste.

**UNIVERSITY DEPARTMENT OF BIOTECHNOLOGY  
VINOBA BHAVE UNIVERSITY,  
HAZARIBAG**

**REGULATION FOR ADD ON COURSES/DIPLOMA COURSES IN POST GRADUATE DEPARTMENTS**

- 1. SHORT TITLE & COMMENCEMENT:** This regulation shall be called "THE REGULATION FOR ADD ON COURSES / DIPLOMA COURSES IN POST GRADUATE DEPARTMENTS.
- 2. ELIGIBILITY:**
  - a)* Qualifying degree: Bachelors degree in BIOLOGY discipline.
  - b)* The candidate must hold qualifying degree from a recognized university incorporated by an act of the central or state legislatures in India or other educational institutions by an act of parliament registered under section 2 (F)/12 (B) of UGC act 1956 or declared to be deemed of an University under section 3 of UGC act, 1956 or passed an equivalent qualification recognized by the ministry of HRD, Government of India.
  - c)* At the time of the counseling candidates will be required to show their original certificates & marksheet of 10+ 2 & Graduation level (if Passed) , entrance exam, admit card, caste certificate & any special categories certificate if any.
  - d)* Candidates appearing for the final examination of their bachelor's program can also apply & if selected can join the program provisionally. They should clear their qualifying exam.
  - e)* A candidate seeking admission to the Post graduation course in Biotechnology/ Zoology/Botany shall be eligible for admission to Add on/ Diploma course.
  - f)* A candidate who has passed the Bachelor of Science degree course in Biotechnology/Botany/Zoology (Hons./Pass Course) but not intended in pursuing with the Post Graduation course can also take admission in Add on/ Diploma Course.
- 3. SELECTION:** The selection of candidates for admission to the course will be on the basis of an entrance examination held by the University. The admission notice will be released in leading English/Hindi newspapers. Selection shall be on All India Bases and reservation Policy will be strictly followed.
- 4. TIME SCALE FOR ACADEMIC ACTIVITY:** The basic units of time for academic activity for the Add on/ Diploma programme shall be of a semester July to December & January to June. A basic contact period in which a teacher engages the students will be for duration of 60 minutes. If circumstances warrants the department may schedule course programme during vacation.
- 5. CUT-OFF DATE OF THE COURSE:** Last date of Admission to Add on/ Diploma course will be 31<sup>st</sup> June of every month.

6. **WORKING DAYS IN AN ACADEMIC YEAR:** Each academic year shall consist of not less than 180 working days.
7. **COURSES OF STUDY:** The University shall offer courses during a semester indicated mainly from consideration of minimum enrolment & facilities available. The competent authority comprising of the university/department have the right to cancel any or all course of study if the requirement are not satisfied.
8. **REGISTRATION:** Every candidate of Add on/ Diploma course shall first register himself/herself of the courses offered he/she intends pursuing by submitting the prescribed application form duly filled in by remitting the prescribed fee to THE REGISTRAR, VINOBA BHAVE UNIVERSITY, HAZARIBAG within 30 days from the cut off date prescribed for Add on/ Diploma course Provided he/she possess the minimum qualification as laid down & got approved by the Director/Course Coordinator of the Add on/ Diploma course Department. Student admitted shall have to submit migration certificate and necessary documents.
9. **FEE:** Fee payable by the candidate including fee payable for examination shall be as laid down in administrative instructions issued from time to time by the University/ department for the purpose.
10. **STUDENT DISCIPLINE:** Every student is required to observe a polite & disciplined behavior both inside & outside the campus & should not indulge in any activity which would tend to bring down the prestige of the institute or disturb the peaceful & congenial environment of the campus. Any act of indiscipline on the part of the student may result into adequate discredit & it will be mentioned in his/her academic report card.
11. The department in consultation with the university shall have the right to change /modify any regulation or part thereof in the academic interest of the student.
12. **TEACHING FACULTY:**
  - A) Shall be of the specialized discipline.
  - B) Guest lecturers drawn from department /other department/individual organization /expert in the field.
  - C) The guest faculty/internal faculty may be remunerated as per on lecture of one hour duration & as per University guidelines.
13. **MEDIUM OF INSTRUCTION:** The medium of instruction and examination in all subjects shall be in English.
14. **SCHEME OF EXAMINATION:** There shall be one examination, four each at the end of one semester &, second semester.
15. **ATTENDANCE:** Each candidate should have attended at least 80% of the total number of classes conducted in an academic year from the date of commencement of the term to the last working day as notified by university in each of the subjects prescribed for that year separately in theory and practical including, Seminar, workshop & Clinical training. Only such candidates are eligible to appear for the University Examinations in their first attempt. Special classes conducted for any purpose shall be considered for the calculation of

percentage for eligibility. A candidate lacking in prescribed percentage of attendance in any subjects either in theory or Practical in the first appearance will not be eligible to appear for the University Examination in that subject. The Director of the department, on the recommendation of the coordinator of the course, will have the authority to condone deficiency up to 5% of the lectures/practical.

16. During the course, the student will be eligible for leave for 30 days. No other kind of leave or vacation will be admissible. In exceptional circumstances, a student may be granted 30 days leave. Not due on the condition that he/she shall work for the same number of days after the date on which he would have otherwise completed the course. If any student avail leave of more than 60 days in any year (i.e 30 days admissible leave plus 30 days leave not due), his /her session will be shifted by the one year.
17. The admission intake for each course shall be not more than 40.
18. The regular faculty member of the P.G. Department of Biotechnology shall be the Co-coordinator for , training and examination of these courses.
19. The Diploma course in each semester shall have 20 credits. Each credit will have 15 hours of workload out of which 2 credits should be assigned to field work/training. The proof of this should be submitted during examination e.g. work experience certificate/ dissertation/ report etc. duly issued & signed by the concerned institutional authority / coordinator/faculty. Each theory period shall be of one hour duration.
20. Subject and hours of teaching for Theory and Practical –The number of hours of teaching theory and practical, subject wise Diploma course are shown in Table-1, Table-II

**As an illustration, awards could be given at each stage as per Table 1 below: -**

NSQF Level	Skill component credits	General Education Credits	Normal Duration	Exit Points/Awards
4	18	12	One Semester	Dertificate
5	36	24	Two semesters	Diploma
6	72	48	Four Semesters	Advance Diploma
7	144	96	Six Semesters	B.Voc.

**Table 1 : Grades and Grade Points**

Letter Grade	Grade Point
O (Out standing)	10
A+ (Excellent)	9
A (Very Good)	8
B+ (Good)	7
B (Above Average)	6
C (Average)	5
P (Pass)	4



F(Fail)	0
Ab (Absent)	0

## **Syllabus for Diploma in Forensic Science**

**(5X6= 30 credits)**

### **Semester II**

#### **Paper 1: General Forensic Science**

**(5 credits)**

**Unit 1:** Definition, History, Development and Scope of forensic Science in India.

**Unit 2:** State and Central Forensic Science Laboratories, their structure and functioning.

**Unit3:** Principle of forensic science. Forensic Science laboratory & other forensic institutions .Investigator & his qualities, General guidelines for investigator.

**Unit 4:** Duties & responsibilities of Police, CID, CBI, NIA.

#### **Paper - 2: Crime scene management**

**(5 credits)**

**Unit 1:** Scene of Crime: Meaning of scene of crime, Primary & Secondary scene of crime. Types of scene of crime, Search methods at scene of crime. Collection, preservation, packaging and forwarding of physical and trace elements for analysis.

**Unit 2:** Methods of preservation: Photography - importance of photography, general guidelines, admissibility in court. Various forms such as videography, photogrammetry etc.

**Unit 3:** Sketching of scene of crime: Types of sketch, general guidelines for sketching, methods for determination of location, rough sketch, finished sketch, projection sketch, importance of sketch.

**Unit 4:** Investigation: FIR, Case diary. Cognizable & Non-cognizable offences, investigation in cognizable offences.

#### **Paper – 3: Practical- Examination methods in forensic science (5 credits)**

- ✓ Examination of physical evidences including, blood, semen, saliva, fecal matter hair, fiber.
- ✓ Chromatographic techniques: TLC, HPLC, GCMS.
- ✓ Spectroscopic methods: UV, Visible,
- ✓ Electrophoretic techniques: Gel and immunoelectrophoresis etc.
- ✓ Preliminary examination of documents, Age of documents
- ✓ Study of Crime records
- ✓ Inks, papers and their scientific examinations including instrumental analysis

## Semester III

### **Paper – 4: Fingerprints, documents and other impression (5 credits)**

**Unit 1:** History, Characteristics, Pattern Characteristics, Type of Pattern Classification and types of Fingerprints, Location and Preservation of fingerprints, Development of Latent prints, Matching of fingerprints, Presentation in Courts.

**Unit 2:** Documents: Types of Document, Writing instruments and their characteristics, Ink and their examination, Paper and its examination, Hand writing and its characteristics, Factors affecting hand writing, Samples for comparison, Disguised and Indented writings and their detection. Typed and Computer generated documents, their comparison. Alteration in documents and their detection.

**Unit 3:** Identification and individualization from foot prints and teeth. Foot & Shoe prints methods of their preservation and examination. Tyre marks and Track marks and their examination.

**Unit 4:** Explosives, fire arms ammunitions and their compositions, Improvised Explosive Devices. Comparison and identification of cartridges, bullets and fire arms. Bombs and explosives: Composition, ignition, combustion and detonation. Examination of country made bombs

### **Paper– 5: Practical- Examination methods in forensic science (5 credits)**

- ✓ Analysis of alcohol and illicit liquor: methyl and ethyl alcohol in body fluid and breathe. Analysis of petroleum products.
- ✓ Chemical examination and physiology and pharmacology of insecticides and pesticides.
- ✓ Psychotropic drugs: sedative, stimulant, opiates and drug of abuse.
- ✓ Extraction isolation and identification of poison from viscera tissues and body fluids.

### **Paper – 6: Advancement in forensic science (5 credits) (Seminar, Lab visit and project)**

- ✓ DNA fingerprinting
- ✓ DNA profiling
- ✓ Death due to asphyxia, sexual offences and infanticide
- ✓ Forensic psychiatry & Lie detection: Brain mapping, Narco analysis
- ✓ Biometric techniques
- ✓ Cyber forensics
- ✓ Anonymous and disguised writings
- ✓ Identification of hand writing, signature and detection of forgeries.

# Syllabus for Diploma in Food Quality Assessment and Food Safety

(5X6=30 Credit)

Semester II

**Paper: Food Microbiology**

**(5 Credits)**

## **Unit I**

Microbiological history of food. Types of micro-organism normally associated with food-mold, yeast, and bacteria, Microbial growth pattern, physical and chemical factors influencing destruction of microorganisms. Microorganisms in natural food products and their control.

## **Unit II**

Biochemical changes caused by microorganisms, deterioration and spoilage of various types of food products – Physical, chemical and microbiological spoilages (Enzymatic or fermentative spoilage – rancidity, hydrolytic spoilage, putrefaction, souring, off flavour etc.; Texture deformations – slime, ropiness, curdling, discoloration etc.; Toxin production –endotoxins and exotoxins).

## **Unit III**

Contaminants of foods-stuffs, fruits vegetables, cereals, pulses, oilseeds, milk and meat during handling and processing. Microbial spoilage of foods – food borne pathogens, food poisoning, food infection and intoxication. Examples: *E. coli O157:H7*, *Salmonella*, *Campylobacter jejuni*, *Bacillus cereus*, *Shigella sp.*, *Clostridium sp.*, *Staphylococcus sp.*, *Norwalk like viruses*, Hepatitis. Analytical techniques in Microbiology- Screening and Enumeration of spoilage microorganisms.

## **Unit IV**

Detection of pathogens in food (Traditional Biochemical test using kits, specialized media), Rapid detection technique for microorganisms – Total ATP measurement, PCR based, Biosensor based, immunological (Latex agglutinations, ELISA, Immunomagnetic assays, etc.), Bacteriophage based markers etc. Food fermentation -Traditional fermented foods of India and other Asian countries; Probiotics and prebiotics; Fermented foods based on milk, meat and vegetables; Fermented beverages.

]

**Unit I**

Importance of food. Scope of food chemistry. Introduction to different food groups: their classification and importance. Water in food, water activity and shelf life of food. Carbohydrates-chemical reactions, functional properties of sugars and polysaccharides in foods chemical make-up, properties, nutritional and industrial importance.

**Unit II**

Proteins: nutritional aspects– amino acids, essential amino acids, biological value, PER (Protein Efficiency Ratio), and industrial importance. Lipids: classification, and use of lipids in foods, physical and chemical properties, essential fatty acids, Polyunsaturated Fatty Acids hydrogenation, rancidity and industrial importance.

**Unit III**

A Processing and preservation of food -preservation by low-temperature, heat, drying, chemical, non-thermal methods and irradiation. Vitamins and Minerals, Effect of processing on vitamins and minerals. Effect of processing and storage of Vitamins. Principles of microbial assay of b group Vitamins.

**Unit IV**

Food pigments and synthetic dyes Natural pigments, their occurrence and characteristic properties, their changes during processing and storage, industrial applications. Enzymes used in food industry: Definition, importance, sources, nomenclature, classification and their applications in food processing.

1. Introduction to basic microbiology, laboratory practices.
2. Cultivation and sub-culturing of Microbes.
3. Direct microscopic examination of foods.
4. Estimation of total microbial count of yeast and molds.
5. Estimation of total microbial bacterial plate count of food sample by direct microscopic and SPC method.
6. Assessment of air using Surface Impingement method.
7. Enumeration of Coliforms and indicator organisms (Most Probable Number)
8. Study of the growth curve of micro-organisms.
9. Study of the microbiological quality of milk by MBR test.
10. Estimation of total microbial count of (a) milk products (b) fruits and vegetable products (c) meat, fish and poultry products (d) canned foods.

## Semester-III

### **Paper IV -Food Processing, Packaging and Quality Management (5 Credits)**

#### **Unit I**

Food packaging: Definitions, objectives and functions of packaging and packaging materials. Packaging requirements and selection of packaging materials; Types of packaging materials.

#### **Unit II**

Food packaging systems: Different forms of packaging such as rigid, semi-rigid, flexible forms and different packaging system for (a) dehydrated foods (b) frozen foods (c) dairy products (d) fresh fruits and vegetables (e) meat, poultry and sea foods.

#### **Unit III**

Packaging equipment and machinery: Vacuum, CA and MA packaging machine; gas packaging machine; seal and shrink packaging machine; form and fill sealing machine; aseptic packaging systems; bottling machines: carton making machines. Food Quality: importance and functions of quality control. Methods of quality, assessment of food materials-fruits, vegetables, cereals, dairy products, meat, poultry, egg and processed food products.

#### **Unit IV**

Sanitation and hygiene, GMP, GLP, Statistical quality control. Food laws and standard, PFA, AGMARK. Sampling and specification of raw materials and finished products, Concept of Codex Alimentarius/USFDA/ISO 9000 series, rules and regulations for waste disposals. Food adulteration and food safety. HACCP, Sensory evaluation-introduction, panel screening, Sensory and instrumental analysis in quality control, IPR and Patents, ISO system – 9001, 14001, 17025 and 22000.

### **Paper V – Practical**

**(5 Credits)**

1. Determination of moisture in a given food sample.
2. Determination of protein and carbohydrates in a given food sample.
3. Determination of ash in a given food sample.
4. Determination of crude fat in a given food sample
5. Estimation of acidity of given food sample/beverage
6. Estimation of total non reducing and reducing sugars.
7. Estimation of vitamin C in given food sample.
8. Determination of diastase enzyme activity
9. Determination of pigments in a given food sample.
10. Determination of water vapour transmission rate for different materials.
11. Estimation of toxins and pesticides in food.
12. Detection of adulteration in foods.

### **Paper VI- Project Work**

**(5 Credits)**