Choice Based Credit System (CBCS)

RADHA GOVIND UNIVERSITY
RAMGARH

M.Sc. Biotechnology

FACULTY OF SCIENCE

SYLLABUS OF COURSES TO BE OFFERED

Core Courses & Elective Courses

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 1st and 2nd semesters and second part as M.Sc final, consisting of 3rd and 4th 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 Radha Govind 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 level).

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 counselling to be conducted at the University preferably in the month of June each year.

Method of Admission: The admission to the 1st 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	**7%**
Privilege of the University	
(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) Olmpic 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 **a**long 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 **counselling** 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, Radha Govind University.

Course Structure

The Course structure of Semester I-1V 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 per week	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 per week	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 **Subject Code: BTM-402**

Paper: XIX **Paper: XX Dissertation/Project Work**

Fundamentals of Research Methodology **(*Course based on project and its seminar)*. (=02 credits) (=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 = 1st +2nd + 3rd +4th 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 ½ the number of total theory courses of the semester(any) fraction is rounded off to the 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 1st, 2nd and 3rd 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 evaluation 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 etc. 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 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 2nd/3rd/4th 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.*

(i) First Division:	60% and above
(ii)Second Division:	45% and above but less than 60%
(iii)Failed:	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.

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

2nd 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 behaviour, performance at seminar, etc.

12. Scheme of Examination:

As and when required, the Board of Studies in Biotechnology, Radha Govind University 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 Radha Govind University, 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, Radha Govind University. 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 4th 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**
TOTAL	**420**	180	**168**	72	**600**	**240**

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**
TOTAL	**420**	**180**	168	**72**	**600**	**240**

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	**70**	**30**	28	**12**	**100**	**40**

Management(Elective from other Department)						
TOTAL	**420**	**180**	**168**	**72**	**600**	**240**

FOURTH SEMESTER

XIX. RESEARCH METHODOLOGY	Max. Marks 100	**Min. Aggr. Marks for Passing = 40**
XX. DISSERTATION /PROJECT WORK (Six Months)	100	=240
Objective	100	
Review of Literature	100	
Methodology	100	
Analysis & Interpretation of Result	100	
Language & Presentation	100	
Viva voce		
TOTAL MARKS	**700**	**=280**

AGGREGATE OF 1st, 2nd,3rd & 4th Semesters

Total Marks =2500 **Pass Marks=(720+280)=1000**

COURSES OF STUDY (M.Sc. in Biotechnology)
FIRST SEMESTER

Paper: BTM -101 : Cell Biology

Unit I **(10 periods)**

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 **(10 periods)**

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 **(15 periods)**

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 **(10 periods)**

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, 6th Edition, Garland Science
2. Molecular Cell Biology, Lodish et al., 5th Edition, Free Man
3. Developmental Biology, SF Gilbert, Sinauer Associates Inc.,7th Edition
4. The Cell – A Molecular Approach, 6th Edition, Geoffrey M.Copper,Sinauer Asociates
5. Molecular Biology, Friedfelder D, Jones and Bartlett Publication, (1998).
6. Principles of Biochemistry,Lehninger, Freeman,5th Edition
7. Cell Biology: T.devasena

Paper: BTM-102 : Microbial Physiology & Genetics

Unit I **(10 periods)**

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 **(10 periods)**

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 **(15 periods)**

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 **(10 periods)**

Procaryotic 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.5th edition (2000).
2. Brock Biology of Microogranisms, Madigan M.T. Martinko, J.M. and Parker, J. Prentice- Hall NY, USA (6th edition).
3. Microbiology, Pelczar, M.J. Jr. Chan E.C.S. and Kreig , N.R. Tata McGraw Hill, NY, USA (5th edition).
5. Microbiology- A Laboratory Manual, Cappuccino, J.G. and Sherman N. Addison Wesley, UK,(10th edition).
6. Microbiological Application: A Laboratory Manual in General Microbiology Benson, H.J, Alfred Brown, McGraw Hill, NY, USA (10th edition).

Paper: BTM-103 : Biostatistics & Computer Applications in Biology

Unit I **(10 periods)**

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 **(12 periods)**

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 **(13 periods)**

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 **(10 periods)**

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).

Paper: BTM-104: BIOCHEMISTRY

Unit I **(10 periods)**

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 **(10 periods)**

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 **(12 periods)**

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 **(13 periods)**

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, 2nd 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,5th Edition
6. Biochemistry,Jermey M. Berg,John L.Tymcozko.7th Edition
7. Harper's Biochemistry, Murray RK et al., Prentice Hall International (1999).

Paper: BTM-105 **Practical** **Credit: 3**

List of Practicals: **(45 periods)**

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

Paper: BTM-106: Communicative English

Unit-1

Introduction, Business Correspondence **(10 periods)**

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 **(10 periods)**

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 **(08 periods)**

Grammar

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

Unit-4 **(12 periods)**

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 **(05 periods)**

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

SECOND SEMESTER

Paper: BTM-201: Genetic Engineering

Unit I **(15 periods)**

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 **(10 periods)**

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 **(10 periods)**

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, and plants.

Unit IV **(10 periods)**

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.

Paper: BTM-202: Methods in Molecular Diagnostics

UNIT-I **(15 periods)**

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 **(15 periods)**

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 RNA 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 **(09 periods)**

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

UNIT-IV **(06 periods)**

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, Elsivier publication, USA, 5th edition (2012).

2. Molecular Diagnostic for the clinical laboratorian, William B. Coleman, Gregory J. Tsongalis, Humana Press,USA, 2nd edition,.

Paper: BTM-202: *In Silico* Drug Designing

Unit I **(10 periods)**

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 **(15 periods)**

Discovery & Development of Drug: History of drug discovery, strategies in drug discoveries, lead discoveries, phrmacophore identification, lead development, screening of compounds, toxicological evaluation of new drugs, Pre-Clinical testing, Clinical trials, Bioavailability of the drug, Pharmacokinetics. Rational Drug Design-Strucutre, 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 **(10 periods)**

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 **(10 periods)**

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, (2nd edition), 2004.

2. Drug Design- Kenneth M Merz Je, Dagmar Ringe, Charles M. Renyolds, Cambride University Press, (2010 edition).

Paper: BTM-203 : Molecular Biology & Biophysics

Unit I **(15 periods)**

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 anti- sense molecules, disruption of RNA structure; applications of antisense.

Unit II **(10 periods)**

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 **(10 periods)**

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 Sepctroscopy & Flame Photometry.

Unit IV **(10 periods)**

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, 3rd 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 5th Edition) J. Darnell, H. Lodish and D. Baltimore, , Freeman American Books, Inc., USA, 1994.
5. Molecular Biology of the Cell (4th Edition) B. Alberts, Garland Science
6. Gene VI (6th Edition) Benjamin Lewin, Oxford University press, U.K., 1998.
7. Molecular Biology- David Freifelder, 2nd Edition, Narosa Publishing House.

Paper: BTM-204: Biology of the immune system

Unit I **(15 periods)**

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 **(10 periods)**

Cells of the immune system; haematopoiesis 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 **(10 periods)**

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 **(10 periods)**

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 immunodeficiences, 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, 7th edition, Lippincotts Williams and wilkins (2012).
4. Roitt's essential Immunology, Roitt I.M. and Delves P.J., Blackwell Science Ltd., (2001).

Paper: BTM-205 **Practical**

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 T3 in a given serum sample.
20. To assay T4 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

Paper: BTM-206: Fundamentals of Economics

Micro Economics

Module -1- Consumer Behaviour **(15 periods)**

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

Module -II- Production Function **(10 periods)**

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 **(10 periods)**

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 **(10 periods)**

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

Macro Economics **(10 periods)**

Module V- National income- concepts and methods of measurement. Fisharian 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 **(15 periods)**

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 **(15 periods)**

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 **(05 periods)**

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 **(10 periods)**

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. lan 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

Paper: BTM-302: Bioprocess Engineering and Technology

Unit I **(15 periods)**

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 **(15 periods)**

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 **(10 periods)**

Industrial production of solvents: Ethyl alcohol, citric and acetic acids; enzymes; amylases, proteases, cellulases; vitamin B12, vitamin C, antibiotics (penicillin, streptomycin,). Microbes in mineral beneficiation & petroleum industry (MEOR). Immobilization.

Unit IV **(05 periods)**

Elementary idea of Diary & 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

Paper: BTM-303 : Plant Biotechnology

Unit I **(10 periods)**

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 **(10 periods)**

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 **(10 periods)**

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 **(15 periods)**

Chloroplast transformation: vectors, mechanisms, advantages and limitations, homoplastomic 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,2nd 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,2nd Edition,Oxford & IBH publishing co.pvt.ltd

Paper: BTM-304: Environmental Biotechnology

Unit -I **(15 periods)**

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 **(10 periods)**

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 **(05 periods)**

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

Unit IV **(15 periods)**

Biological N2 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 Cunninghum & 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,,11th edition, Rastogi publicxation.

6.Microbial Ecology,Ronald M. Atlas & Richarad Bartha, Pearson publication,4th edition

Paper: BTM-305 : Practical

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

IPR & Patenting

UNIT I **(05 periods)**

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 **(15 periods)**

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 **(15 periods)**

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 **(10 periods)**

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.

Paper: BTM-306 : Marketing Management

UNIT I : **(15 periods)**

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 : **(10 periods)**

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: **(10 periods)**

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: **(05 periods)**

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: **(05 periods)**

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 12th Edition).

2. Stanton William J-Fundamentals of Marketing (Mc Graw Hill)

3. Kotler, Philip and Armstrong Graw- Principles of Marketing (Pearson Education, 11th Edition).
4. Kotler, Philip, Keller Kevin Lane, Koshy Abraham and Jha Mithileshwar- Marketing Management: A south. Asian Perspective (Pearson Education 12th Education)
5. Ramasw3amy V.S. and Namakumari S.-Marketing Management : Planning, Implementation and Control(Mac Millan, 3rd Edition)
6. Etzel M.J., Walker B.J. and Stanton William J- Marketing concept & Cases special Indian Edition. (Tata Mc Graw Hill, 13th Edition)
7. Mc. Carthy and Perreault- Bsic Marketing: A global Marketting Approach (Tata Mc Graw Hill, 15th Edition).
8. Kurtz and Boone- Principles of Marketing (Thomson India Edition)

Paper: BTM-306 : Entrepreneurship Development

UNIT I : **(15 periods)**

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: **(15 periods)**

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: **(05 periods)**

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 **(05 periods)**

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 **(05 periods)**

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 **(15 periods)**

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 **(10 periods)**

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

Unit III **(05 periods)**

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

Unit IV **(15 periods)**

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.

DISSERTATION/PROJECT WORK
a) Objective b) Review of Literature c) Methodology d) Analysis & Interpretation of Result e) Language & Presentation f) Viva voce