REGULATIONS, SCHEME AND SYLLABUS

FOR

M.Sc. APPLIED MICROBIOLOGY

(UNDER CSS)

AT

ST.THOMAS COLLEGE, PALA

Affiliated to

MAHATMA GANDHI UNIVERSITY
KOTTAYAM, KERALA, INDIA

W.E.F.2012 ADMISSION

Preface

In tune with the changing scenario in higher education, Mahatma Gandhi University decided to introduce Credit Semester System in all its regular Post-graduate programmes from 2012-2013 academic year. Regulations for the same were approved by order No. 5386/L/Acad/PGCSS (R)/2011 of Mahatma Gandhi University. Subsequently, a draft syllabus was prepared for M.Sc. Applied microbiology conforming to the general guidelines of the curriculum for the post-graduate programmes. These are exciting times in Biology. The world of Biology has been transformed in the last few decades. There was too much to select from. However, the Board of studies designed the programme envisioning the following objectives;

- To encourage a clear, comprehensive and advanced mastery in the field of Applied Microbiology.
- To provide basic principles of biological sciences with special reference to Microbiology and its Applicable branches.
- Enabling the students to explore the intricacies of life forms at cellular, molecular and nano level.
- To sustain students' motivation and enthusiasm and to help them not only to appreciate the beauty of microbial life forms but also to inspire them to explore the amaizing property of microbial life infavour of human life.
- To develop problem solving skills in students and encourage them to carry out innovative research projects thereby enkindling in them the spirit of knowledge creation.

Salient features

I. These Regulations shall come into force from the Academic Year 2012-2013 onwards.

II. The regulation provided herein shall apply to all regular post-graduate programmes, MA/MSc/MCom, conducted by the affiliated colleges/Institutions (Government/Aided/unaided/ Self-financing, and Constituent colleges of Mahatma Gandhi University with effect from the academic year 2012-2013 admission onwards.

III. The provisions here in supersede all the existing regulations for the regular post-graduate programmes conducted by the affiliated colleges and centres of the Mahatma Gandhi University unless otherwise specified.

IV. These shall not apply for the programme conducted in distance/off campus and private registration mode which will continue to be in annual scheme.

V. Every Programme conducted under Credit Semester System shall be monitored by the College Council.

1. Important definitions

Programme - the entire course of study and Examinations.

Duration of Programme - duration of post-graduate programme shall be of 4 semesters.

Semester - a term consisting of a minimum of 90 working days, inclusive of examination, distributed over a minimum of 18 weeks of 5 working days each.

Academic week - a unit of 5 working days in which distribution of work is organised from day 1 to day 5, with 5 contact hours of 1 hour duration in each day. A sequence of 18 such academic week constitutes a semester.

Zero semester - a semester in which a student is permitted to opt out due to unforeseen genuine reasons.

Course - a segment of subject matter to be covered in a semester. Each Course is designed variously under lectures/tutorials/laboratory or fieldwork/seminar/project/practical training/ assignments/evalua tion etc., to meet effective teaching and learning needs.

Credit (Cr) - of a course is a measure of the weekly unit of work assigned for that course in a semester.

Course Credit - One credit of the course is defined as a minimum of one hour lecture/minimum of 2 hours lab/field work per week for 18 weeks in a Semester. The course will be considered as completed only by conducting the final examination. No regular student shall register for more than 24 credits and less than 16 credits per semester. The total minimum credits, required for completing a PG programme is 80.

Programme Core course - a course that the student admitted to a particular programme must successfully complete to receive the Degree and which cannot be substituted by any other course.

Programme Elective course - a course, which can be substituted, by equivalent course from the same subject and a minimum number of courses is required to complete the programme.
Programme Project - a regular project work with stated credits on which the student undergo a project under the supervision of a teacher in the parent department/any appropriate research center in order to submit a dissertation on the project work as specified.

Internship – an internship in the fourth semester with stated credit on which the students should undergo a 15 days internship in the field of Microbiology in any industries/ hospitals/ research institutes and they should submit a duly signed report to the concerned internal supervisor. They should also present the report to a three member internal committee chaired by the HOD / course coordinator of the mother department

Tutorial - a class to provide an opportunity to interact with students at their individual level to identify the strength and weakness of individual students.

Seminar - a lecture expected to train the student in self-study, collection of relevant matter from the books and Internet resources, editing, document writing, typing and presentation.

Evaluation - every student shall be evaluated by 25% internal assessment and 75% external assessment.

Repeat course - a course that is repeated by a student for having failed in that course in an earlier registration.

Improvement course - a course registered by a student for improving his performance in that particular course.

Audit Course - a course for which no credits are awarded

Department - any teaching Department offering a course of study approved by the University in a college as per the Act or Statute of the University

Parent Department - the Department which offers a particular post graduate progrramme.

Department Council - the body of all teachers of a Department in a College

Faculty Advisor - a teacher nominated by a Department Council to coordinate the continuous evaluation and other academic activities undertaken in the Department.

Course Teacher - the teacher who is taking classes on the course

College Co-ordinator - a teacher from the college nominated by the College Council to look into the matters relating to MGU-CSS-PG System

Letter Grade or simply, **Grade** - in a course is a letter symbol (A, B, C, D, E) which indicates the broad level of performance of a student in a course.
Each letter grade is assigned a **'Grade point' (G)** which is an integer indicating the numerical equivalent of the broad level of performance of a student in a course.

Credit point (P) - of a course is the value obtained by multiplying the grade point (G) by the Credit (Cr) of the course P = G x Cr.

Extra credits are additional credits awarded to a student over and above the minimum credits required for a programme for achievements in co-curricular activities carried out outside the regular class hours, as decided by the university.

Weight - a numerical measure quantifying the comparative range of an answer or the comparative importance assigned to different components like theory and practical, internal and external examinations, core and elective subjects, project and viva-voce etc.

Weighted Grade Point - is grade points multiplied by weight.

Weighted Grade Point Average (WGPA) - an index of the performance of a student in a course. It is obtained by dividing the sum of the weighted Grade Points by the sum of the weights of the grade points. WGPA shall be obtained for CE (Continuous evaluation) and ESE (End semester evaluation) separately and then the combined WGPA shall be obtained for each course.

Grade Point Average (GPA) - an index of the performance of a student in a course. It is obtained by dividing the sum of the weighted grade point obtained in the course by the sum of the weights of Course.

Semester Grade point average (SGPA) - the value obtained by dividing the sum of credit points (P) obtained by a student in the various courses taken in a semester by the total number of credits taken by him/her in that semester. The grade points shall be rounded off to two decimal places. SGPA determines the overall performance of a student at the end of a semester.

Cumulative Grade point average (CGPA) - the value obtained by dividing the sum of credit points in all the courses taken by the student for the entire programme by the total number of credits and shall be rounded off to two decimal places.

Grace Grade Points - grade points awarded to course/s, as per the choice of the student, in recognition of meritorious achievements in NCC/NSS/Sports/Arts and cultural activities.

2. Programme structure

(a) The programme includes two types of courses, **Program Core (PC)** courses and **Program Elective (PE)** Courses. There shall be a **Program Project (PP)** with dissertation to be undertaken by all students. The Programme also includes **assignments**, **seminars/practical** and **viva**.

(b) There are **3 PE courses** for M Sc Applied Microbiology programme for the choice of students subject to the availability of facility and infrastructure in the institution and the selected one will be the subject of specialization of the programme.

(c) There is an internship in the fourth semester with stated credit on which the students should undergo a 15 days internship in the field of biological science in any industries/ hospitals/ research institutes and they should submit a duly signed report to the concerned internal supervisor. They should also present the report to a three member internal committee chaired by the HOD / course coordinator of the mother department.

(d) Project work shall be completed by working outside the regular teaching hours. Project work shall be carried out under the supervision of a teacher in the concerned department. A candidate may, however, in certain cases be permitted to work on the project in an industrial/Research Organization on the recommendation of the supervisor.

(e) There should be an internal assessment and external assessment for the project work. The external evaluation of the Project work is followed by presentation of work including dissertation and Viva-Voce. The title and the credit with grade awarded for the program project should be entered in the grade card issued by the university.

(f) **Assignments**: Every student shall submit one assignment as an internal component for every course with a weightage one. The Topic for the assignment shall be allotted within the 6^{th} week of instruction.

(g) **Seminar Lectures** - Every student shall deliver one seminar lecture as an internal component for every course with a weightage two. The seminar lecture is expected to train the student in self-study, collection of relevant matter from the books and Internet resources, editing, document writing, typing and presentation.

(h) Every student shall undergo at least two class tests as an internal component for every course with a weightage 1 each. The weighted average shall be taken for awarding the grade for class tests.

(i) The attendance of students for each course shall be another component of internal assessment as prescribed with weightage one.

(j) No course shall have more than 4 credits.

(k) Comprehensive Viva-voce shall be conducted at the end semester of the program. Comprehensive Viva-Voce covers questions from all courses in the programme.

3. Attendance

(a) The minimum requirement of aggregate attendance during a semester for appearing the end semester examination shall be 75%. Condonation of shortage of attendance to a maximum of 10 days in a semester, subject to a maximum of two times during the whole period of post graduate programme may be granted by the University.

(b) If a student represents his/her institution, University, State or Nation in Sports, NCC, NSS or Cultural or any other officially sponsored activities such as college union/university union activities, he/she shall be eligible to claim the attendance for the actual number of days participated, subject to a maximum of 10 days in a semester based on the specific recommendations of the Head of the Department and Principal of the College concerned.

(c) A student who does not satisfy the requirements of attendance shall not be permitted to take the end semester examinations.

4. Registration/duration

(a) The duration of PG programmes shall be 4 semesters. The duration of each semester shall be 90 working days. Odd semester starts from June to October and even semesters from December to April. There will be one month semester breaks each in November and May.

(b) A student may be permitted to complete the programme, on valid reasons, within a period of 8 continuous semesters from the date of commencement of the first semester of the programmes.

5. Admission

(a) The admission to all PG programmes shall be as per the rules and regulations of the University. The eligibility criteria for admission shall be as announced by the University from time to time. Separate rank lists shall be drawn up for reserved seats as per the existing rules.

(b) There shall be a uniform academic and examination calendar prepared by the University for the conducing the programmes. The University shall ensure that the calendar is strictly followed.

(c) There shall be provision for credit transfer subject to the conditions specified by the Board of Studies concerned.

6. Admission requirements

(a) A candidate seeking admissions to M.Sc. Applied Microbiology must have at least 55% Marks in the following graduate courses Model I and Model II of Biological sciences (Zoology, Botany, Biotechnology, Microbiology, Biochemistry, and Biophysics, Industrial Microbiology, Medical

Microbiology, Food science and quality control) or Chemistry. Selection of candidates will be on the basis of index mark with a weightage of 50%, 40% and 10% for marks in relevant areas of specialization at the graduation level, marks for entrance examination and interview respectively.

(b) The candidate must forward the enrollment form to the Controller of Examinations of the University through the Head of the Institution, in which he/she is currently studying.

(c) Students admitted under this programme are governed by the Regulations in force.

7. Promotion

A student who registers for the end semester examination shall be promoted to the next semester.

8. Examinations

(a) There shall be University examination at the end of each semester.

(b) Practical examinations shall be conducted by the University at the end of each semester.

(c) Project evaluation and viva-voce shall be conducted at the end of the programme only.

(d) Practical examination shall be conducted by two external examiners and one internal examiner.

(e) **End-Semester Examinations**: The examinations shall normally at the end of each semester.

(f) There shall be one end-semester examination for practical (two days) course and 3 hours duration examination in each lecture based course

(g) A question paper may contain short answer type/annotation, short essay type questions/problems and long essay type questions. Different types of questions shall have different weightage to quantify their range. Weightage can vary from course to course depending on their comparative importance, but a general pattern may be followed by the Board of Studies.

9. Evaluation and grading

Evaluation: The evaluation scheme for each course shall contain two parts; (a) internal evaluation and

(b) External evaluation. 25% weightage shall be given to internal evaluation and the remaining 75% to external evaluation and the ratio and weightage between internal and external is 1:3. Both internal and external evaluation shall be carried out using direct grading system.

(a) **Internal evaluation**: The internal evaluation shall be based on predetermined transparent system involving periodic written tests, assignments, seminars and attendance in respect of theory courses and based on written tests, lab skill/records/viva and attendance in respect of practical courses. The weightage assigned to various components for internal evaluation is a follows.

Table 1. Components of Internal Evaluation:

Component	Weightage
(i) Assignment	1
(ii) Seminar	2
(iii) Attendance	1
(iv) Two Test papers	2

Table 2. Grade points:

Letter Grade	Performance	Grade point (G)	Grade Range
A	Excellent	4	3.5 to 4.00
B	Very Good	3	2.5 to 3.49
C	Good	2	1.5 to 2.49
D	Average	1	0.5 to 1.49
E	Poor	0	0.0 to 0.49

Table- 3. Grades for Attendance:

% of attendance	Grade
> 90%	A
Between 85 and 90	B
Between 80 and below 85	C
Between 75 and below 80	D
< 75	E

Table- 4. Assignment: grading components:

Component	Weight
(i) Punctuality	1
(ii) Review	1
(iii) Content	2
(iv) Conclusion	1
(v) Reference	1

Table - 5. Seminar: grading components:

Component	Weight
(i) Area/Topic selected	1
(ii) Review/Reference	1
(iii) Content	2
(iv) Presentation	2
(v) Conclusion	1

Table - 6. Practical: Internal assessment components:

Component	Weight
(i) Attendance	1
(ii) Laboratory involvement	2
(iii) Written/Lab test	2
(iv) Record	2
(v) Viva voce	1

Table 7. Internship evaluation: assessment components:

Component	Weight
(i) Punctuality	1
(ii) Report	1
(iii) Content	1
(iv) Viva voce	1

Table 8. Project evaluation: Internal assessment components:

Component	Weight
(i) Punctuality	1
(ii) Experimentation/Data collection	1
(iii) Compilation	1
(iv) Content	1

Table 9. Project evaluation: External assessment components:

Component	Weight
(i) Area/Topic selected	1
(ii) Objectives	2
(iii) Review	1
(iv) Materials and methods	2
(v) Result &Discussion	2
(vi) Presentation	2
(vii) Conclusion/Application	2

(i) To ensure transparency of the evaluation process, the internal assessment grade awarded to the students in each course in a semester shall be published on the notice board at least one week before the commencement of external examination. There shall not be any chance for improvement for internal grade.

(ii) The course teacher and the faculty advisor shall maintain the academic record of each student registered for the course which shall be forwarded to the University through the college Principal and a copy should be kept in the college for at least two years for verification.

(b) External evaluation: The external examination in theory courses is to be conducted by the University with question papers set by external experts. The evaluation of the answer scripts shall be done by examiners based on a well defined scheme of valuation. The external evaluation shall be done immediately after the examination preferably through centralized valuation.
(i) Photocopies of the answer scripts of the external examination shall be made available to the students for scrutiny on request and revaluation/scrutiny of answer scripts shall be done as per the existing rules prevailing in the University.
(ii) The question paper should be strictly on the basis of model question paper set by BOS and there shall be a combined meeting of the question paper setters for scrutiny and finalization of question paper.

10. Direct grading system

Direct Grading System based on a 5-point scale is used to evaluate the performance (External and Internal Examination of students).

Table 10. Direct grading system: Grade points

Letter Grade	Performance	Grade point (G)	Grade Range
A	Excellent	4	3.5 to 4.00
B	Very Good	3	2.5 to 3.49
C	Good	2	1.5 to 2.49
D	Average	1	0.5 to 1.49
E	Poor	0	0.0 to 0.49

(a) The overall grade for a programme for certification shall be based on CGPA with a 7-point scale given below:

Table 11. Overall grade: 7-point scale

CGPA	Grade
3.80 to 4.00	A+
3.50 to 3.79	A
3.00 to 3.49	B+
2.50 to 2.99	B
2.00 to 2.49	C+
1.50 to 1.99	C
1.00 to 1.49	D

(b) A separate minimum of C Grade for internal and external are required for a pass for a course. For a pass in a programme, a separate minimum grade C is required for all the courses and must score a minimum CGPA of 1.50 or an overall grade of C and above.

(c) Each course is evaluated by assigning a letter grade (A, B, C, D or E) to that course by the method of direct grading. The internal (weightage = 1) and external (weightage = 3) components of a course are separately graded and then combined to get the grade of the course after taking into account of their weightage.

(d) A separate minimum of C grade is required for a pass for both internal evaluation and external evaluation for every course.

(e) A student who fails to secure a minimum grade for a pass in a course will be permitted to write the examination along with the next batch. There will be no supplementary examination.

(f) After the successful completion of a semester, Semester Grade Point Average (SGPA) of a student in that semester is calculated using the formula given below. For the successful completion of semester, a student should pass all courses and score a minimum SGPA of 1.50. However, a student is permitted to move to the next semester irrespective of her/his SGPA. For instance, if a student has registered for 'n' courses of credits C1, C2 ……, Cn in a semester and if she/he has scored credit points P1, P2……., Pn respectively in these courses, then SGPA of the student in that semester is calculated using the formula, SGPA = (P1 + P2 +…….+ Pn)/(C1 + C2 +……+ Cn)

CGPA = [(SGPA)1 x S1 + (SGPA)2 x S2 + (SGPA)3 x S3 + (SGPA)4 x S4]/ (S1+ S2 + S3 + S4)
Where S1, S2, S3, and S4 are the total credits in semesters 1, 2, 3 and 4 respectively.

11. Pattern of questions

(a) Questions shall be set to assess knowledge acquired, standard application of knowledge, application of knowledge in new situations, critical evaluation of knowledge and the ability to synthesize knowledge.

The question setter shall ensure that questions covering all skills are set. He/she shall also submit a detailed scheme of evaluation along with the question paper. A question paper shall be a judicious mix of short answer type, short essay type/problem solving type and long essay type questions.

(b) Weight: Different types of questions shall be given different weights to quantify their range as follows:

Table 12. Question paper pattern:

Sl. No.	Type of questions	Weight	No. of questions to be answered
1.	Short answer type questions	1	8 out of 12
2.	Short essay(problem solving type questions)	2	6 out of 9
3.	Long essay type questions	5	2 out of 4

12. Grade card

The University under its seal shall issue to the students, a grade card on completion of each semester, which shall contain the following information.

(i) Name of the University.

(ii) Name of college.

(iii) Title of the PG Programme.

(iv) Name of Semester.

(v) Name and Register Number of students.

(vi) Code number, Title and Credits of each course opted in the semester, Title and Credits of the Project Work.

(vii) Internal, external and Total grade, Grade Point (G), Letter grade and Credit point (P) in each course opted in the semester.

(viii) The total credits, total credit points and SGPA in the semester.

The Final Grade Card issued at the end of the final semester shall contain the details of all courses taken during the entire programme including those taken over and above the prescribed minimum credits for obtaining the degree. The Final Grade Card shall show the CGPA and the overall letter grade of a student for the entire programme.

13. Award of degree

The successful completion of all the courses with 'C' grade shall be the minimum requirement for the award of the degree.

14. Monitoring committee

There shall be a Monitoring Committee constituted by the Vice-chancellor to monitor the internal evaluations conducted by institutions. The Course teacher, Faculty Advisor, and the College Coordinator should keep all the records of the internal evaluation, for at least a period of two years, for verification.

15. Grievence redressal committee

(a) College level: The College shall form a Grievance Redress Committee in each Department comprising of course teacher and one senior teacher as members and the Head of the Department as Chairman. The Committee shall address all grievances relating to the internal assessment grades of the students. There shall be a college level Grievance Redress Committee comprising of Faculty advisor, two senior teachers and two staff council members (one shall be an elected member) and the Principal as Chairman.

(b) University level: The University shall form a Grievance Redress Committee as per the existing norms.

Table 13. Programme courses, Teaching hours and Credit distribution: Total credits – 80

Semester	Course	Teaching Hrs.	Credit	Total credits
I	PG1AMBC01	4	4	19
	PG1AMBC02	4	4	
	PG1AMBC03	4	4	
	PG1AMBC04	3	3	
	PG1AMBC05	5	2	
	PG1AMBC06	5	2	
II	PG2AMBC07	4	4	19
	PG2AMBC08	4	4	
	PG2AMBC09	4	4	
	PG2AMBC10	3	3	
	PG2AMBC11	5	2	
	PG2AMBC12	5	2	
III	PG3AMBC13	4	4	19
	PG3AMBC14	4	4	
	PG3AMBC15	4	4	
	PG3AMBC16	3	3	
	PG3AMBC17	5	2	
	PG3AMBC18	5	2	
IV	PG4AMBE01	3	3	23
	PG4AMBE02	3	3	
	PG4AMBE03	3	3	
	PG4AMBE04	6	3	
	PG4AMBC19	-	3	
	PG4AMBC20	-	4	
	PG4AMBC21	-	4	

A. Consolidation of grades for internal evaluation

If B, C, B, and A grades are scored by a student for attendance, assignment, seminar and test paper respectively for a particular course, then her/his CE for that course shall be consolidated as follows:

Table 14. Internal evaluation: Consolidation of grades (Theory)

Component	Weight (W)	Grade awarded	Grade point (G)	Weighted Grade Points (W x G)
Attendance	1	B	3	3
Assignment	1	C	2	2
Seminar	2	B	3	6
Test paper	2	A	4	8
Total	6			19
Grade: Total weighted grade points/Total weights = 19/6 = 3.16 = Grade B				

The components are defined for internal evaluation of practical work and their weights are given (Table 6). If B, A, C, B and C grades are scored by a student for attendance, Laboratory involvement, Test, Record and Viva-voce respectively for a particular course, then her/his CE for that course shall be consolidated as follows:

Table 14. Internal evaluation: Consolidation of grades (Practical)

Component	Weight (W)	Grade awarded	Grade point (G)	Weighted Grade Points (W x G)
Attendance	1	B	3	3
Laboratory involvement	2	A	4	8
Written/Lab test	2	C	2	4
Record	2	B	3	6
Viva-voce/Quiz	1	C	2	2
Total	8			23
Grade: Total weighted grade points/Total weights = 23/8 = 2.88 = Grade B				

The grade of an answer paper (ESE Practical) shall be consolidated by similar procedure discussed above by assigning weights for the various components. (E.g., Procedure, Preparation, Experiment, Identification, Calculation, Accuracy of the reported values, Presentation of results, Diagrams, etc).

B. Consolidation of grades for external (one answer paper - Theory)

The external evaluation of theory courses shall be consolidated as given below in Table 15 with different grades awarded to various questions.

Table - 15. Model evaluation sheet and Grade Calculation:

Type of question	Question Nos.	Grade awarded	Grade points	Weightage	Weighted Grade Points
Short answer	1	B	3	1	3
	2	0	0	0	0
	3	A	4	1	4
	4	D	1	1	1
	5	0	0	0	0
	6	A	4	1	4
	7	B	3	1	3
	8	0	0	0	0
	9	A	4	1	4
	10	0	0	0	0
	11	C	2	1	2
	12	E	0	1	0
Short essay	13	B	3	2	6
	14	C	2	2	4
	15	0	0	0	0
	16	0	0	0	0
	17	0	0	0	0
	18	A	4	2	8
	19	C	2	2	4
	20	E	0	2	0
	21	A	4	2	8
Long essay	22	C	2	5	10
	23	0	0	0	0
	24	0	0	0	0
	25	B	3	5	15
Total				30	76
Calculation : Overall grade of an answer paper = sum of weighted grade points/ sum of the weightage = 76/30 = 2.53 = Grade B					

C. Consolidation of the grade of a course:

The grade for a course is consolidated by combining the ESE and CE grades taking care of their weights. For a particular course, if the grades scored by a student are C and B respectively for the external and the continuous evaluation, as shown in the above examples, then, the grade for the course shall be consolidated as follows:

Table 16. Consolidation of course grade

Examination	Weight	Grade awarded	Grade points (G)	Weighted Grade point (W x G)
External	3	C	2	6
Internal	1	B	3	3
Total	4			9
Grade of a course (GPA)	Total weighted grade points/Total weights = 9/4 = 2.25 = Grade C			

D. Consolidation of SGPA

SGPA is obtained by dividing the sum of credit points (P) obtained in a semester by the sum of credits (C) taken in that semester. After the successful completion of a semester, Semester Grade Point Average (SGPA) of a student in that semester shall be calculated using the formula given. In M Sc Botany programme, a student takes three courses each of 4 credits, one course of 3 credits and 2 practical courses each of 2 credits in the I, II, and III semesters. However, the IV semester has a different combination of courses and credits as explained below. After consolidating the grade for each course as demonstrated above, SGPA is consolidated as follows:

Table 17. Consolidation of SGPA for Semesters I, II, III.

Course code	**Title of course**	**Credit (C)**	**Grade awarded**	**Grade points (G)**	**Credit Points (P = C x G)**
---	--	4	A	4	16
----	--	4	C	2	8
----	--	4	B	3	12
----		3	B	3	9
---	--	4	C	2	8
Total		19			53
SGPA	Total credit points/ Total credits = 53/19 = 2.78 = Grade B				

Table 18. Consolidation of SGPA for Semester IV

Course code	Title of course	Credit (C)	Grade awarded	Grade points (G)	Credit Points (P = C x G)
---	--	4	A	4	16
---	--	4	C	2	8
---	--	4	B	3	12
---	--	4	C	2	8
---	Project	4	B	3	12
---	Viva	3	A	4	12
Total		23			68
SGPA	Total credit points/ Total credits = 68/23 = 2.96 = Grade B				

E. Consolidation of CGPA

If the candidate is awarded two A grades, one B Grade and one C Grade for the four semesters and has 80 credits, the CGPA is calculated as fallows.

Table 19. Consolidation of CGPA

Semester	Credit taken	Grade	Grade point	Credit points
I	19	A	4	76
II	19	A	4	76
III	19	B	3	57
IV	23	C	2	46
Total	80			255
CGPA	Total credit points/ Total credits = 255/80 = 3.18 (which is between 3.00 and 3.49 in 7 point scale). The overall grade awarded is B+			

CORE PAPERS for I semester:

Course code	**Subject**	**Credits**
PG1AMBC01	Biochemistry & Microbial Metabolism	4
PG1AMBC02	Biophysics & Instrumentation	4
PG1AMBC03	Virology	4
PG1AMBC04	Fundamentals of Microbiology	3
PG1AMBC05	Practical I	2
PG1AMBC06	Practical II	2

CORE PAPERS for II semester:

Course code	Subject	Credits
PG2AMBC07	Microbial genetics & Molecular Biology	4
PG2AMBC08	Bioinformatics	4
PG2AMBC09	Immunology	4
PG2AMBC10	Biostatistics	3
PG2AMBC11	Practical III	2
PG2AMBC12	Practical IV	2

CORE PAPERS for III semester:

Course code	Subject	Credits
PG3AMBC13	Bioprocess technology	4
PG3AMBC14	Recombinant DNA technology	4
PG3AMBC15	Medical Microbiology	4
PG3AMBC16	Food & Dairy Microbiology	3
PG3AMBC17	Practical V	2
PG3AMBC18	Practical VI	2

ELECTIVE PAPERS (only three) for IV semester:

Course code	Subject	Credits
*PG4AMBE01	Pharmaceutical Microbiology	3
*PG4AMBE02	Microbial ecotechnology & Soil Microbiology	3
*PG4AMBE03	Clinical Microbiology	3
*PG4AMBE04	Nano Biotechnology & Space microbiology	3
PG4AMBC19	Practical – VII	3
PG4AMBC20	Internship	3
PG4AMBC21	Project	4
PG4AMBE01	Viva-voce	4

Out of four elective papers only three can be opted for a semester at the centre

SYLLABUS

PAPER- PG1AMBC01 **BIOCHEMISTRY AND MICROBIAL METABOLISM**

Credit-4

Unit-I: Biomolecules

Carbohydrates- Structural polysaccharides (cellulose, chitins, starch, agar and glycogen). Mucopolysaccharides, sialic acids, bacterial cell wall polysaccharides, glycoproteins, membrane glycoproteins and their biological functions.

Proteins- Primary structure - determination of amino acid sequence (sequncing) of proteins. The peptide bond: Ramachandran plot. Secondary structure - weak interactions involved - alpha helix and beta sheet and beta turns structure. Pauling and Corey model for fibrous proteins. Collagen - triple helix. Super secondary structures - helix-loop-helix. Tertiary structure - alpha and beta domains. Quaternary structure - structure of hemoglobin. Structure and biological functions of fibrous proteins (keratin, collagen).Globular proteins (Hemoglobin and myoglobin). Introduction to - Sickel cell Hb, lipoproteins, metalloproteins, glycoproteins, nucleoproteins. Denaturation and renaturation of proteins.

Lipids - Classification – simple, compound and derived lipids- structure and functions. Eicosanoids- types and function. Lipoproteins- types and function. Cholesterol its structure and biological properties. Essential fatty acids, Glycerides. saponification value, rancidity of fats, iodine number.

Unit- 2: Advanced Enzymology

Enzymes: Characteristics, nomenclature and classification, holoenzymes, apoenzymes & prosthetic groups, Kinetics of single substrate enzyme catalysed reaction: Michaelis-Menten equation, Brigg's Haldane equation, Lineweaver- Burk equation, Eadie- Hofstee & Hanes equation, Haldane relationship for reversible reactions

Mechanism of enzyme action - binding of substrate and lowering of activation energy, catalysis, acid- base catalysis, mechanism of action- chymotrypsin, ribonuclease & lysozyme. Metal activated enzymes & metalloenzymes, role of coenzymes.

Reversible inhibition - competitive, uncompetitive, noncompetitive inhibition. Irreversible inhibition- suicide inhibitors. Allosteric enzymes

Unit- 3: Metabolism and Bioenergetics

Carbohydrate metabolism

Anaerobic metabolism- EMP, Gluconeogenesis, HMP Shunt, ED pathway, Phosphoketolase and double phosphoketolase pathway, Methylglyoxal bypass, Alcoholic fermentation, Pasteur effect.

Aerobic metabolism- Citric Acid Cycle, Anaplerotic and Amphibolic role of Citric Acid Cycle, biosynthesis of cell wall peptidoglycan.

Regulation of carbohydrate metabolism- Regulation of glycogen metabolism – hormonal regulation and second messenger mediated regulation

Electron transport chain

Mitochondrial Electron transport chain and oxidative phosphorylation: Mitochondrial transport systems. Nature, order and organization of carriers of electron transport chain, transfer of electrons through protein complexes of ETC and inhibitors of electron transport chain. Oxidative phosphorylation: Coupling between oxidation and phosphorylation (Chemiosmotic hypothesis including evidences supporting this hypothesis). Proton gradient generation,, ATP synthase.

Lipid metabolism

Oxidation of fatty acids – α, β & ώ, Ketone bodies - Formation, utilization and clinical significance. Biosynthesis of fatty acids- Palmitic acid, Elongation of fatty acids- mitochondrial and microsomal. Metabolism of triglycerides, phospholipids . Biosynthesis of cholesterol, Metabolism of lipoproteins.

Unit -4: Nucleic acid structure and metabolism

Watson & crick model, various stabilizing forces in DNA structure. Metabolism of purines - De novo and salvage pathways for biosynthesis of Purine. Biosynthesis of pyrimidines. Degradation of purines and pyrimidines.

Unit – 5: Biological membranes and transport:

Molecular constituents of membranes, supramolecular architecture of membranes and asymmetric nature of biological membrane. Solute transport across membranes; Fick's law, simple (Passive) diffusion, facilitated diffusion and active transport (primary and secondary). Uniport, symport and antiport transport systems. Ionophores and porins. ATP - driven active transport: Na+ - K+ -ATPase of plasma membrane, Ca2+ -ATPase,

References

1. *Understanding Enzymes by Trevor Palmer*
2. *Enzyme Kinetics by Paul Engel. 1977. John Wiley and Sons. Inc., New York.*
3. *Enzymes by Dixon and Webb, 3 rd Edition 1979. Academic Press, New York*
4. *Biochemistry by Stryer 5th Edition WH Freeman 2001*
5. *Fundamentals of Enzymology. 3rd Edition by Price*
6. *Principles of Biochemistry. 2 nd Edition by Horton*
7. *Biochemistry by Voet.*
8. *Principles of Biochemistry, Lehninger- David L. Nelson, Michael M Cox*

PAPER PG1AMBC02 BIOPHYSICS AND INSTRUMENTATION

Credit-4

Unit-1: Thermodynamics

Laws of thermodynamics, thermodynamic equilibrium, Concepts of enthalpy, entropy and free energy in biological systems, high energy compounds, redox reactions, Chemical kinetics.

Unit –2: Basic laboratory Instruments

Microscopy- Working principles of microscopes (Bright light, phase contrast, interference & fluorescence microscope and electron microscopes), Laminar-air flow. **Centrifugation:** Basic principles, Relative centrifugal force, Factors affecting sedimentation velocity, sedimentation coefficient, determination of molecular weight, Types of centrifuges , preparative and analytical centrifuges- differential centrifugation and density gradient methods and their applications. **Chromatographic techniques** - Theory, principles and applications of thin layer chromatography, gel filtration chromatography, ion exchange chromatography, affinity chromatography, gas liquid chromatography, high pressure/ performance liquid chromatography (HPLC) GCMS.

Electrophoretic techniques - Basic principles of electrophoresis, theory and application of AGE, SDS PAGE, pulse field electrophoresis, Isoelectric focusing.

Unit – 3: Spectroscopy, crystallography and Immobilization

X-ray crystallography, Spectroscopic techniques, theory and applications of UV- Visible, IR, NMR, Fluorescence spectroscopy ,immobilization methods viz. carrier binding, entrapment & cross linking.` Analytical, therapeutic & industrial applications. Properties of immobilized enzymes.

Unit – 4: Radioisotopic techniques

Use of radioisotopes in life sciences, radioactive labeling, principle and application of tracer techniques, detection and measurement of radioactivity using ionization chamber, proportional chamber, Geiger- Muller and Scintillation counters, autoradiography and its applications.

Unit – 5: Conformations of Nucleic acids

Structural polymorphism, Supercoiling, Topoisomerase, DNA- protein interaction, RNA-protein interaction, t-RNA structure

References

1. *Instrumental Methods of Analysis. 6th Edition by H.H. Willard, L.L. Merritt Jr. and others. 1986. CBS Publishers and Distributors.*
2. *Instrumental Methods of Chemical Analysis. 1989 by Chatwal G and Anand, S. Himalaya Publishing House, Mumbai.*
3. *Spectroscopy. Volume 1. Edited by B.B. Straughan and S. Walker. Chapman and Hall Ltd.*
4. *Gel Electrophoresis of Proteins- A Practical Approach by Hanes.*
5. *Analytical Biochemistry by Holme.*
6. *Spectroscopy by B.P. Straughan and S. Walker.*
7. *Practical aspects of Gas Chromatography and Mass Spectrometry 1984 by Gordon M. Message, John Wiley and Sons, New York.*
8. *Isotopes and radiations in Biology by C.C. Thornburn, Butterworth and Co. Ltd., London.*
9. Biophysical chemistry -Upadhya

PAPER PG1AMBC03 VIROLOGY

Credit-4

Unit –1: Classification and Morphology of Viruses

Cataloging the virus through virus classification schemes of ICTV / ICNV. Morphology and ultra-structure of viruses. Virus related agents, viroids and prions.

Unit – 2: Cultivation and assay of viruses

Cultivation of viruses using embryonated eggs, experimental animals and cell cultures (Cell-lines, cell strains and transgenic systems). Purification of viruses by adsorption, precipitation, Serological methods – haeme agglutination and ELISA. Assay of viruses – Physical and Chemical methods. Infectivity Assays (Plaque, hyperplastic effect and end-point) Genetic analysis of viruses by classical genetic methods.

Unit – 3: Viral Multiplications & Control of Viruses

Mechanism of virus adsorption and entry into the host cell including genome replication and mRNA production by animal viruses, mechanism of RNA synthesis, mechanism of DNA synthesis, transcription mechanism and post transcriptional processing, translation of viral proteins, assembly, exit and maturation of progeny virions, multiplication of bacteriophages Control of viral infections through vaccines, interferons and chemotherapeutic agents. Structure, genomic organization, pathogenesis and control of Human immunodeficiency virus.

Phage Genetics

T4 virulent phage: structure, life cycle. Lamda temperate phage: Structure, genetic map, lytic and lysogenic cycle, lysogenic repression and phage immunity.

Unit-4: Overview of medical virology

Herpesvirus, Poliovirus, Rabiesvirus, Arboviruses, Hepatitis, HIV, Oncogenic viruses etc.

Unit-5: Prions and slow viral infections

Mechanisam of prion diseases, CJD, mad cow, bovine spongiform encephalopathy, slow viral infections

References

1. *Medical Virology 10 Th Edition by Morag C and Tim bury M C 1994. Churchil*
2. *Virology 3 rd Edition by Conrat H.F., Kimball P.C. and Levy J.A. 1994. Prentice Hall, Englewood Cliff, New Jersey.*
3. *Text Book on Principles of Bacteriology, Virology and Immunology Topley and Wilsons 1995.*
4. *Applied Virology. 1984. Edited by Edonard Kurstak. Academic Press Inc.*
5. *Introduction to Modern Virology by Dimmock.*
6. *Prion diseases by Gaschup, M.H.*
7. *Clinical virology Manual by Steven, S., Adinka, R.L., Young, S.A.*
8. *Principles of Virology. 2000 by Edward Arnold.*

PAPER PG1AMBC04 FUNDAMENTALS OF MICROBIOLOGY

Credit-3

Unit-1: History of Microbiology

History of Microbiology. Principles of classification of microbes; morphological, metabolic and molecular criteria for the classification, A brief introduction to major group of bacteria. Ultra structure of bacteria.

Unit- 2: Microbial Cultivation

Nutritional types requirements of bacteria. Cultivation of bacteria: Pure culture techniques different media. Culture media and preparation:- Preservation of cultures aerobic and anaerobic culture techniques. Batch and synchronous cultures. Growth curve and factors influencing growth

Unit- 3: Control of Microbial growth

Principles and techniques:- Physical and Chemical methods. Disinfection- Method of action of disinfectants. Methods of testing disinfectants.

Unit- 4: Microbial physiology

Staining characteristics, Gram staining, AFB staining, florescent staining, serological characteristics:- surface antigen, capsular antigen & flagellar antigen, Cultural characteristics, Photosynthetic microorganisms, cyclic and non-cyclic photophosphorylation, electron transport chain in photosynthetic bacteria. Bacterial aerobic respiration, Bacterial anaerobic respiration: introduction. Nitrate, carbonate and sulfate as electron acceptors. Electron transport chains in some anaerobic bacteria. Mechanism of oxygen toxicity. Bacterial transport system-ABC, Sec pathway, PTS, role of permeases in transport, different permeases in E. coli.

Unit-5: Microbial Diversity

General properties of fungi, fungal classification, economic importance of fungi, Mycoplasma, Actinomycetes, Archebacteria (extremophiles) and microbial algae.

References

1. *Microbial Physiology and Metabolism by Caldwell D.R. 1995Brown Publishers.*
2. *Microbial Physiology by Moat A.G. and Foster J. W. 1999.. Wiley.*
3. *Prokaryotic Development by Brun. Y.V. and Shimkets L.J. 2000. ASM Press.*
4. *Advances in Microbial Physiology. Volumes. Edited by By A.H. Rose. Academic Press, New York.*
5. *Applied Microbial Physiology by Rhodes.*
6. *Principles of bacteriology, virology and immunology Vol I Topley and Wilson*
7 *Zinser, Microbiology*
8. *Microbiology , Prescottt, Harley and klien*
9. *Foundations in Microbiology Talaro and Talaro*
10. *Text book of Microbiology, R Ananthanarayanan C K J Panicker*
11. *Microbiology, Pelczar, Chan and Kreig.*

PAPER PG1AMBC05 PRACTICAL I

(BIOCHEMISTRY & MICROBIAL METABOLISM, BIOPHYSICS & INSTRUMENTATION)

Credit- 2

1. Qualitative analysis of Carbohydrate mixture (a combination of polysaccharide, disaccharide and monosaccharide) following schematic analysis.

   (Starch, Dextrin, Maltose, Lactose, Sucrose, Glucose, Fructose, Galactose, Xylose)\

2. A. Estimation of Carbohydrates (Any three to be done)

   - Estimation of Total Sugars by Anthrone Method
   - Estimation of Reducing Sugars by DNS Method
   - Estimation of Fructose by Roe – Pappadapoulose Method
   - Estimation of Reducing Sugars by Nelson- Somogyi's Method
   - Estimation of glucose by Ortho- toluidine Method

   B. Estimation of Amino acids (Any two to be done)

   - Estimation of Tyrosine by Lowry's Method
   - Estimation of Methionine
   - Estimation of Tryptophan

   C. Estimation of Proteins (Any two to be done)

   - Estimation of Proteins by Lowry's Method
   - Estimation of Proteins by Benedicts Method
   - Estimation of Proteins by Bradford's Method

   D. Estimation of Lipids

   - Estimation of cholesterol by Zak's Method

   E. Estimation of Nucleic acids

   - Estimation of DNA by Diphenylamine Method
   - Estimation of RNA by Orcinol Method

3. Chromatographic Techniques

    - Separation of Amino acids by Paper Chromatography (Ascending/ Descending). Minimum of three standard amino acids and two unknown amino acids should be given
    - Thin Layer Chromatography to separate Carbohydrates/ Amino acids/ Lipids.
    - Separation of Biomolecules by Column Chromatography.

4. Enzymology

    - Estimation of the activity of SGOT and SGPT in the serum sample.

5. Spectrophotometer

    - U-V Spectrum analysis
    - Interpretation of the given XRD-data
    - Interpretation of the given NMR-data

PAPER PG1AMBC06 PRACTICAL II

Fundamentals of Microbiology, &Virology

Credit- 2

- Measurement of micro organisms: using ocular micrometer. Hanging drop technique for demonstrating motility of bacteria, Preparation of culture media: for microorganisms, cultivation of bacteria.
- Staining techniques:, Gram staining- Acid fast staining- Spore staining- Metachromatic granule staining, Flagellar staining,- Capsule staining and Fungal staining (LPCB). Antibiotic sensitivity tests, testing of disinfectants. Cultivation of viruses in embreyonated eggs. Serological tests for diagnosis of viral infections(DOT ELISA),

PAPER PG1AMBC07 Microbial Genetics and MolecularBiology

Credit-4

Unit -1: Microbial Genetics & central dogma of Molecular biology

Gene expression and regulation: Operons and regulons, repression and activation of *Lac,* trp, and, arb operon. Feedback inhibition and regulation of virulence genes in pathogenic bacteria. Extra chromosomal elements, Signal transduction in microbes. A brief account of genetic recombination in bacteria (transformation, conjugation and transduction),

DNA replication, transcription, post transcriptional modifications, translation, post translational modification,

Unit-2: Mutagenesis

Molecular basis of mutations, Types of gene mutations, suppression of mutations. Radiation induced mutations, toxicity testing. Systems that safeguard DNA - DNA methylation and DNA repair mechanisms –Daughter – strand gap repair (in lessions) bypass synthesis, transcription coupled DNA repair, Direct reversal of DNA damage, excision repair, mismatch repair, error prone repair by homologous recombination, end joining repair, SOS repair

Unt-3: Transposible elements and Genetic recombination

Transposition: Structure of Transposons, mechanism of transposition, transposon mutagenesis.

Genetic recombination; Hollyday model, Meselson- radding model and illegitimate recombination. Genetic counciling

Unit-4: Molecular techniques

Blotting: Principles, types of blotting, immunoblotting- Southern, Northern, Western and Dot blots. DNA amplification: PCR, RT- PCR. DNA sequencing: Various methods of DNA sequencing. Gene silencing: RNA interference (RNAi). Mapping of genome: Molecular markers as tools for mapping- Restriction Fragment Length Polymorphism (RFLP), randomly amplified polymorphic DNA (RAPD), simple sequence length polymorphism (SSCP), amplified fragment length polymorphism (AFLP). Functional genomics: entire genome expression analysis-microarrays, expressed sequence tags (ESTs), serial analysis of gene expression (SAGE), single nucleotide polymorphism (SNP).

Unit - 5: Molecular biology of cancer

Benign and malignant tumors, types of cancer, properties of cancerous cells, stages in cancer development, functions of tumor suppressor gene products. cancer-causing agents, proto oncogenes and oncogenes, apoptosis, anti-apoptotic proteins and DNA repair proteins, P53 as tumor suppressor genes, induced cell suicide, telomerase expression & immortalization of cells.

References

1. *Microbial Genetics by Maloy ET. Al. 1994. Jones and Bartlett Publishers.*
2. *Molecular Genetics of Bacteria by J. W. Dale. 1994. John Wiley and Sons.*
3. *Modern Microbial Genetics. 1991 by Streips and Yasbin. Niley Ltd.*
4. *Moleculat Biology of the Gene 4th Edition by J.D. Watson, N.H. Hoppkins, J.W. Roberts, J.A. Steitz and A.M. Weiner. 1987, The Benjamin / Cummings Publications Co. California.*
5. *Gene VII by Lewin Oxford University Press. 2000.*
6. *Bacterial and Bacteriophage Genetics. 4 th Editions by Birge.*
7. *Microbial Genetics by Frefielder. 4th Edition.*
8. *DNA repair and mutagenesis. 1995 by Errol C. Friedberg, Graham C. Walker and Wolfram, Siede, ASM Publications.*
9. *Molecular Genetics of Bacteria, 1997 by Larry, Snyder and Wendy, Champness, ASM Publications.*
10. *Recombinant DNA by Watson, J.D.*
11. *Mobile DNA II by Nancy Craig, Martin Gellet Allan Lambowitz.*

PAPER PG1AMBC08 - BIOINFORMATICS

Credit-4

Unit-1: Bioinformatics and its applications

Introduction to bio informatics, BI over view, types of data bases, data mining, objectives of bio informatics, applications, challenges in molecular biology, careers in BI, skills required by BI, virology data bases &diseases data bases, COGS cluster, structure classification data base, public domain databases for nucleic acids and protein sequences and protein structure data bases metabolic pathways KEGG databases, organism specific data bases.

Unit- 2: Whole genome analysis

Whole genome analysis; preparation of ordered cosmid libraries, bacterial artificial chromosome libraries, comparitive genomics, functional genomics. Protein analysis; two dimensional separations of total cellular proteins, isolation and sequence analysis of individual proteins, microarray, protein micro array advantages and disadvantages of DNA and protein micro array

Unit- 3: Sequence analysis

Sequence analysis; local and global alignments; scoring matrices, dot plots, heuristic methods, dynamic programing ,open reading frames, ESTS, unigene , DNA analysis for repeats (direct and inverted palindromes) related tools BLAST, FASTA, SSEARCH phylogenitic analysis multiple alignment ; CLUSTAL W &PHYLIP, molecular visualization tools and software; Swisspdb, Rasmol gene prediction software; genscan, expasy tools, web based bio informatics application, online analysis tools and servers, annotation systems- DAS etc.

Unit- 4: Structural biology

Structural biology; macro molecules , principles of structural organization, conformational analysis, structure determination, visualization and computational methods used in protein structure prediction, homology modelling, threading, abinitio, neural networks, structure based drug design; molecular docking, mechanisms in molecular docking, virtual screening, active site analysis tools, docking tools de novo Ligand design. Application in docking, personalized drug design, related online tools.

Unit- 5: Advanced bioinformatics

Commercial application of BI; definition, genome technology, High throughput sequencing and assembly. Genomics in medicine, Disease monitoring, profiles for therapeutic molecular targeting. Diagnostics, drug discovery and genomics, Comparative proteomics and its applications, IPR and Bioinformatics patents.

Reference

1.Bioinformatics Prakash S Lohar

2.Basic Bioinformatics S.Lgnacimuthu,SJ

3. Bioinformatics Dr.K, Mani,N.Vijayaraj

4. Bioinformatics Databases And Algorithms N.Gautham

5. Bioinformatics Concepts,Skills And Applications S.C.Rastogi,Namitha Mendinatta.

6.Introduction To Bioinformatics TK Attwood,D J Parry-Smith

7.Biotechnology By B D Singh

PAPER PG1AMBC09 - IMMUNOLOGY

Credit-4

Unit – 1: Immune System

Introduction to immunology, infections. Organs and cells involved in immune system. Lymphocytes, their subpopulation, their properties and functions, membrane bound receptors.

Unit – 2: Antigens and Immunoglobulins

Concept of haptens, determinants, conditions of antigenicity, antigens and immunogenecity, superantigen. Immunoglobulins: Structure and properties of immunoglobulin classes. Clonal selection theory, hybridoma technology for monoclonal antibodies and designer monoclonal antibodies. Structural basis of antibody diversity. Freund's adjuvants and its significance.

Unit – 3: Antigen – Antibody reactions

Antigen-Antibody reaction by precipitation, agglutination and complement fixation. Complement system: Classical, alternate, lectin pathway of complement activation.

Non-specific immune mechanism: - Surface defenses, tissue defenses, opsonization, inflammatory reaction. Tissue metabolites with bactericidal properties (lysozyme, nuclein, histone, protamine, basic peptides of tissues – leukins, phagocytins, lecterins, haemocompounds).

Unit – 4: Expressions of Immune Response

Antigen processing and presentation, MHC restriction, generation of humoral and cell mediated immune response, maturation and activation of B and T lymphocytes, cytokines and their role in immune regulation, Immunological tolerance & regulation. Cell mediated cytotoxicity: Mechanism of T cells and NK cell mediated lysis, ADCC, and macrophage mediated cytotoxicity.

Unit - 5: Immunity in Medical biology

Transplantation immunology: MHC, typing, types of grafts, grafts rejection, GVH reactions, mechanism of graft rejection, and prevention of graft rejection. Immuno deficiencies and autoimmunity. Hypersensitivity, Tumor immunology, immune hematology – ABO, Rh, and Duffy systems, transfusion reactions, Immune response against parasitic and viral infection.

References

1. *Fundamental immunology, Paul w e (ed)*
2. *Principles of bacteriology, virology and immunity Vol I Topley and Wilson.*
3. *Essential clinical immunology- Helen chappu and Mansel haeny*
4. *Introduction to immunology John w Kimball*
5. *Textbook of microbiology, Ananthanarayanan and Jayaram paicker.*
6. *Essential immunology Roitt*
7. *Basic and clinical immunology stiles, Stobo,Fuden berg wells (eds)*
8. *Microbiology and immunology David J Hantges*

PAPER PG1AMBC10 BIOSTATISTICS

Credit-3

Unit –1: Introduction to Biostatistics

Types of data, primary and secondary, methods of collecting primary data ,graphical representation of data –histogram, frequency polygon, frequency curves, ogives, diagrammatic representation. Measures of central tendency: mean, median, mode, measures of dispersion- range quartile deviation, mean deviation & standard deviation], coefficient of variation, correlation-positive &negative, Karl pearson's, rank correlation, regression lines &prediction, coefficient of determination, concept of multiple regression.

Unit –2: Probability

Events, classical & frequency definitions, conditional probability, independent events, addition & multiplication theorems –simple examples, concept of random variable and its p.d.f, Baye's theorem.Standarad probability distributions –Binomial, Poisson and Normal properties, Simple problems and applications.

Unit – 3: Population statistics

Population and sample, Different types of samples simple random, stratified, systematic and cluster, non probability samples, estimators sampling distribution and standard errors confidence intervals for the mean of a normal population and for populations proportion

Unit- 4: Tests of hypothesis

Type 1 and Type 2 errors significance level, Tests for mean of a normal population equality of variances, equality of means, tests for proportion, equality of proportions, tests for significance of a correlation coefficient.

Unit-5: Sampling Theory and Design of Experiments:

Non parametric tests –Chi square test for goodness of fit and independence of attributes, Design of experiments –principles of experimentation, randomization, replication and local control, CRD, RBD and LSD, ANOVA for one way & 2-way classifications basic ideas of factional experiments. Statistical softwares SPSS and R for computation of mean, variance correlation, t tests, F tests etc..

References

1. *PAUSE V G and Sukhame P V (1967) statistical methods for agricultural workers.*
2. *Arora P N, Malhan P K (1996) Biostatistics Himalaya publishing house.*
3. *Gupta S C and Kapoor V K (2002) fundamentals of mathematical statistics Sultan Chand and sons*
4. *Nigam A K , V K Gupta (1979) handbook on analysis of agricultural experiments I A S R I New Delhi*
5. *E Balaguruswamy (1992) basic programming Tata Mc Graw hill*
6. *Paul r kinnear and coll in d gray (1997) SPSS for windows made simple.*
7. *Ron cody and ray pass (1995) SAS programmigm by example SAS institute, u s*

PAPER PG1AMBC 11 PRACTICAL III

Credit-2

Bio-statistics and Bio-informatics

- Classify a given data using frequency distribution and represent it graphically.
- Analysis of data for mean, median, mode, mean deviation, standard deviation, standard error and coefficient of variation.
- Test the significance of a given data using't', 'X^2' and F tests.
- Analysis of data for correlation and regression, Analysis of set of data in CRD, RBD, LSD.

Bioinformatics- All programs and packages included in theory syllabus.

PAPER PG1AMBC12 PRACTICAL IV

Molecular Biology and Immunology

Credit-2

- Isolation, purification and estimation of DNA and RNA from eukaryotic and prokariotic cells. Isolation of plasmids.
  Mini prepration
  Midi prepration
  Maxi prepration
- RFLP, ligation, PCR, transformation, RAPD.
- Preparation and standardization of antigens, immune sera, serological tests for diagnosis of microbial infections- Widal test, VDRL, ELIZA test.
- Studies on antiobody-antigen reaction: agglutination and precipitation test.

PAPER PG1AMBC13 BIOPROCESS TECHNOLOGY

Credit-4

Unit - 1: Microbial strain improvement

Isolation, selection and improvement of microbial cultures:

Isolation of microorganisms, primary and secondary screening for the desired product. Strain improvement for the selected organism: strategies of strain improvement for primary & secondary metabolites with relevant examples. Use of recombinant DNA technology & protoplast fusion techniques for strain improvement. Improvement of industrial strains by modifying properties other than product yield. Preservation of cultures

Unit–2: Bioreactors and Fermentation process

Design of a basic fermenter: body construction, aerators, agitators, baffles, foam separators, valves & steam traps, Types of Reactors: Tower fermenter, CSTR, Photopbioreactor, airlift fermenter. Transport phenomena in fermentation: oxygen transfer, determination of K_La, factors affecting K_La, Scale up of bioreactors.

Control: - online and offline control. pH probe, temperature probe, DO probe, Tacchometer, Load cells Control of Bioreactor, Types of control, Feed forward control, cascade control, adaptive control, complex control systems, PID control systems. Computer application on the control of Bioreactor

Fermentation process Kinetics of growth in batch culture, continuous culture with respect to substrate utilization, Monod kinetics, Specific growth rate, steady statecondition, fed-batch fermentation, yield of biomass & productivity, media formulation for industrial process.

Unit – 3: Down stream processing

Biomass separation by centrifugation, filtration, flocculation and other recent developments. Cell disintegration: Physical, chemical and enzymatic methods. Extraction: Solvent, two phase, liquid extraction, whole broth, aqueous multiphase extraction. Purification by different methods. Concentration by precipitation, ultra-filtration, reverse osmosis. Drying and crystallization.

Unit – 4: Applications of microbial enzymes

Microbial enzymes in textile, leather, wood industries and detergents & clinical

diagnostics. Use of microbes in mineral beneficiation and oil recovery. Industrial Production - organic acids (citric acid, acetic acid and gluconic acid), solvents (acetone, butanol, Ethanol), Antibiotics (penicillin, streptomycin, tetracycline), Amino acids (lysine, histamine), vitamins- riboflavin, vitamin K, Single Cell Protein.

Unit- 5: Animal cell culture

Laboratory facilities for tissue culture, different substrate for the cell growth media for mammalian cell culture, impact of serum in culture media, primary culture, application of animal cell culture. Intoduction to concepts in cell biology (renewal potency), definition of terms (adult stem cell, embryonic stem cell, germ line stem cell), cell differentiation (muscles & bone stem cell, hematopoetic stem cell) Stem cells & therapeutics.

References

1. *Principles of Fermentation Technology by Stanbury, P.F., Whitaker A. and Hall. 1995. Butterworth Heinemann*
2. *Biochemical Reactors by Atkinson B., Pion, Ltd. London.*
3. *Biotechnology - A Text Book of Industrial Microbiology by Cruger.*
4. *Fermentation Biotechnology: Industrial Perspectives by Chand.*
5. *Biochemical Engineering Fundamentals by Bailey and Ollis, Tata McGraw Hill, N.Y.*
6. *Biotechnology. Volume 3. Edited by H. J. Rehm and G. Reed. Verlag Chemie. 1983.*
7. *Biotechnology- A textbook of Industrial Microbiology by Creuger and Creuger, Sinaeur Associates.*
8. *Industrial Microbiology by L.E. Casida, Wiley Eastern*

PAPER PG1AMBC14 RECOMBINANT DNA TECHNOLOGY

Credit-4

Unit – 1: Enzymes in genetic recombination

Core techniques and essential enzymes used in recombination: restriction endonucleases, type I, II, III, recognition sequences, properties, classification of type II endonucleases, their activity. DNA ligase: Properties and specificity, S1 nuclease, BAL 31 nuclease, DNA polymerase, polynucleotide kinase, phosphatase, reverse transcriptase its activity and mode of action.

Unit – 2: Plasmids

Properties, incompatibility, isolation and purification techniques, plasmid vectors and their properties, copy number, PBR 322 – its construction and derivatives, single stranded plasmids, promoter probevectors, runaway plasmid vectors. Bacteriophage lambda (l) as a vector: Essential features, organization of l genome, general structure, rationale for vector construction cosmids, phasmids, filamentous phage vectors, l zap, l blue print vectors,shuttle vectors. Expression vectors, promoter probe vectors, vectors for library construction.

Unit- 3: Specialized cloning strategies

Genomic DNA libraries, chromosome walking and jumping, cDNA libraries, short gun cloning, directed cloning, phage display. Recombinant DNA technology with reference to cloning and production of interferon and insulin. Fusion proteins, Miscellaneous applications of genetically engineered micro organisms (GEMS) / genetically modified organisms (GMO's). Chemical synthesis of DNA. Restriction digestion, ligation and transformation (α- complimentation). Cloning techniques and methods of gene transfer, screening of recombinant DNA by colony hybradisation, electrophoretic mobility shift assay,(EMSA).

Unit – 4: Molecular mapping of genome

Genetic and physical maps, physical mapping and map –based cloning, choice of mapping population, simple sequence repeat loci, southern and fluorescence in situ hybridization for genome analysis, Chromosome microdissection and microcloning, Germplasm maintenance.

Unit-5: Application of Genetic engineering

Appilcations in industrial & healthcare, Gene therapy for inherited disorders and neoplastic disorders, human cloning and bioethics, therapeutic cloning, bone marrow transplantation. Terminator gene therapy, Knock out and knock down. Applications in Agriculture

Reference

1. *Glick BR, Pasternak JJ. (2003). Molecular Biotechnology. ASM Press Washington D.C.*
2. *Old and Primrose (2001). Principles of Gene Manipulation. Blackwell Scientific Publication.*
3. *Brown TA (2006). Gene Cloning. Blackwell Publishing.*
4. *Sambrook, Fritsch and Miniatis (2006). Molecular cloning- A laboratory manual. Cold Spring Harber Laboratory Press.*
5. *Nicholl DST (2008). An Introduction to Genetic Engineering, Cambridge University Press.*
6. *Principles of Gene Manipulations 1994 by Old and Primrose Blackwell Scientific Publications.*
7. *DNA Cloning: A Practical Approach by D.M. Glower and B.D. Hames, IRL Press, Oxford. 1995.*
8. *Molecular Biotechnology 2nd Edition by S.B. Primrose. Blackwell Scientific Publishers, Oxford. 1994.*
9. *Genetic Engineering and Introduction to Gene Analysis and Exploitation in Eukaryotes by S.M. Kingsman and A.J. Kingsman, Blackwell Scientific Publications, Oxford 1998.*
10. *PCR Technology - Principles and Applications for DNA Amplification by Henry A. Erlich (Ed.) Stockton Press. 1989.*
11. *Biotechnology: A Guide to Genetic Engineering by Peters.*
12. *Genetic Engineering – 2000 by Nicholl.*
13. *Recombinant DNA and Biotechnology: Guide for Teachers. 2nd Edition by Helen Kreuz. 2001.ASM Publications.*
14. *Molecular Biotechnology: Principles and Applications of Recombinant DNA. 2 nd Edition. 1998 by Bernard R. Glick and Jack J. Pastemak, ASM Publications.*

PAPER PG1AMBC15 MEDICAL MICROBIOLOGY

Credit-4

Unit-1: Systematic Bacteriology

Diseases caused by Gram positive cocci – Staphylococcus and Streptococcus,

Diseases caused by Gram negative cocci - meningitis, gonorrhea;

Mycobacteriacace - tuberculosis, leprosy,

Disease caused by toxigenic bacteria- Diphtheria, Clostridium, Bacillus, Vibrio

Mycoplasma, Chlamydia, Coxiella, Rikettsia, Haemophilus,Treponema, Propionibacterium

Zoonotic bacteria – Brucella, Erysipelothrix, listeria, yersinia

Diseases caused by Gram negative bacteria of family Enterobacteriaceae -Salmonella, bacillary dysentery, UTI, E.coli, Helicobactor, Klebsiella, Proteus; sexually transmitted diseases (spirochaetes); Diseases caused by mycoplasma, Chlamydia, Bordetella, Pseudomonas, Legionella ;

Unit-2: Overview of medical mycology

Superficial, subcutaneous, systemic and opportunistic mycosis

Unit-3: Overview of medical parasitology:

Important protozoal diseases: Malaria, Leishmaniasis, amoebiasism, trypanosome.

Toxoplasma, Trichomonas

References

1. *BERGEY'S MANUEL of systemic bacteriology vol I-IV by Kreig n r (ed)*
2. *Principles of bacteriology, virology and immunology Topley and Wilson*
3. *Zinsser microbiology*
4. *Textbook of microbiology by Ananthanarayanan and Panicker.*
5. *Medical microbiology, Mackie and McCartney*
6. *Review of medical microbiology, Jawetzz, Melnik and Adelberg*
7. *Principles of bacteriology virology and immunity Vol I by Wilson*
8. *Medical mycology a practical approach by Evads and Richardson*
9. *Parasitology k d Chatterjee*

PAPER PG1AMBC16 FOOD and DAIRY MICROBIOLOGY

Credit-3

Unit – 1: Industrial Food fermentations

Starter cultures and their biochemical activities, production and preservation of the following fermented foods.

a. Soy sauce fermentation by Moulds

b. Fermented vegetables – Saurkraut

c. Fermented Meat – Sausages

d. Production and application of Bakers Yeast

e. Application of microbial enzymes in food industry

Unit – 2: Quality assurances in foods

Food borne infections and intoxications; bacterial with examples of infective and toxic types –, Clostridium, Salmonella, Shigella, Staphylococcus, Campylobacter, Listeria. Mycotoxins in food with reference to Aspergillus species. Quality assurance: Microbiological quality standards of food. Government regulatory practices and policies. FDA, EPA, HACCP, ISI, ISO.

Unit –3: Food preservation methods

Radiations - UV, Gamma and microwave, Temperature, Chemical and naturally occurring antimicrobials

Unit – 4: Microbiology of cheese and beverage fermentation.

Microbiology of fermented milk products (acidophilus milk, yoghurt, cheese). Role of microorganisms in beverages – tea and coffee fermentations. Vinegar Fermentation, microbiology of wine industry.

Unit - 5: Advanced Food Microbiology

Genetically modified foods. Biosensors in food, Applications of microbial enzymes in dairy industry [Protease, Lipases]. Utilization and disposal of dairy by-product - whey.

References

1. Food Microbiology. 2nd Edition by Adams
2. Basic Food Microbiology by Banwart George J.
3. Food Microbiology: Fundamentals and Frontiers by Dolle
4. Biotechnology: Food Fermentation Microbiology, Biochemistry and Technology. Volume 2 by Joshi.
5. Fundamentals of Dairy Microbiology by Prajapati.
6. Essentials of Food Microbiology. Edited by John Garbult. Arnold International Students Edition.

7. Microbiology of Fermented Foods. Volume II and I. By Brian J. Wood.Elsiever Applied Science Publication.
8. Microbiology of Foods by John C. Ayres. J. Orwin Mundt. William E. Sandinee. W. H. Freeman and Co.
9. Dairy Microbiology by Robinson. Volume II and I.
10. Food Microbiology: Fundamentals and Frontiers. 2nd Edition by Michaell P. Doyle, Larry R. Beuchat and Thomas I. Montville (Eds.), ASM Publications. and Dixie D. Whitt. ASM Publications.
11. Advances in Applied Microbiology by D. Pearlman, Academic Press.

PAPER PAPER PG1AMBC17 - PRACTICAL V

Credit-2

Bioprocess Engineering, And r- DNA Technology

- Crowded plate technique for isolation of antibiotic producing organisms.
- Antibiotic production & assay techniques.
- Isolation of amylase producing organisam from appropriate samples and qualitative estimation of the enzyme after pilot fermentation.
- Fermentation- submerged and solid state.
- mushroom cultivation.
- Production of ethyl alcohol and wine, production of organic acids- citric acid and lactic acid, Immobilization of cells and enzymes.
- Transformation –α complimentation

PAPER PG1AMBC18 - PRACTICAL VI

Credit-2

FOOD & DIARY MICROBIOLOGY AND MEDICAL MICROBIOLOGY

- Microbiological examination of food, milk, vegetables, meat, fish, etc.
- Demonstration of methylene blue reductase test, methods used for spoilage, counting of yeast and molds, culturing of canned products, sterility tests for canned foods.
- Analysis of butter.
- Collection of materials for the study of pathogenic fungi, Culture methods for the isolation of pathogenic fungi, Identification of pathogenic fungi.
- Microscopic examination of peripheral blood smears for malarial parasites.

PG4AMBE01 **PHARMACEUTICAL MICROBIOLOGY**

Credit-3

Unit – 1: Antibiotics and their Mechanism of action

Antibiotics and synthetic antimicrobial agents. Mechanism of action of antibiotics (inhibitors of cell wall synthesis, nucleic acid and protein synthesis). Molecular principles of drug targeting. Bacterial resistance to antibiotics. Mode of action of bacterial killing by quinolinones. Bacterial resistance to quionolinones. Mode of action of non – antibiotic antimicrobial agents. How the antimicrobial agents reach the targets (cellular permeability barrier, cellular transport system and drug diffusion).

Unit – 2: Microbial production and Spoilage of pharmaceutical Products

Microbial contamination and spoilage of pharmaceutical products (sterile injectibles, non injectibles, ophthalmic preparations and implants) and their sterilization.Other pharmaceuticals produced by microbial fermentations (streptokinase, streptodornase). New vaccine technology, DNA vaccines, synthetic peptide vaccines, multivalent subunit vaccines. Vaccine clinical trials.

Unit -3: Regulatory practices, biosensors and applications in Pharmaceuticals

Financing R&D capital and market outlook. IP, BP, USP. Government regulatory practices and policies, FDA perspective. Rational drug design. Immobilization procedures for pharmaceutical applications (liposomes). Macromolecular, cellular and synthetic drug carriers. Biosensors in pharmaceuticals.

Unit – 4: Quality Assurance and Validation

Good Manufacturing Practices (GMP) and Good Laboratory Practices (GLP) in pharmaceutical industry. Regulatory aspects of quality control. Quality assurance and quality management in pharmaceuticals ISO, WHO and US certification. Sterilization control and sterility testing (heat sterilization, D value, z value, survival curve, Radiation, gaseous and filter sterilization) Chemical and biological indicators. Safety in microbiology laboratory. (Designing of Microbiology laboratory)

References

1 . Pharmaceutical Microbiology – Edt. by W.B.Hugo & A.D.Russell Sixth edition. Blackwell scientific Publications.

2. Analytical Microbiology –Edt by Frederick Kavanagh Volume I & II. Academic Press New York.

3. Quinolinone antimicrobial agents – Edt. by David C. Hooper, John S.Wolfson .ASM Washington DC.

4. Quality control in the Pharmaceutical Industry - Edt. by Murray S.Cooper Vol.2. Academic Press New York.

5. Biotechnology – Edt. by H.J.Rehm & G.Reed, Vol 4. VCH Publications, Federal Republic of Germany.

6. Pharmaceutical Biotechnology by S.P.Vyas & V.K.Dixit. CBS Publishers & Distributors, New Delhi.

7. Good Manufacturing Practices for Pharmaceuticals Second Edition, by Sydney H.Willig, Murray M.Tuckerman, William S.Hitchings IV. Mercel Dekker N.York.

8. Advances in Applied Biotechnology Series Vol 10, Biopharmaceuticals in transition. Industrial Biotechnology Association by Paine Webber. Gulf Publishing Company Houston.

9. Drug Carriers in biology & Medicine Edt. by Gregory Gregoriadis. Academic Press New York.

10. Quality Assurance in Microbiology by Rajesh Bhatia, Rattan lal

PG4AMBE02 MICROBIAL ECOTECHNOLOGY & SOIL MICROBIOLOGY

Credit-3

Unit – 1: Microbial Ecosystem

Introduction to- Aeromicrobiology: Microorganisms in outdoor atmospheric environment, nature of bioaerosols, their fate and transport. Microorganisms in soil-environments: Surface, subsurface and deep soil conditions. Microorganisms in various aquatic environments: Freshwater, brackish-water, Biogeochemical cycles-sulpor,nitrogen, Marine microbiology. Role of microorganisms for biomonitoring of various quality-parameters related to water and wastewater - Indicator organisms, single species laboratory bioassays and biosensors.

Unit-2: Waste water treatment & Bioremediation of Xenobiotics

Brief introduction to various stages of wastewater treatment: Primary, secondary and tertiary treatment. Batch and continuous reactor-systems: Attached growth and suspended culture systems, stabilization ponds. Control of pathogens in water and wastewater, Use of microorganisms for removal of various toxins and metallic ions from wastewater, Utilization of microbial consortium for the treatment of solid waste [Muncipal Solid Waste]

Microbiology of degradation of xenobiotics in the environment, ecological considerations, decay behaviour, oil pollution, surfactants and pesticides. Genetically Modified Organisms released and its environmental impact assessment and ethical issues.

Unit-3: Biofertilizer, Biopesticides and other microbial products:

Mass cultivation of microbial inoculants; Rhizobium, PSM, BGA; algalization; *Azolla*. Microbial products and plant health: PGPR (plant growth promoting rhizobacteria); significance of mycorrhizae; toxin producing microbes (antibiotics, aflatoxin, etc.); microbial herbicides;

Biological control (NPV, CPV, GV, BT, Pseudomonas, Trichoderma, Nosema sps)

Modern trends in microbial production-Microbial production of bioplastics (PHB, PHA), Useful features of bio-fuels, the substrate digester and the microorganisms in the process of biogas production (biomethanation). Production of bioethanol from sugar, molasses, and cellulosic materials, Biodiesel from hydrocarbons Use of microbes in environmental bioremediation

Unit – 4: Soil microbiology &microbial interaction

Soilmicroflora, factors affecting soilflora, Mycorhizza, interaction among soil microbes, plant microbe interaction, composting technology, production of silage

Plant diseases and control: - Bacterial disease of plant- host pathogen interaction, Soft rot, wilt, blights, viral pathogen of plant, fungal pathogen of plant deseminating agents in plant diasease. Viral disease of plants

References

1. *Industrial Microbiology by G. Reed (Ed), CBS Publishers (AVI Publishing Co.)*
2. *Biology of Industrial Microorganisms by A.L. Demain.*
3. *Genetics and Biotechnology of Industrial Microorgansims by C.l. Hershnergey, S.W. Queener and Q. Hegeman. Publisher. ASM. Ewesis ET. Al. 1998. Bioremediation Principles. Mac Graw Hill.*
5. *Annual Reports in Fermentation Processes by D. Pearlman, Academic Press.*
6. *Fundamentals of Biochemical Engineering by Bailey and Ollis.*
7. *Annual Review of Microbiology by Charles E. Cliffton (Volumes)*
8. *Biotechnology, A textbook of industrial Microbiology by Creuger and Creuger, Sinaeur associates.*
9. *Manual of industrial Microbiology and Biotechnology 2nd edition by Davis J.E. and Demain A.L. ASM publications.*
10. *Agricultural microbiology by rangaswamay G*
11. *Soil microbiology by Waksman SA*
12. *Soil microorganism and plant growth, N.S Subba Rao*

PG4AMBE03 **CLINICAL MICROBIOLOGY**

Credit-3

Unit-1: Microbiology Laboratory Safety& the Laboratory Role in Infection Control

General Safety Principles, Handling of Biologic Hazards, Disposal of Infectious waste, Chemical Safety, General concepts in infection control practice, Outbreak investigation, education, emerging and reemerging pathogens

Unit-2: Performance improvement in the microbiology laboratory

General guidelines for establishing quality control, performance improvement, analytical analysis of tests, clinical analysis of test, operational analysis of test, choosing a laboratory method, test validation.

Unit-2: Host-Parasite Interaction

Indigenous Microbial Flora- skin, mouth, respiratory tract, gastrointestinal tract, genitourinary tract, Pathogenicity, Opportunistic pathogens, Pathogens, Virulence, Host Resistance Factors, Infectious Agent Factors , Routes of Transmission

Unit-3: Specimen collection and Processing

Basic principle of specimen collection, specimen receipt and processing, culture works up, Non routine specimens, Collection and processing of blood, urine, feces, sputum etc

Unit-4: Microscopic examination of infected material & Antimicrobial Susceptibility Testing

Preparation of samples, examination of prepared sample, grading or classifying materials, quality control in direct microscopic examination, MIC, MBC, time - kill assay, measurement of antibiotic concentration in body fluids, automated antimicrobial susceptibility test, methods for detecting antimicrobial inactivating enzyme, quality control of antimicrobial susceptibility test,

Nosocomial infections - Common nosocomial infections, control of infection, hospital hygiene

References

1. *BERGEY'S MANUEL of systemic bacteriology vol I-IV by Kreig n r (ed)*
2. *Principles of bacteriology, virology and immunology Topley and Wilson*
3. *Zinsser microbiology*
4. *Textbook of microbiology by Ananthanarayanan and Panicker.*
5. *Medical microbiology, Mackie and McCartney*
6. *Review of medical microbiology, Jawetzz, Melnik and Adelberg*
7. *Principles of bacteriology virology and immunity Vol I by Wilson*
8. *Medical mycology a practical approach by Evads and Richardson*
9. *Parasitology k d Chatterjee*
10. *Diagonostic Microbiology, Mahon*

PG4AMBE04 **NANOBIOTECHNOLOGY &SPACE MICROBIOLOGY**

Credit-3

Unit- 1:

Functional Principles of Nanobiotechnology, Basic biology principles and practice of micro fabrication techniques, Atomic force microscopy, biological production of metal nano particles, macro molecular assemblies.

Unit- 2:

Bacterial structure relevant to nanobiotechnology, Cubosomes, Dendrimers, DNA Nanoparticle Conjugates, DNA Octahedron, Fullerenes, Nanoshells, Carbon Nanotubes, Nanopores, Nano structured Sillicon, Viruses as nano-particles, nano chemicals and application.,

Unit- 3:

Drug delivery tools through nano biotechnology, tumor targeting and other diagnostic applications, nano particle based immobilization assays, quantum dots technology and its application, immuno-nanotechnology

Biosensors and nano biotechnology, principles used in construction of microelectronic devices, sensors and macro mechanical structures and their functioning,

DNA based Nanostructures- DNA-protein nanostructures-Methods- Self assembled DNA nanotubes—Nucleic acid Nanoparticles, DNA as a Biomolecular template-DNA branching-Metallization- Properties

Unit-4: Space Microbiology

Space Microbiology: An Overview, Monitoring of astronauts microbial flora: Alterations in the load of medically important microorganisms, ESA STONE experiment. Evaluating the Biological Potential in Samples Returned from Planetary Satellites and Small Solar System Bodies.

Reference:

- *Nanobiotechnology- concepts, applications and perspectives, Niemeyer, Christof m. Mirkin, Chad A., Wiley publishers.*
- *Nanobiotechnology of biomimetic membranes, Martin, Donald (edt), Springer Verlag publishers.*
- *Melgardt M.deVilliers, Pornanong Aramwit, Glen S.Kwon, Nanotechnology in Drug Delivery, Springer-American Association of Pharmaceutical Scientists Press 2009*

- *The Handbook of Nanomedicine, Kewal K.Jain*
- *Bio Nanotechnology, Elisabeth S.Pappazoglou, Aravind Parthasarathy*
- *Biomedical Nanostructures, Kenneth E.Goonsalves, Craig R.Halberstadt, Cate T. Laurecin, Lakshmi S.Nair*

PG4AMBC19**- PRACTICAL VII**

Credit-3

- Techniques for collection of clinical specimens for microbiological analysis.
- Packaging and transport of specimens.
- Microbiological examination of clinical specimens, isolation and characterization of bacteria from clinical specimens, virulence and toxigenicity tests.
- Antimicrobial sensitivity testing for clinical isolates.
- Water quality analysis- chemical and microbial analysis

  BOD,
  COD,
  Dissolvged oxygen
  Ions estimation, (Cl^-, $Ca2^+$, etc)

- Lethal effect of temperature on microorganisms (TDP,TDT)
- Serological tests - ASO, RPR
- Isolation of PSM, Rhizobium, and Bejerinkia from soil
- Mini production of Pseudomonas biopesticides.
- Enumeration of soil microorganisam and calculation of rhizhosphere to non rhizhosphere ratio