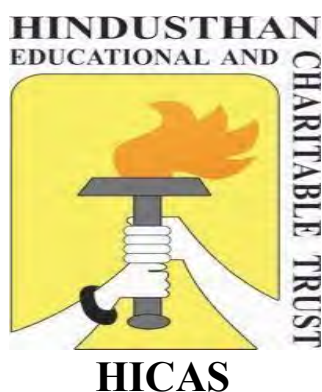


**LEARNING OUTCOMES–BASED CURRICULUM
FRAMEWORK (LOCF)**

in the

UNDERGRADUATE PROGRAMME MICROBIOLOGY

**FOR THE STUDENTS ADMITTED FROM THE
ACADEMIC YEAR 2022 - 2023 AND ONWARDS**



HINDUSTHAN COLLEGE OF ARTS & SCIENCE (AUTONOMOUS)
(Affiliated to Bharathiar University and Accredited by NAAC)

**COIMBATORE-641028
TAMILNADU, INDIA.**

Phone: 0422-4440555

Website: www.hindusthan.net/hicas/

PREAMBLE

Microbiology is the study of microorganisms or microbes such as bacteria, viruses, fungi, algae, cyanobacteria, protozoa and prions. They are extremely important as their diverse activities range from causation of deadly diseases in humans, animals and plants to production of highly useful products like antibiotics, enzymes, alcohol, fermented foods and recycling of dead and decaying organic matter in the nature. Thus the science of Microbiology has an important role to play in health, agriculture, environment and industry. Several discoveries in the last two to three decades, which significantly impact these areas, have put Microbiology on the centre stage of teaching, research and development all over the globe.

VISION

To become a centre of academic excellence with highly qualified, knowledgeable, competent Microbiologists

To empower students as responsible citizens who can work for the progress of the society

MISSION

To incorporate outcome based curriculum by practicing innovative teaching methodologies both in theory and practicals

Building self confidence, values and optimistic thinking among the students.

PROGRAMME EDUCATIONAL OBJECTIVES (PEO)

- **PEO 1:** To understand the impact of Microbiology in societal and environmental contexts
- **PEO 2:** To evaluate the need for sustainable development
- **PEO 3:** To select and apply appropriate techniques and skills required as competitive Microbiologist
- **PEO 4:** To make students knowledgeable about the basic concepts in a wide ranging context which involve the use of knowledge and skills of Microbiology
- **PEO 5:** To interpret the role of Microbiologists in the life science industries

PROGRAMME OUTCOMES (PO's)

- **PO1:** Acquire knowledge applicable to diverse areas in medical, industrial, environment, genetics, agriculture, food and others.
- **PO2:** Apply problem solving and analyzing skills during the laboratory work and critical thinking as related to Microbiology
- **PO3:** Develop ethical awareness which is mandatory for practicing a scientific discipline including ethics of working in a laboratory, environmental sustainability and ethics followed for scientific publishing of their research work in future.
- **PO4:** Compare the data of biological macromolecules and analyze tools and databases with an interdisciplinary approach.
- **PO5:** Develop communication skills in written as well as spoken language which are must for them to pursue higher studies in reputed universities and research institutions spread across the globe.
- **PO6:** Develop a broader perspective in Microbiology to enable him/her to identify challenging societal problems and recognize the need for life-long learning in the broadest context of technological change.
- **PO7:** Analyse problems involving microbes, articulate these with peers/ team members/ other stake holders, and undertake remedial measures/ research projects etc.

PROGRAMME SPECIFIC OUTCOME (PSO)

PSO1: Acquire and apply knowledge relevant to Microbiology.

PSO2: Discover research ethics (public policy, biosafety, and intellectual property rights) involving microorganisms to contribute knowledge in the field of Microbiology.

PSO3: Explain their work through written, oral, and visual presentations, including an original research proposal

PSO4: Identify careers in the industry, agriculture, and applied research where biological system is employed

PSO5: Interpret the required attributes of knowledge, skills and temperament related to the subject of Microbiology

HINDUSTHAN COLLEGE OF ARTS & SCIENCE (AUTONOMOUS), COIMBATORE-641028

SCHEME OF EXAMINATIONS - CBCS & LOCF PATTERN

(For the Students admitted from the Academic year 2022-2023 and Onwards)

UG PROGRAMME

Programme: B.Sc

Branch: MICROBIOLOGY

Part	Course Code	Course Type	Course Title	Credit points	Lecture Hours/Week		Exam Duration (hours)	MAX. MARKS		
					Theory	Practical		I.E.	E.E	Total
Semester - I										
I	22LAT01/ 22LAH01/ 22LAM01/ 22LAF01	MIL	Tamil-I/ Hindi-I/ Malayalam - I/ French-I	4	6	-	3	50	50	100
II	22ENG01	AECC	English - I	4	6	-	3	50	50	100
III	22MBU01	DSC	Core I - Basic concepts of Microbiology	5	5	-	3	50	50	100
III	22MBU02	DSC	Core II - Practical I - Basic concepts of Microbiology	3	-	5	6	50	50	100
III	22MBU03	GE	Allied I: Chemistry	4	4	-	3	50	50	100
III	22MBU04	GE	Allied II: Practical II - Chemistry	2	-	3	3	50	50	100
IV	22MBUE01	AEE	Open Elective - I	2	3	-	3	100	-	100
IV	22GSU01	AECC	Environmental Studies	1	2	-	2	50	-	50
IV	22MBUV01	SEC	VAC-I/Life Skills-I @ / Communicative English	1*	2	-	2	50*	-	50**
IV	-	SEC	SDR- Student Development Report	Assessment will be in the Fifth Semester						
V	-	AECC	Extension Activities NSS/NCC/SPORTS/YRC/SIS/SA	Assessment will be in the Fourth Semester						
Total				25	28	8		450	300	750
Semester - II										
I	22LAT02/ 22LAH02/ 22LAM02/ 22LAF02	MIL	Tamil-II/ Hindi-II/ Malayalam- II/French-II	4	6	-	3	50	50	100
II	22ENG02	AECC	English - II	4	6	-	3	50	50	100
III	22MBU05	DSC	Core - III - Biomolecules	2	3	-	3	50	50	100
III	22MBU06	DSC	Core - IV - Practical III / Biomolecules	2	-	2	3	50	50	100
III	22MBU07	DSC	Core - V - Microbial Physiology and Metabolism	4	4	-	3	50	50	100
III	22MBU08	DSC	Core - VI - Practical IV / Microbial Physiology and Metabolism	3	-	5	9	50	50	100
III	22MBU09	GE	Allied III: Biochemistry	3	3	-	3	50	50	100
III	22MBU10	GE	Allied IV: Practical V - Biochemistry	2	-	3	3	50	50	100

III	22MBU11	SEC	Internship / Industrial Visit / Mini Project	1	-	-	-	100	-	100
IV	22MBUV02	SEC	VAC-II/Life Skills-II @ / Language	1*	2	-	2	50*	-	50**
IV	22MBUJ01	SEC	Aptitude / Placement Training	Grade*	2	-	2	50*	-	50**
Total				25	26	10		500	400	900
Semester - III										
III	22MBU12	DSC	Core - VII - Microbial Taxonomy and Diversity	5	5	-	3	50	50	100
III	22MBU13	DSC	Core - VIII – Practical - VI Microbial Taxonomy and Diversity	2	-	4	3	50	50	100
III	22MBU14	DSE	Elective I /DSE I	4	4	-	3	50	50	100
III	22MBU15	DSE	Elective II/DSE II – Practical VII	3	-	5	9	50	50	100
III	22MBU16	GE	Allied V- Basic Computers and Bioinformatics	5	5	-	3	50	50	100
III	22MBU17	GE	Allied VI: Practical-VIII- Basic Computers and Bioinformatics	3	-	5	3	50	50	100
IV	22MBUE02	AEE	Open Elective-II	2	3	-	3	100	-	100
IV	22GSU02	AECC	Human Rights	1	2	-	2	50	-	50
IV	22MBUJ02	SEC	Aptitude / Placement Training	Grade*	2	-	2	50*	-	50**
IV	22MBUJ03	SEC	Online Course	-	1	-	-	-	-	C/NC [‡]
Total				25	22	14		450	300	750
Semester - IV										
III	22MBU18	DSC	Core - IX - Medical Microbiology	5	5	-	3	50	50	100
III	22MBU19	DSC	Core - X - Immunology	5	5	-	3	50	50	100
III	22MBU20	DSC	Core - XI - Practical IX Medical Microbiology	3	-	5	9	50	50	100
III	22MBU21	DSC	Core - XII - Practical-X – Immunology	2	-	4	9	50	50	100
III	22MBU22	DSC	Core - XIII - Advanced Microbiology	4	4	-	3	50	50	100
III	22MBU23	GE	Allied VII: Biophysics, Biomathematics & Biostatistics	3	3	-	3	50	50	100
III	22MBU24	GE	Allied VIII: Practical XI: Biophysics, Biomathematics & Biostatistics	2	-	3	3	50	50	100
III	22MBU25	SEC	Internship / Institutional Training / Mini-Project	1	-	-	-	100	-	100
IV	22MBUV03	ACC	VAC-III	1*	2	-	2	50*	-	50**
IV	22MBUJ04	SEC	Aptitude / Placement Training	Grade*	2	-	2	50*		50**

IV	22MBUJ05	SEC	Online Course	-	1	-	-	-	-	C/NC ⁺
IV	22GSU03	AECC	Internet Security	1	2	-	2	50	-	50
V	22GSU04	AECC	Extension Activities NSS/NCC/SPORTS/YRC/SIS/SA#	2	-	-	-	-	-	C/NC ⁺
Total				28	24	12		500	350	850
Semester – V										
III	22MBU26	DSC	Core - XIV - Virology and Nanotechnology	4	4	-	3	50	50	100
III	22MBU27	DSC	Core - XV - Environmental and Agricultural Microbiology	4	4	-	3	50	50	100
III	22MBU28	DSC	Core - XVI – Genetic Engineering	4	4	-	9	50	50	100
III	22MBU29	DSC	Core - XVII - Practical XII Virology and Nanotechnology	3	-	5	9	50	50	100
III	22MBU30	DSC	Core – XVIII - Practical – XIII Environmental and Agricultural Microbiology	3	-	5	9	50	50	100
III	22MBU31	DSC	Core – XIX - Practical - XIV Genetic Engineering	3	-	5	9	50	50	100
IV	22MBUE03	AEE	Open Elective-III	2	3		3	100	-	100
IV	22GSU05	AECC	General Awareness	1	1		2	50	-	50
IV	22GSU06	AECC	Law of Ethics	1	-		2	50	-	50
IV	22MBUV04	ACC	VAC-IV	1*	2		2	50*	-	50**
IV	22MBUJ06	SEC	Aptitude / Placement Training	Grade*	2		2	50*	-	50**
IV	22MBUJ07	SEC	Online Course	-	1		-	-	-	C/NC ⁺
IV	22MBUJ08	SEC	SDR- Student Development Report	2*	-	-	-	-	-	-
Total				25	21	15		500	300	800
Semester – VI										
III	22MBU32	DSE	Elective III/DSE III	3	5	-	3	50	50	100
III	22MBU33	DSE	Elective IV/DSE IV	3	5	-	3	50	50	100
III	22MBU34	DSC	Core - XX - Self-Study Course	3	-	-	3	50	50	100
III	22MBU35	SEC	Project Work /StudentResearch / Paper	4	-	26	-	50	50	100
Total				13	10	26		200	200	400
Grand Total				141+6				2600	1850	4450 + 400**

UG - Scheme of Evaluation (Internal & External Components)

(For the students admitted during the academic year 2022-2023 and onwards)

1. Internal Marks for all UG

Components	Marks
Test I	10
Test II	10
Model Exam	10
Assignment	5
Attendance*	5
Internal Assessment components **	10
TOTAL	50

*Split-up of Attendance Marks

- * 75-79 - 1 marks
- * 80-84 - 2 marks
- * 85-89 - 3 marks
- * 90-94 - 4 marks
- * 95-100 - 5 marks

** List of components for Internal Assessment (MCQ Compulsory)

S.No	Components
1	Multiple choice questions
2	Club activities
3	Assignment
4	Seminar

(Any two components from the above list with five marks each will be calculated
.2x5=10 marks)

2. a) Components for Practical I.E.

b) Components for Practical E.E.

Components	Marks
Test -I	15
Test - II	15
Observation	10
Application*	10
Total	50

Components	Marks
Experiments/Exercise	40
Record	5
Viva	5
Total	50

3. Institutional/ Industrial Training, Mini Project and Major Project Work

Institutional /Industrial Training (I.E)		Mini Project (I.E)	Major Project Work		
Component	Marks	Marks	Component	Marks	Total Marks
Work diary	25	-	I.E: a)Attendance	20	
Report	50	50	b)Review/Work diary*	30	50
Viva-voce	25	50			
Total	100	100	E.E** a) Evaluation	30	
			b)Viva-voce	20	50
			Total		100

*Review is for Individual Project and Work Diary is for Group Projects
(group consisting of minimum 3 and maximum 5)

**Evaluation of report and conduct of viva voce will be done jointly by Internal and External Examiners

4. Guidelines for Internet Security/Human Rights/ Law of Ethics/ Environmental Studies (Part IV)

Components	Marks
Two Tests (each 2 hours) of 20 marks each [4 out of 7 descriptive type questions $4 \times 5 = 20$ Marks]	40
Two assignments (2 x 5)	10
Total	50

5. Guidelines for General Awareness (Part IV)

Components	Marks
Two Tests (each 2 hours) of 25 marks each [50 objective type questions $50 \times 1/2 = 25$ Marks]	50

6. Guidelines for open Elective (Part IV)

Components	Marks
Two Tests (each 2 hours) of 50 marks each [5 out of 8 descriptive type questions $5 \times 10 = 50$ Marks]	100

7. Value Added Courses and Aptitude/Placement courses:

Components	Marks
Two Test (each 1 hour) of 25 marks each QP is objective pattern ($25 \times 1 = 25$)	50
Total	50

Guidelines:

1. The passing minimum for these items should be 40%
2. If the candidate fails to secure 40% passing minimum, he / she may have to reappear for the same in the subsequent Semesters
3. Item No's:4,5,6 and 7 are to be treated as 100% Internal papers.
4. For item No.7, Tests conducted through online modules (Google Form/any other)
5. Item No.2: * - Application should be from the relevant practical subject other than the Listed programmes. It must be enclosed in the practical record.

UG PATTERN
QUESTION PAPER PATTERN FOR CIA I and CIA II EXAM

Reg.No:----- Q.P.CODE:

HINDUSTHAN COLLEGE OF ARTS & SCIENCE (AUTONOMOUS)

----- **DEGREE CIA-I/CIA-II EXAMINATIONS** -----20---

(----- SEMESTER)

BRANCH: -----

SUBJECT NAME: -----

Time: Two Hours

Maximum:50 Marks

SECTION - A (6 x 1 = 6 Marks)

Answer ALL Questions

ALL Questions Carry EQUAL Marks

(Q.No: 1 to 6: Multiple choice/Fill up the blanks /True or False questions)

SECTION - B (4x 6 = 24 marks)

Answer ALL Questions

ALL Questions Carry EQUAL Marks

(Q.No: 7 to 10 Either Or type)

SECTION - C (2x10 = 20 marks)

Answer any TWO Questions out of THREE Questions

ALL Questions Carry EQUAL Marks

(Q.No: 11 to 13)

QUESTION PAPER PATTERN FOR MODEL/END SEMESTER EXAMINATION

Reg.No:-----

Q.P.CODE:

HINDUSTHAN COLLEGE OF ARTS & SCIENCE (AUTONOMOUS)

----- **DEGREE MODEL EXAMINATIONS** -----20-----

(-----SEMESTER)

BRANCH : -----

SUBJECT NAME:-----

Duration: Three Hours

Maximum: 70 Marks

SECTION - A (10x1=10 Marks)

Answer ALL Questions

ALL Questions Carry EQUAL Marks

(Q.No 1 to 10 Multiple choice/Fill up the blanks /True or False questions)

(Two questions from each unit)

SECTION - B (5x6=30 Marks)

Answer ALL Questions

ALL Questions Carry EQUAL Marks

(Q.No 11 to 15 Either or type)

(One question from each Unit)

SECTION- C (3x10=30 Marks)

Answer any THREE Questions out of FIVE Questions

ALL Questions carry EQUAL Marks

(Q.No 16 to 20) (One question from each Unit)

Blue Print of Question Paper for all UG Programmes

(For the academic year 2021-22, 2022-23)

Max. Marks: 50

FOR CIA I CIA II - QUESTION PATTERN

Sec	Question No	Type	No of Question	Questions to be answered	Mark per question	K-level
A	1 to 6	MCQ/ True or False/ Fill up	6	6	1 (6x1=6)	All Questions will be K1
B	7 to 10	Either or Type (a or b)	8	4	6 (4x6=24)	4 Questions will be in K2 4 Questions will be in K3
C	11 to 13	Open choice	3	2	10 (2x10=20)	1 Question will be in K3 2 Question will be in K4

FOR MODEL/ESE - QUESTION PATTERN

Max. Marks:70

Sec	Question No	Type	No of Question	Questions to be answered	Mark per question	K-level
A	1 to 10	MCQ/ True or False/ Fill up	10	10	1 (10x1=10)	All Questions will be K1
B	11 to 15	Either or Type (a or b)	10	5	6 (5x6=30)	6 Questions will be in K2 4 Questions will be in K3
C	16 to 20	Open choice	5	3	10 (3x10=30)	2 Question will be in K3 3 Question will be in K4

(For the academic year 2020-21)

FOR CIA I CIA II - QUESTION PATTERN

Max. Marks:50

Sec	Question No	Type	No of Question	Questions to be answered	Mark per question	K-level
A	1 to 6	MCQ/ True or False/ Fill up	6	6	1 (6x1=6)	All Questions will be K1
B	7 to 10	Either or Type (a or b)	8	4	5 (4x5=20)	4 Questions will be in K2 4 Questions will be in K3
C	11 to 13	Either or Type (a or b)	6	3	8 (3x8=24)	3 Question will be in K3 3 Question will be in K4

FOR MODEL/ESE - QUESTION PATTERN

Max. Marks:70

Sec	Question No	Type	No of Question	Questions to be answered	Mark per question	K-level
A	1 to 10	MCQ/ True or False/ Fill up	10	10	1 (10x1=10)	All Questions will be K1
B	11 to 15	Either or Type (a or b)	10	5	4 (5x4=20)	6 Questions will be in K2 4 Questions will be in K3
C	16 to 20	Either or Type (a or b)	10	5	8 (5x8=40)	5 Question will be in K3 5 Question will be in K4

Blue Print of Question Paper

Distribution of section-wise marks with K levels for UG 2021-22, 2022-23

CIA							
Sec.	K1	K2	K3	K4	Total questions	Questions to be answered	Total marks
A - MCQ/T or F / Fill up	6				6	6	6x1=6
B - Either or type		4	4		8	4	4x6=24
C - Open choice			1	2	3	2	2x10=20
Total Marks	6	24	34	20			84
% of marks without choice	7.14	28.57	40.48	23.81			100

Model Exam							
Sec.	K1	K2	K3	K4	Total questions	Questions to be answered	Total marks
A- MCQ/T or F/ Fill up	10				10	10	10x1=10
B - Either or type		6	4		10	5	5x6=30
C - Open choice			2	3	5	3	3x10=30
Total Marks	10	36	44	30			120
% of marks without choice	8.33	30	36.67	25			100

Distribution of section-wise marks with K levels for UG (2020-21)

CIA							
Sec.	K1	K2	K3	K4	Total questions	Questions to be answered	Total marks
A MCQ/T or F/ Fill up	6				6	6	6x1=6
B - Either or type		4	4		8	4	4x5=20
C - Either or type			3	3	6	3	3x8=24
Total Marks	6	20	54	24			104
% of marks without choice	5.77	19.23	51.92	23.08			100

Model Exam							
Sec.	K1	K2	K3	K4	Total questions	Questions to be answered	Total marks
A MCQ/True or False/ Fill up	10				10	10	10x1=10
B - Either or type		6	4		10	5	5x4=20
C - Either or type			5	5	10	5	5x8=40
Total Marks	10	24	56	40			130
% of marks without choice	7.69	18.46	43.08	30.77			100

UG Programme Regulations for the academic year 2022-2023

1. Internal marks components for the candidates admitted from the academic year 2022-2023 and onwards is as follows.

For Theory courses

Components	Marks
Test I	10
Test II	10
Model Exam	10
Assignment	5
Attendance	5
Internal Assessment components	10
TOTAL	50

For Practical courses

Components	Marks
Test -I	15
Test - II	15
Observation/Exercise	10
Application*	10
TOTAL	50

2. The pattern of the question paper for External Examination will be maximum of 70 marks for theory courses, the marks obtained will be converted into 50 as per the scheme.
3. Passing minimum for all UG programme is 40% in Internal and 40 % in External and the composition of total 40 marks out of 100 marks.
4. Internship / Institutional Training / Mini-Project is related to the discipline. The students can be permitted to complete the Internship / Institutional Training / Mini-Project before the end of First year (end of II semester) and before the end of the second year (end of IV semester) and submit a report.

Internship / Institutional Training	Duration: Not more than seven days
Mini project	During the course of study for not more than seven days.

5. Project work is considered as a special course involving application of knowledge in problem solving/analyzing/exploring a real-life situation. A Project work may be given in lieu of a discipline specific elective paper. Distribution of marks for major project for all UG programme will be 50:50 pattern for both Internal and External in total of 100/200 marks.
6. Two tests for fully internal subjects should be conducted during CIA-I and CIA -II by the department.
7. Retest for the failure candidates in CIA I or CIA II or Part IV or Part V or Extra credit courses should be conducted during the model examination after getting approval from the COE office. The candidates who are not able to complete the minimum pass mark in internal components even getting chance of reappearance, will be treated as arrear candidates.
8. For the Theory cum Practical blended courses, 50:50 Internal and External pattern will be followed for theory examination and Fully internal pattern will be followed for Practical examination. For theory part, External examination will be conducted as regular pattern (max of 70 marks) and it will be converted into 25 marks.

Course	Internal Marks		External marks		Total marks (Max. marks 50)	
	Min.	Max.	Min.	Max.	Min.	Max.
Theory	10	25	10	25	20	50
Practical	20	50	-		20	50

For Practical components for Theory cum Practical courses (Fully Internal)

Components	Marks
Test I	10
Test II	10
Experiment/Excercise	20
Record	5
Viva	5
Total	50

The Internal mark 50 will be converted into 25.

9. For the candidates admitted under the Fast Track System (FTS) must register their names to their concerned department heads and get approval from the COE office at the beginning of the III semester.
10. Students who are not willing to select the Project/Research work in Semester VI, can chose the theory papers offered by their departments as per the prescribed theory pattern.
11. Self Study will be a Core Paper of the department for which the examination pattern will be as like part III courses is followed.
12. NSS / NCC/Sports/YRC / SIS / SA is mandatory for all students as per New Education Policy and the students must attend the allocated hours within two years and complete the programme. They will be evaluated during the end of second year (Fourth Semester) and also a certificate will be issued.
- 13.SDR – Student Development Report to be received by the department from the students till end of the fifth semester. (Evidences of Curricular activities and Co-curricular activities)
- 14.For online courses minimum of 2 certificates in any of the online platform is mandatory.
- 15.Open elective courses:
Departments can offer list of subjects which teaches moral ethics to the young community for the better future. The topics relevant to Indian ethics, Culture, Women rights, Yoga, Green farming, Indian constitution etc., as an open elective courses. These courses can be offered by the department or other department as inter department courses. Marks earned for this courses will not be included for CGPA calculations.

Extension Activities

NSS – National Service Scheme, as enrolled member with the College Unit.

NCC – National Credit Corps, as enrolled member with the College Unit.

SPORTS – Sports & Games Participation with College Team

YRC/RRC–Youth Red Cross / Red Ribbon Club, as enrolled member with the College Unit.

Rotaract Club - Rotaract Club, as enrolled member with the College Unit.

SIS – Special Interest Subjects, as approved by the Academic Council

SA – Social Activity for not less than 50 hours with NGGO like Aram Foundation / Shanthi Social Service /Siruthuli /Kulungal Pathukappu Amaipu /Old age Home / Nature Foundation / etc.

Regulations of Fast Track System (FTS)

- From the academic year 2021-22, our college is offering Fast Track System (FTS) for all UG and PG programmes. In this system, we are offering two courses under the course type of Discipline Specific Elective (DSE) in the sixth semester for all UG programmes and fourth semester for all PG programmes, which are equivalent and related with National Programme on Technology Enhanced Learning/Study Webs of Active-Learning for Young Aspiring Minds (NPTEL/SWAYAM) courses.
- The students have the option of taking two subjects of the sixth semester of their programme through NPTEL/SWAYAM portal from the list given by NPTEL and can complete the online course before fifth semester and submit the received original certificates to the COE office for getting approval. If the student completes these courses before the beginning of the sixth semester (UG)/fourth semester (PG), the candidate can be considered and exempted to write the examination from the assigned DSE courses in the sixth semester/fourth semester. They should complete only the self study course and project work during the VI/IV semester as assigned in the scheme. The candidate who completes the online courses and submits the successful course completion credentials, the credit transfer will be considered as per our Scheme of Examination for qualifying the degree. The minimum duration of the registered online course must be 12 weeks. Course duration of less than 12 weeks will not be considered.
- For all PG programmes, the candidates who were admitted during the academic year 2021-2022 under the Fast track system, for the self study course, the internal mark component will be as follows. For others regular internal pattern follows.

TEST	Max. Marks	Mode
CIA I	50 (50x1=50)	Online objective type
Model Exam.	50 (50x1=50)	Online objective type

Out of these two tests, the total marks will be converted into 40 marks as Internal.

- For all UG programmes, the candidates who were admitted during the academic year 2021-2022 under the Fast track system, for the self study course, the internal mark component will be as follows. For others regular internal pattern follows.

TEST	Max. Marks	Mode
CIA I	50 (50x1=50)	Online objective type
CIA II	50 (50x1=50)	Online objective type
Model Exam.	50 (50x1=50)	Online objective type

Out of three tests, the total mark will be converted into 30 marks as Internal.

- For the students admitted in Fast Track System, must enroll their names to the concerned department heads and get approval from the COE office at the beginning of III semester for all UG Programmes and at the beginning of II semester for all PG programmes.
- The students who cleared and got certified for online courses under the fast track system, the grade obtained will be converted into average marks of range. The received certificates must be submitted to the COE office for approval of the Controller and the Principal. The FTS courses will be treated as fully external.

ABSTRACT FOR SCHEME OF EXAMINATION

(For the candidates admitted during the academic year 2022 - 2023 and onwards)

Part	Course	Papers	Credit	Total Credits	Marks	Total Marks
Part I	Languages/ (MIL)	2	4	8	100	200
Part II	English/AECC-I	2	4	8	100	200
Part III	Core /DSC	19	2/3/4/5	66	100	1900
	Self-Study Course / DSC	1	3	3	100	100
	Allied /GE	8	2/3/4/5	24	100	800
	Electives/DSE	4	3/4	13	100	400
	Project / SEC	1	4	4	100	100
	Internship/Institutional Training/Mini-Project	2	1	2	100	200
Part IV	Open Electives /AEE	3	2	6	100	300
	AECC –EVS/ HR/IS/GA/LE	5	1	5	50	250
	Value Added Course	2	1	2*	50	100**
	Aptitude / Placement Training / SEC	4	Grade*	Grade*	50	200**
	Online courses / SEC	3	-	-	-	C/NC
	Life Skills / SEC	2	1	2*	50	100**
	SDR- Student Development Report	1	2	2*	-	-
Part V	Extension Activities NSS / NCC/Sports/YRC / SIS / SA – AECC	2	2	2	-	C/NC
	Total			141 (6 Extra Credits)		4450 + (400**)

List of Open Elective Papers	
Open Electives	Yoga for Human Excellence Human Health & Hygiene Indian Culture and Heritage Indian Constitution and Political System Consumer Awareness and Protection Professional Ethics and Human Values Human Rights, Women's Rights & Gender Equality Disaster Management Green Farming Corporate Relations Start up a Business Research Methodology and IPR General Studies for Competitive Examinations IIT JAM Examination (for Science only) CUCET Examination
VAC Papers	<ol style="list-style-type: none"> 1. Human Microbiome 2. Public Health Microbiology 3. Mushroom Cultivation Technology 4. Biofertilizers and Biopesticides 5. Quality assurance and Control in Food & Pharmaceutical Industries 6. Forensic Microbiology 7. Intellectual Property Rights 8. Plant Pathology & Disease Management 9. Microbial Biotechnology 10. Communicable and Non-Communicable Diseases 11. Medical Informatics
Courses offered by the Departments to other Programmes	

ELECTIVES

List of Elective Papers/ DSE (Can choose any one of the paper as electives)			
	Course Code	Semester	Title
Electives/ DSE-I	22MBU14A	III	Microbial Genetics
	22MBU14B		Pharmaceutical Microbiology
	22MBU14C		Textile Microbiology
Electives/ DSE-II	22MBU15A	III	Practical VII - Microbial Genetics
	22MBU15B		Practical VII - Pharmaceutical Microbiology
	22MBU15C		Practical VII – Textile Microbiology
Electives/ DSE-III	22MBU32A	VI	Food Microbiology & Food safety
	22MBU32B		Entrepreneurship in Microbiology
	22MBU32C		Veterinary Microbiology
Electives/ DSE-IV	22MBU33A	VI	Industrial Microbiology
	22MBU33B		Cell and Molecular Biology
	22MBU33C		Microbial Enzyme Technology

ONLINE COURSES (Elective III/DSE III Elective IV/DSE IV / Fast track)

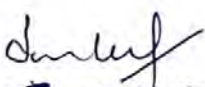
OLC 4: Food Microbiology and Food Safety

(SWAYAM)

OLC 5: Industrial Biotechnology (SWAYAM)


Syllabus Coordinator


Academic Council – Member Secretary


BOS-Chairman/Chairperson
Department of Microbiology
Hindusthan College of Arts & Science -
Coimbatore - 641 028


PRINCIPAL
Principal
Hindusthan College of Arts & Science (Autonomous),
Hindusthan Gardens, Behind Nava India,
Coimbatore - 641 028.

DEPARTMENT OF MICROBIOLOGY				CLASS: I B.Sc Microbiology				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours / Week	CIA	Ext	Total
I	DSC	22MBU01	Core I - Basic concepts of Microbiology	5	5	50	50	100

Nature of Course		
Knowledge and Skill Oriented	Employability Oriented	✓
	Entrepreneurship Oriented	✓
	Skill Development	✓

Course Objectives			
<ul style="list-style-type: none"> To discuss about the basics and fundamentals of Microbiology To illustrate the structure and function of bacteria To construct knowledge on microscopic techniques to observe the microorganisms To develop basic skills in aseptic techniques To impart knowledge on the methods to cultivate and preserve microorganisms 			
Unit	Course Contents	Hours	K Level
I	History and Scope of Microbiology Spontaneous generation theory and conflict - Contributions of Antony Von Leeuwenhoek - Joseph Lister - Louis Pasteur - Robert Koch - Edward Jenner- Elie Metchnikoff - Martinus Beijerinck - Alexander Fleming - Selman Abraham Waksman - John Tyndall – Sergei WinoGradsky - Scope of Microbiology - Microbiology Institutions in India.	12	Up to K4
II	Bacterial Cell structure and Function Shapes of Bacteria - Subcellular structures of microbes- slime layer - capsule, cell wall- Gram positive and Gram negative, cytoplasmic membrane – fimbriae - pili- flagella - storage granules- comparison of prokaryotic and eukaryotic organisms- sporulation and germination- cell division in bacteria - binary fission.	12	Up to K4
III	Microscopy and Staining Techniques Working principle and applications of light microscopes- Bright field, Dark field, Phase contrast, Fluorescence, confocal scanning microscope-Electron microscope- SEM and TEM- <i>in situ</i> Electron Microscopy. Staining methods- Simple and Differential (Gram and Acid fast), Negative, Capsule, Flagellar, Endospore and fungal staining – Wet mount and LPCB.	12	Up to K4
IV	Sterilization and Disinfection Principles, methods of sterilization: Physical methods: Dry heat (Hot air oven), Moist heat (Autoclave) – Sterilization control. Filtration (Membrane & HEPA) - Biosafety cabinets and Radiation (UV). Pasteurization – Tyndall effect - Chemical sterilization: Chemical agents and mode of action: Phenol Coefficient test–Fumigation.	12	Up to K4
V	Culture techniques, Maintenance and Preservation of cultures Media preparations: Solid and liquid- Types of media: Synthetic and semi synthetic enriched, enrichment, selective, differential. Anaerobic culture technique: Wright's tube, RCM method, Roll tube, McIntosh fields jar method. Pure culture technique: Serial dilution, pour, spread, streak plate methods. Culture preservation – Agar slant culture - Mineral oil method – Saline suspension – preservation by drying in vacuum – Lyophilization - Culture collection centers.	12	Up to K4

Note: The Questions should be asked in the ratio of 100% theory

Book for Study

Prescott, Harely.P and Klein.A., "Microbiology", McGraw Hill Publishers, New Delhi.2017

Books for Reference

1. R.C Dubey., "Textbook of Microbiology", S. Chand and Company Ltd, New Delhi. 2013
2. Geeta Sumbali and Mehrotra R.S., "Principles of Microbiology", Tata McGraw Hill Publishers.New Delhi.2009.
3. Gerard J. Tortora and Berdell R. Funke Christine L. Case., "Microbiology, An Introduction", Calif Benjamin/Cummings Pub. Co., SanFrancisco.2015
4. Jacquelyn G. Black, Laura J. Black., "Microbiology: Principles and Explorations", Wileys Publishers, New Jersey.2012
5. Michael Joseph Pelczar, Roger Delbert Reid., "Microbiology", Krishna Prakashan Media, 2003

Web Resources

<<https://open.oregonstate.education/generalmicrobiology/>>

<https://open.oregonstate.education/generalmicrobiology/chapter/bacteria-cell-walls/>

Pedagogy : Chalk & Talk, Exercise, Assignments & ppts.

Rationale for Nature of the Course:

- This course provides a strong foundation on the basic concepts of Microbiology.

Activities to be given

- To compile a book on the "Contribution of Scientists in Microbiology" (One student – one scientist)

Course Learning Outcomes

CLOs	On Completion of the Course, the students should be able to	K - Level
CLO1	Summarize the fundamental concepts of Microbiology and analyze the contributions of scientists	Upto K4
CLO2	Explain the structure and function of bacterial cell.	Upto K4
CLO3	Apply microscopic techniques to observe and categorize microorganisms	Upto K4
CLO4	Compare the core principles of sterilization and the different methods of sterilization.	Upto K4
CLO5	Discover the pure culture techniques and Illustrate preservation of cultures	Upto K4

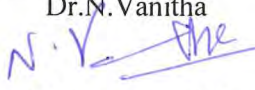
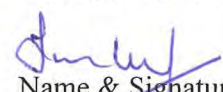
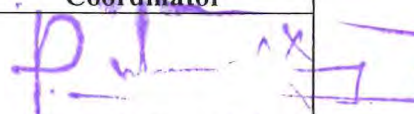
Mapping of Course Learning Outcomes (CLOs) with Programme Outcomes (POs)

CLOs	Programme Outcomes						
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CLO 1	1	2	3	2	3	3	2
CLO 2	2	2	1	3	2	2	3
CLO 3	2	1	2	3	3	3	2
CLO 4	2	2	1	3	2	3	3
CLO 5	3	3	2	3	3	3	2

3 – Advance Application

2 – Intermediate Level

1 – Basic Level

Course Designed by	Verified by HOD	Approved by CDC Coordinator
Dr.N.Vanitha  Name & Signature of the Staff	Dr.Lali Growther  Name & Signature	 Name & Signature

HEAD

Department of Microbiology
Hindusthan College of Arts & Science
Coimbatore - 641 028

Co-ordinator
Curriculum Development Cell
Hindusthan College of Arts & Science,
Coimbatore-641 028.

DEPARTMENT OF MICROBIOLOGY				CLASS: I B.Sc Microbiology				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours / Week	CIA	Ext	Total
I	DSC	22MBU02	Core II - Practical I – Basic Concepts of Microbiology	3	5	50	50	100

Nature of Course		
Knowledge and Skill Oriented	Employability Oriented	✓
	Entrepreneurship Oriented	✓
	Skill Development	✓

Course Objectives			
<ol style="list-style-type: none"> To learn the bio-safety and good laboratory practices To illustrate the structure and function of bacteria To construct knowledge on microscopic techniques to observe the microorganisms To develop basic skills in aseptic techniques and to impart knowledge on sterilization methods To cultivate and preserve microorganisms 			
S.No.	Course Contents	Hours	K Level
1.	Microbiology – Good laboratory practices & Biosafety.	4	Up to K4
2.	Cleaning of Glassware.	4	Up to K4
3.	Operation and maintenance of Microscope.	4	Up to K4
4.	Culture media preparation and colony characteristics in agar medium.	4	Up to K4
5.	Growth pattern in liquid media	4	Up to K4
6.	Selective and differential media: a) EMB agar b) Mannitol salt agar d) Mac conkey agar e) SS agar	4	Up to K4
7.	Pure culture techniques – Serial dilution, Pour plate, Spread plate and Streak Plate methods	4	Up to K4
8.	Demonstration of the presence of microflora in the environment by exposing nutrient agar plates in the air	4	Up to K4
9.	Enumeration of bacteria, fungi and actinomycetes from soil.	4	Up to K4
10.	Determination of Motility – Hanging drop method, agar deep and swarming motility assay.	4	Up to K4
11.	Staining Methods a. Simple staining b. Gram staining c. Negative staining d. Acid fast staining(demo) e. Endospore staining f. Fungal wet mount –KOH g. Fungal staining – Lacto Phenol Cotton Blue	4	Up to K4
12.	Micrometry- Determination of size of bacteria.	4	Up to K4
13.	Cultivation of anaerobes- Wright's tube method, Mc'Intosh fildes Jar, RCM	3	Up to K4
14.	Assessment of sterility of Hot air oven and Autoclave	3	Up to K4
15.	Bacterial culture preservation techniques – Paraffin method (Mineral oil),	3	Up to K4

	Saline suspension method and silica gel.		
16.	Permanent slide preparation	3	Up to K4

Note: The Questions should be asked in the ratio of 100% practical

Book for Study

N. Murugalatha, Lali Growther, J. Vimalin Hena, N. Hema Shenpagam, R. Anitha, D. Kanchana Devi, G. Rajalakshmi, "Microbiological Techniques", 2013, MJP Publisher.

Books for Reference

1. James G. Cappuccino, Natalie Sherman, "Microbiology: A Laboratory Manual", 2014: Pearson.
2. R. Saravanan, D. Dhachinamoorthi, CH. MM. Prasada Rao, A "Handbook of Practical Microbiology" Paperback, S Chand & Company, 2019.
3. Emanuel Goldman (Editor), Lorrence H Green., "Practical Handbook of Microbiology" 3rd Edition, Kindle Edition. CRC Press; 3rd edition, 2015.
4. D. Roy Cullimore, "Practical Atlas for Bacterial Identification", 2nd Edition, Kindle Edition, 2010.
5. Alberts, B, "Essential cell biology". 3rd ed. New York: Garland Science, 2009.

Web Resources

<https://www.ronaldschulte.nl/files/Laboratory_manual_in_general_microbiology.pdf>
<https://microbiologyonline.org/file/7926d7789d8a2f7b2075109f68c3175e.pdf>

Pedagogy : Chalk & Talk, Exercise, Assignments & ppts.

Rationale for Nature of the Course

- Hands-on training makes easier to understand and correlate theoretical concepts

Activities to be given

- To prepare permanent slides

Course Learning Outcomes

CLOs	On Completion of the Course, the students should be able to	K - Level
CLO1	Practice handling of glasswares and experiment with equipments	Upto K4
CLO2	Identify, test and interpret the microbial growth in different media	Upto K4
CLO3	Experiment with various staining techniques, micrometry and hanging drop method	Upto K4
CLO4	Interpret the pure culture techniques and differentiate cultures in media	Upto K4
CLO5	Apply and analyze anaerobic cultivation methods	Upto K4

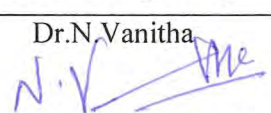
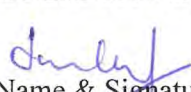
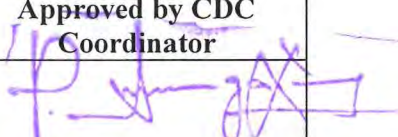
Mapping of Course Learning Outcomes (CLOs) with Programme Outcomes (POs)

CLOs	Programme Outcomes						
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CLO 1	1	2	3	1	3	3	2
CLO 2	2	2	1	3	3	2	3
CLO 3	2	1	2	3	3	3	2
CLO 4	2	2	1	3	3	3	3
CLO 5	3	3	2	3	3	3	2

3 – Advance Application

2 – Intermediate Level

1 – Basic Level

Course Designed by	Verified by HOD	Approved by CDC Coordinator
Dr.N.Vanitha  Name & Signature of the Staff	Dr.Lali Growther  Name & Signature	 Name & Signature

HEAD
Department of Microbiology
Hindusthan College of Arts & Science
Coimbatore - 641 024

Co-ordinator
Curriculum Development Cell
Hindusthan College of Arts & Science,
Coimbatore-641 028.

DEPARTMENT OF MICROBIOLOGY				CLASS: I B.Sc MICROBIOLOGY				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours / Week	CIA	Ext	Total
I	GE	22MBU03	Allied-I: Chemistry	4	4	50	50	100

Nature of Course		
Knowledge and Skill Oriented	Employability Oriented	✓
	Entrepreneurship Oriented	✓
	Skill Development	✓

Course Objectives			
<ul style="list-style-type: none"> To learn about atomic structure and bonding. To know the basic industrial application of chemical compounds. To understand the core concepts of organic chemistry i.e. resonance, inductive effect, hyperconjugation, etc. and their application. To acquire knowledge on the concepts of conductance. To write a general form of the rate law for any chemical reaction and define the order of a chemical reaction. 			
Unit	Course Contents	Hours	K Level
I	Chemical Bonding Molecular orbital theory - bonding, antibonding and non-bonding orbitals. MO configuration of H ₂ , N ₂ , O ₂ , F ₂ . Bond order. Diamagnetism and paramagnetism. Preparation, properties, structure and uses of Borane, NaBH ₄ and Borazole.	09	Up to K4
II	Industrial Chemistry Synthesis, properties and uses of silicones. Fuel gases: natural gas, water gas, semi water gas, carburetted water gas, producer gas, oil gas (manufacturing details not required). Dye Chemistry Terms: Chromophore, auxochrome, bathochromic shift, hypsochromic shift, hyperchromic effect, hypsochromic effect- Dyes: azo (Methyl Orange) and triphenylmethane (Malachite green) dyes- Preparation and uses.	09	Up to K4
III	Covalent bonds Orbital overlap, hybridization, geometry of organic molecules- CH ₄ , C ₂ H ₄ , and C ₂ H ₂ . Effects in properties of compounds - Inductive effect, electromeric, mesomeric, hyperconjugative and steric effect. Stereoisomerism: Conditions of optical activity - Optical isomerism of tartaric acid, Racemisation - Resolution of racemates, Geometrical isomerism of maleic and fumaric acids.	10	Up to K4
IV	Conductance Types (definition only) - Ostwald dilution law - Kohlraush's law-Applications. Conductometric titrations. pH and its calculations- Buffers in living systems- Action of buffer solutions- Henderson Hasselbalch equation	10	Up to K4
V	Solutions and Chemical Kinetics Types - Liquid in Liquid - Raoult's law - Deviation from ideal behavior (positive and negative deviation) - Fractional distillation. Kinetics- Rate, order, molecularity, pseudo first order, determination of order. Effect of temperature on the rate. Energy of activation.	10	Up to K4

Note: The Questions should be asked in the ratio of 100% theory

Book for Study

Dr. Veeraiyan. V, "Text book of Allied Chemistry", High mount publishing house, Chennai – 14, 2006.

Books for Reference

1. P.L.Soni, Sultan, "Inorganic Chemistry", Chand & Sons., 2013.
2. Malik, Wahid U., G.D. Tuli and R.D .Madan . "Selected Topics in Inorganic Chemistry", 7th ed., New Delhi S.Chand& Company Ltd., 2007
3. B.S. Bahl, Arun bahl, S. "Advanced Organic Chemistry", Chand&Co., 2005.
4. B.S. Bahl and G.D. Tuli.S, "Essentials of Physical Chemistry", Chand&Co., 2010.
5. P.L.Soni, D.B. Dharmarke, Sultan "Text book of Physical Chemistry", Chand & Sons., 2014.

Web Resources

<<https://www.emedicalprep.com/study-material/chemistry/chemical-bonding/molecular-orbital-theory/>>

<<http://eyrie.shef.ac.uk/eee/cpe630/comfun5.html>>

Pedagogy : Chalk & Talk, Exercise, Assignments & ppts.

Rationale for Nature of the Course:

- This course provides a strong foundation on the basic concepts of various discipline in chemistry.

Activities to be given

- Poster presentation

Course Learning Outcomes

CLOs	On Completion of the Course, the students should be able to	K - Level
CLO1	Correlate the chemical bonding structure	Upto K4
CLO2	Categorize and illustrate the geometric and isomeric properties of molecules	Upto K4
CLO3	Apply and analyze the laws of conductance and buffer solutions	Upto K4
CLO4	Categorize solutions chemically	Upto K4
CLO5	Analyze the rate and order of chemical reactions	Upto K4

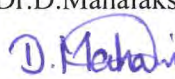
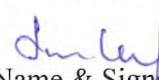
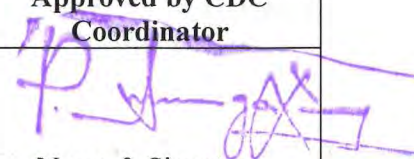
Mapping of Course Learning Outcomes (CLOs) with Programme Outcomes (POs)

CLOs	Programme Outcomes						
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CLO 1	1	2	3	1	3	3	2
CLO 2	2	2	1	3	3	3	3
CLO 3	2	1	2	3	3	2	2
CLO 4	2	2	1	3	3	3	3
CLO 5	3	3	2	3	2	3	3

3 – Advance Application

2 – Intermediate Level

1 – Basic Level

Course Designed by	Verified by HOD	Approved by CDC Coordinator
Dr.D.Mahalakshmi  Name & Signature of the Staff	Dr.Lali Growther  Name & Signature	 Name & Signature

25
HEAD
Department of Microbiology
Hindusthan College of Arts & Science
Coimbatore- 641 028

Co-ordinator
Curriculum Development Cell
Hindusthan College of Arts & Science,
Coimbatore-641 028.

DEPARTMENT OF MICROBIOLOGY				CLASS: I B.Sc MICROBIOLOGY				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours / Week	CIA	Ext	Total
I	GE	22MBU04	Allied II- Practical II - Chemistry	2	3	50	50	100

Nature of Course		
Knowledge and Skill Oriented	Employability Oriented	✓
	Entrepreneurship Oriented	✓
	Skill Development	✓

Course Objectives			
1. To develop the quantitative skills in volumetric analysis. 2. To estimate the quantity of chemical compounds through volumetric analysis. 3. To understand various procedures in organic compound analysis. 4. To know the elemental composition in organic compounds. 5. To distinguish between organic compounds.			
S.No.	Course Contents	Hours	K Level
1	Estimation of Sodium Hydroxide using standard Sodium Carbonate.	4	Up to K4
2	Estimation of Hydrochloric acid- standard Oxalic acid.	4	Up to K4
3	Estimation of Oxalic acid- standard Sulphuric acid.	4	Up to K4
4	Estimation of Ferrous Sulphate- standard Mohr salt solution.	4	Up to K4
5	Estimation of $KMnO_4$ - standard Ferrous Sulphate.	4	Up to K4
ORGANIC ANALYSIS			
6	1. Systematic analysis of organic substance i) Detection of Elements (N, S, Halogens). ii) To distinguish between aliphatic and Aromatic. iii) To distinguish between saturated and unsaturated. iv) Functional group tests for phenols, acids (mono and di), aromatic primary amine, amide, diamide, carbohydrate. v) Functional groups characterized by confirmatory test.	16	Up to K4

Note: The Questions should be asked in the ratio of 100% practical

Book for Study

- Vogel's "Text book of quantitative Chemical Analysis" Sixth edition-J Mendham, R C Denney, J D Barnes, M J K Thomas, 2009

Books for Reference

- Julio Atkins, Peter; De Paula "Physical Chemistry", 7th ed, 2002
- B. Viswanathan, P. S. Raghavan, "Practical Physical Chemistry", 2014
- B.K Sharma, "Instrumental Methods of Chemical Analysis" 1899
- Adamson, A., "Physical chemistry of surfaces". 6th ed. New York : Wiley-VCH Verlag 541.33 ADA, 1997
- Anastas, P., "Handbook of green chemistry": V.5 reactions in water: Green solvents/. Weinheim: Wiley-VCH, 2010.

Web Resources

- <http://www.brainkart.com/article/Estimation-of-sodium-hydroxide_38685/>
- <<https://ncert.nic.in/ncerts/l/lelm108.pdf>>

Pedagogy : Chalk & Talk, Exercise, Assignments & ppts.

Rationale for Nature of the Course:

- This course develops the quantitative analytical skills in volumetric and salt analysis.

Activities to be given

- To prepare standard solutions.

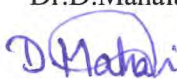
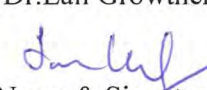
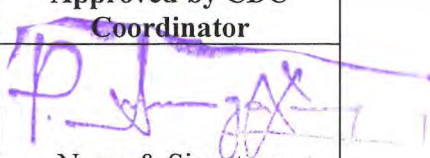
Course Learning Outcomes

CLOs	On Completion of the Course, the students should be able to	K - Level
CLO1	Estimate chemicals by volumetric method	Upto K4
CLO2	Infer the presence of elements	Upto K4
CLO3	Experiment with organic compounds	Upto K4
CLO4	Analyze the functional group tests	Upto K4
CLO5	Analyze and identify compounds using functional groups	Upto K4

Mapping of Course Learning Outcomes (CLOs) with Programme Outcomes (POs)

CLOs	Programme Outcomes						
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CLO 1	1	2	3	1	3	3	2
CLO 2	2	2	1	3	3	3	3
CLO 3	2	1	2	3	3	3	2
CLO 4	2	2	1	3	3	3	3
CLO 5	3	3	2	3	3	3	3

3 – Advance Application 2 – Intermediate Level 1 – Basic Level

Course Designed by	Verified by HOD	Approved by CDC Coordinator
Dr.D.Mahalakshmi  Name & Signature of the Staff	Dr.Lali Growther  Name & Signature	 Name & Signature

HEAD
Department of Microbiology
Hindusthan College of Arts & Science
Coimbatore- 641 028

Co-ordinator
Curriculum Development Cell
Hindusthan College of Arts & Science,
Coimbatore-641 028.

DEPARTMENT OF MICROBIOLOGY				CLASS: I B.Sc MICROBIOLOGY				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours / Week	CIA	Ext	Total
II	DSC	22MBU05	Core - III- Biomolecules	2	3	50	50	100

Nature of Course		
Knowledge and Skill Oriented	Employability Oriented	✓
	Entrepreneurship Oriented	✓
	Skill Development	✓

Course Objectives			
<ul style="list-style-type: none"> To impart knowledge on the molecular basis of life To understand the structure, properties and classification of carbohydrate To give strong foundation on the influence and role of structure in reactivity of biomolecules To understand the biochemical role and significance of macromolecules To explain the mechanism of enzyme catalysis and their commercial applications 			
Unit	Course Contents	Hours	K Level
I	Carbohydrates Carbohydrates: Definition, classification, structure, properties, Chemistry and functions. Monosaccharides – Disaccharides – Oligosaccharides – Polysaccharides.	07	Up to K4
II	Proteins Structure, properties and Classification of amino acids – Chemical reaction of amino acids due to carbonyl and amino groups. Titration curve of amino acid and its significance. Peptides-Glutathione, Oxytocin and Vasopressin. Classification and function of proteins- structural level of organization.	07	Up to K4
III	Lipids Classification and properties of lipids. Types of fatty acids – Significance of lipoproteins, glycolipids and phospholipids. Biological significance of steroids and cholesterol. Lipid functions: cell signals, cofactors, prostaglandins.	08	Up to K4
IV	Nucleic acids Structure of Purines and Pyrimidines; Nucleotides and Nucleosides. DNA: double helix: A, B and Z forms; Denaturation and renaturation of DNA. RNA: types, unusual bases.	07	Up to K4
V	Enzymes Nomenclature of Enzymes - Classification of enzymes with examples, coenzymes and cofactors (structures not required) – Active site: Lock and key model- induced fit hypothesis. Factors affecting enzyme activity. Enzyme inhibitors. Clinical and industrial applications of enzymes.	07	Up to K4

Note: The Questions should be asked in the ratio of 100% theory

Book for Study

Deb A.C., "Fundamentals of biochemistry", New Central Book Agency, Calcutta.2001

Books for Reference

- Moat, A.G. and Foster, J.W., "Microbial Physiology", Springer, New York.2002
- AmbikaShanmugam., "Fundamentals of Biochemistry for Medical Students" WMC Brown Publishers, New Delhi.2016

- Sathyanarayana U., "Biochemistry", Books and Allied Pvt. Ltd., New Delhi.2017
- Lehninger A.L., and Nelson D.L., " Principles of Biochemistry", Cox- CBS Publishers, NewDelhi.2013
- Lubert Stryer., "Biochemistry", Freeman and Company, NewYork.2002

Web Resources

<<https://www.emedicalprep.com/study-material/chemistry/chemical-bonding/molecular-orbital-theory/>>
<https://www.nios.ac.in/media/documents/313courseE/L31.pdf>

Pedagogy : Chalk & Talk, Exercise, Assignments & ppts.

Rationale for Nature of the Course:

- This course provides a strong foundation on the structure, functions and biological significances of various biomolecules

Activities to be given

- Model presentation

Course Learning Outcomes

CLOs	On Completion of the Course, the students should be able to	K - Level
CLO1	Describe and deduce the structure and properties of biomolecules	Upto K4
CLO2	Categorize the structure and properties of carbohydrates	Upto K4
CLO3	Categorize the structure and properties of aminoacids and proteins	Upto K4
CLO4	Classify lipids and nucleic acids	Upto K4
CLO5	Compare the properties of enzyme and their applications	Upto K4

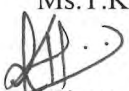
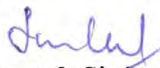

Mapping of Course Learning Outcomes (CLOs) with Programme Outcomes (POs)

CLOs	Programme Outcomes						
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CLO 1	2	2	3	1	3	2	2
CLO 2	2	2	1	3	3	3	3
CLO 3	2	1	2	3	3	3	2
CLO 4	2	2	2	3	2	3	3
CLO 5	3	3	2	3	3	3	3

3 – Advance Application

2 – Intermediate Level

1 – Basic Level

Course Designed by	Verified by HOD	Approved by CDC Coordinator
Ms.T.Krithika  Name & Signature of the Staff	Dr.Lali Growther  Name & Signature	 Name & Signature

20
 Department of Microbiology
 Hindusthan College of Arts & Science
 Coimbatore- 441 028

Co-ordinator
 Curriculum Development Cell
 Hindusthan College of Arts & Science,
 Coimbatore-441 028.

DEPARTMENT OF MICROBIOLOGY				CLASS: I B.Sc MICROBIOLOGY				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours / Week	CIA	Ext	Total
II	DSC	22MBU06	Core - IV - Practical III / Biomolecules	2	2	50	50	100

Nature of Course		
Knowledge and Skill Oriented	Employability Oriented	✓
	Entrepreneurship Oriented	✓
	Skill Development	✓

Course Objectives
<ul style="list-style-type: none"> To analyze biomolecules qualitatively To understand and analyze the types of carbohydrates To analyze major amino acids To characterize lipids and determine acid number To analyze and determine iodine number

List of Practical Experiments		
1. Analysis of carbohydrates a) Glucose b) Fructose c) Sucrose d) Lactose e) Xylose and f) Starch	12	Up to K4
2. Analysis of Amino acids a) Histidine b) Tyrosine c) Tryptophan and d) Arginine	06	Up to K4
3. Determination of acid number of oil	03	Up to K4
4. Determination of iodine number of oil	03	Up to K4

Note: The Questions should be asked in the ratio of 100% practical

Book for Study

R.Sowndravally, D.Pooja, Biochemistry Practical Manual, Elsevier India, 2019.

Books for Reference

- Valleys practical clinical biochemistry, Heineman medical books, NewDelhi, 2006.
- Boyer, R.F., "Modern Experimental Biochemistry". Nenjamin / Cummings publishing company Inc. Redwoodcity, California, 2012.

- G. Sattanathan, S.S. Padmapriya, B. Balamuralikrishnan, "Practical Manual of Biochemistry", Skyfox Publishers, 2020.
- J. Jayaraman, Manuals in Biochemistry, New Age International Pub, Bangalore 2011.
- Plummer, Practical Biochemistry, New Delhi: Tata Mcgraw Hill Publishing Company, 2000.

Web Resources

<[https://www.researchgate.net/publication/332028407 Biochemistry A Practical Manual](https://www.researchgate.net/publication/332028407_Biochemistry_A_Practical_Manual)>

Pedagogy : Chalk & Talk, Exercise, Assignments & ppts.

Rationale for Nature of the Course

- Hands-on experiments enable the student to understand the structure and properties of biomolecules

Activities to be given

- Preparation of an album of reactions of sugars, aminoacids and lipids

Course Learning Outcomes

CLOs	On Completion of the Course, the students should be able to	K - Level
CLO1	Identify and analyze carbohydrates qualitatively	Upto K4
CLO2	Distinguish mono, di and polysaccharides	Upto K4
CLO3	Analyze amino acids qualitatively	Upto K4
CLO4	Distinguish various aminoacids	Upto K4
CLO5	Experiment the properties of lipids	Upto K4


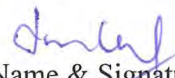

Mapping of Course Learning Outcomes (CLOs) with Programme Outcomes (POs)

CLOs	Programme Outcomes						
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CLO 1	1	2	3	1	3	3	2
CLO 2	2	2	1	3	3	3	3
CLO 3	2	1	2	3	3	3	2
CLO 4	2	2	1	3	3	3	3
CLO 5	3	3	2	3	3	3	3

3 – Advance Application

2 – Intermediate Level

1 – Basic Level

Course Designed by	Verified by HOD	Approved by CDC Coordinator
Ms.T.Krithika  Name & Signature of the Staff	Dr.Lali Growther  Name & Signature	 Name & Signature

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Department of Microbiology
Hindusthan College of Arts & Science
Coimbatore-641 028.

Co-ordinator
Curriculum Development Cell
Hindusthan College of Arts & Science,
Coimbatore-641 028.

DEPARTMENT OF MICROBIOLOGY				CLASS: I B.Sc MICROBIOLOGY				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours / Week	CIA	Ext	Total
II	DSC	22MBU07	Core V-Microbial Physiology and Metabolism	4	4	50	50	100

Nature of Course		
Knowledge and Skill Oriented	Employability Oriented	✓
	Entrepreneurship Oriented	✓
	Skill Development	✓

Course Objectives

1. To transfer knowledge on various aspects of microbial physiology and metabolism
2. To explain the nutritional requirements and role of factors influencing the microbial growth.
3. To understand the mechanism and significance of cell signaling molecules
4. To understand the mechanism of respiration and fermentation
5. To relate various microbial biosynthetic pathways.

Unit	Course Contents	Hours	K Level
I	Nutrition Nutritional requirements of microorganisms –macro elements, micro elements and growth factors, nutritional groups of microbes - transport mechanisms and types-simple diffusion – facilitated diffusion- active transport – group translocation - Iron uptake. Growth curve – Generation time – factors influencing microbial growth – batch, continuous, synchronous growth - diauxic growth. Methods of evaluating microbial growth.	09	Up to K4
II	Aerobic respiration EMP – HMP – ED pathways – TCA cycle- organization of the electron transport chain in Bacteria and comparison of ETC in Mitochondria - Substrate level phosphorylation and oxidative phosphorylation- ATP synthase- uncouplers and Inhibitors.	10	Up to K4
III	Anaerobic respiration and Fermentation Anaerobic respiration – sulphur, nitrogenous compounds, and CO ₂ as terminal electron acceptor - Methanogenesis - Fermentation – alcoholic, lactic acid, propionic, butanediol and mixed acid fermentation.	10	Up to K4
IV	Cell Signaling and Photosynthesis Signaling molecules and their receptors - Functions of cell receptors – quorum sensing. Photosynthesis in green bacteria, purple bacteria and cyanobacteria – oxygenic and anoxygenic, carbon dioxide fixation.	10	Up to K4
V	Biosynthesis Biosynthesis of bacterial cell wall - Biosynthesis of aminoacids (Pyruvate family)- Biosynthesis of fatty acids - general pathway-Biosynthesis of purine and pyrimidine nucleotides denovo and salvage pathways- bioluminescence	09	Up to K4

Note: The Questions should be asked in the ratio of 100% theory

Book for Study

Caldwell DR., "Microbial physiology and Metabolism", WMC Brown Publishers, New Delhi. 1995

Books for Reference

- Schlegel HG., "Microbiology" Cambridge University press, London. 2009
- Stainer, R.Y., Ingraham, J.L., Wheelis, M.L. and Painter, P.R., "Microbial Physiology", McGraw-Hill Higher Education New York. 2008
- Lehninger, Nelson and Cox., "Principles of Biochemistry", W.H. Freeman & Company, New York. 2013
- Murray RK, Granner DK, Mayes PA and Rodwell VW. "Harper's Biochemistry, Appleton and Lange: New York, NY. 2004.
- Doelle HW. Microbial Metabolism, Academic Press. 2005.

Web Resources

<<http://textbookofbacteriology.net/nutgro.html>>

<<https://www.biologydiscussion.com/microorganisms/nutritional-requirements-of-microorganisms/55070>>

Pedagogy : Chalk & Talk, Exercise, Assignments & ppts.

Rationale for Nature of the Course:

- Knowledge gained in this course forms the basis for other application oriented courses in Microbiology

Activities to be given

- Poster presentation

Course Learning Outcomes

CLOs	On Completion of the Course, the students should be able to	K - Level
CLO1	Categorize microbial nutritional requirements and growth of bacteria	Upto K4
CLO2	Illustrate the metabolic pathways involved in aerobic respiration	Upto K4
CLO3	Analyze the pathways of anaerobic respiration and fermentation	Upto K4
CLO4	Categorize the cell signaling molecules	Upto K4
CLO5	Illustrate the microbial biosynthetic pathways	Upto K4

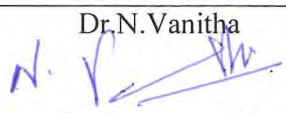
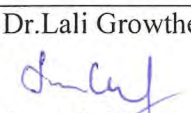
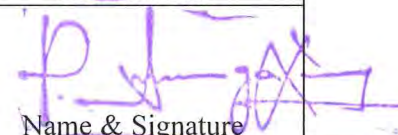
Mapping of Course Learning Outcomes (CLOs) with Programme Outcomes (POs)

CLOs	Programme Outcomes						
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CLO 1	1	2	3	1	3	3	2
CLO 2	2	2	1	3	3	3	3
CLO 3	2	1	2	3	3	3	2
CLO 4	2	2	1	3	3	2	3
CLO 5	3	3	2	3	3	3	3

3 – Advance Application

2 – Intermediate Level

1 – Basic Level

Course Designed by	Verified by HOD	Approved by CDC Coordinator
Dr.N.Vanitha  Name & Signature of the Staff	Dr.Lali Growther  Name & Signature	 Name & Signature

33
HEAD
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Coimbatore

Co-ordinator
Curriculum Development Cell
Hindusthan College of Arts & Science,
Coimbatore-641 028.

DEPARTMENT OF MICROBIOLOGY				CLASS: I B.Sc MICROBIOLOGY				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours / Week	CIA	Ext	Total
I	DSC	22MBU08	Core VI- Practical IV - Microbial Physiology and Metabolism	3	5	50	50	100

Nature of Course		
Knowledge and Skill Oriented	Employability Oriented	✓
	Entrepreneurship Oriented	✓
	Skill Development	✓

Course Objectives			
<ol style="list-style-type: none"> To understand the generation time of bacteria To perform and understand the biochemical characteristics of bacteria. To develop the skill to evaluate different carbohydrate fermentation To study the hydrolytic enzymes in bacteria To analyze the effects of different factors on bacterial growth 			
S.No.	Course Contents	Hours	K Level
1	Determination of generation time of <i>E.coli</i> a. Neubauer counting chamber. b. Turbidity. c. Viable count	09	Up to K4
2	Biochemical characterization: a) IMViC tests. b) Catalase, Oxidase c) Urease and nitrate tests. d) Triple sugar iron agar test.	09	Up to K4
3	Carbohydrate fermentation tests.	09	Up to K4
4	Hydrolysis test: a. Starch hydrolysis. b. Gelatin hydrolysis. c. Casein hydrolysis.	09	Up to K4
5	1. Effect of pH and temperature on growth of <i>E.coli</i> .	08	Up to K4
6	2. Effect of salt on growth of <i>E.coli</i> .	08	Up to K4
7	3. Effect of carbon and nitrogen sources on growth of <i>E.coli</i> .	08	Up to K4

Note: The Questions should be asked in the ratio of 100% practical

Book for Study

N. Murugalatha, Lali Growther, J. Vimalin Hena, N. Hema Shenpagam, R. Anitha, D. Kanchana Devi, G. Rajalakshmi, "Microbiological Techniques", 2013, MJP Publisher.

Books for Reference

1. James G. Cappuccino, Natalie Sherman, Microbiology: A Laboratory Manual, 2014: Pearson.
2. Valleys practical clinical biochemistry, 2006, Heineman medical books, New Delhi
3. R. Sowndravally, D. Pooja, Biochemistry Practical Manual, 2019, Elsevier India.
4. Cappuccino and Sherman. Microbiology – A Laboratory Manual. 7th Edition, Dorling Kindersley (India) Pvt. Ltd., New Delhi. 2012.
5. Gunasekaran P. Laboratory Manual in Microbiology, New Age International (P) Ltd. Publishers, New Delhi. 2008.

Web Resources

<<https://sites.google.com/site/microbialphysiologyoddsem/practicals>>

<https://www.researchgate.net/publication/306018042_Microbiology_Laboratory_Manual>

Pedagogy : Chalk & Talk, Exercise, Assignments & ppts.

Rationale for Nature of the Course:

- This course provides a foundation on the biochemical characterization of microorganisms

Activities to be given

- Preparation of an album on the biochemical characterization of selected cultures (team work)

Course Learning Outcomes

CLOs	On Completion of the Course, the students should be able to	K - Level
CLO1	Calculate the generation time of bacteria by different methods	Upto K4
CLO2	Infer the biochemical characteristics of microorganisms	Upto K4
CLO3	Analyze and identify organisms using carbohydrate fermentation test	Upto K4
CLO4	Examine and analyze the degradation of polymers by microorganisms	Upto K4
CLO5	Infer the factors affecting microbial growth	Upto K4


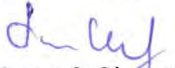
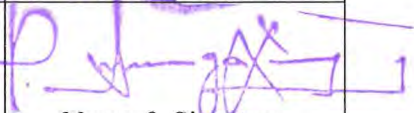
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	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CLO 1	1	2	3	2	3	2	2
CLO 2	2	2	1	3	3	3	3
CLO 3	2	3	2	3	3	3	2
CLO 4	2	2	1	3	3	3	3
CLO 5	3	3	2	3	3	3	3

3 – Advance Application

2 – Intermediate Level

1 – Basic Level

Course Designed by	Verified by HOD	Approved by CDC Coordinator
Dr.N.Hema Shenpagam  Name & Signature of the Staff	Dr.Lali Growther  Name & Signature	 Name & Signature

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HEAD
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Hindusthan College of Arts & Science
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Co-ordinator
Curriculum Development Cell
Hindusthan College of Arts & Science,
Coimbatore-641 028.

DEPARTMENT OF MICROBIOLOGY				CLASS: I B.Sc MICROBIOLOGY				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours / Week	CIA	Ext	Total
II	GE	22MBU09	Allied – III- Biochemistry	3	3	50	50	100

Nature of Course		
Knowledge and Skill Oriented	Employability Oriented	✓
	Entrepreneurship Oriented	✓
	Skill Development	✓

Course Objectives

1. To understand the concepts of buffer systems.
2. To understand the mechanism of extraction and utilization of energy in living cells
3. To explain the fundamental properties and importance of vitamins, minerals and hormones
4. To give insight into the inborn errors of metabolism
5. To explain the principle and applications of various analytical instruments in determination and characterization of biomolecules.

Unit	Course Contents	Hours	K Level
I	Buffer system pH – acid base indicators, principle and application of pH meter - Henderson – Hasselbalch equation – Maintenance of blood pH - buffer systems – respiratory mechanism – renal mechanism - acidosis and alkalosis – distribution of fluids in the body – dehydration. Preparation of solutions- Normality, molarity and molality.	07	Up to K4
II	Bioenergetics Basic principles of thermodynamics – entropy, enthalpy and free energy. High energy phosphates - ATP - oxidation – reduction reactions – Oxidoreductases -oxidases, dehydrogenases, oxygenases.	07	Up to K4
III	Vitamins and Minerals Classification, properties and physiological functions of vitamins – fat soluble – (A,D,E and K) and water soluble (B and C) – RDA - deficiency – toxicity. Macroelements – Physiological importance of Calcium, Phosphorus, Magnesium, Sodium and Potassium – Trace elements – Physiological functions of Iron, Copper , Zinc, Selenium and Iodine	07	Up to K4
IV	Hormones and Inborn errors of Metabolism General characteristics – classification – functions of hormones – oxytocin – vasopressin – thyroid – T3,T4 – pancreas – insulin – Hyperglycemia – Glucagon - Hypoglycemia. Hereditary anemias – sickle cell anemia and thalassemia – errors of carbohydrate (galactosemia) and protein metabolism (phenylketonuria) – disease and syndromes.	07	Up to K4
V	Analytical techniques and its application Shaker, Rotatory vacuum evaporator, Sonicator -Types of centrifuge – low and high speed, Ultra centrifuge - UV and Visible spectrophotometer - IR spectroscopy – FTIR - principle and application- Paper, TLC, Ion exchange, HPLC, AGE, PAGE, QUBIT and Nanodrop.	08	Up to K4

Note: The Questions should be asked in the ratio of 100% theory

Book for Study

Lehninger A.L., and Nelson D.I. "Principles of Biochemistry" Cox- CBS Publishers, New delhi.2005

Books for Reference

1. Ambika Shanmugam., "Fundamentals of Biochemistry for Medical students" WMC Brown Publishers, New Delhi.2008
2. Sathyanarayana U., "Biochemistry" ., Books and Allied Pvt. Ltd., New Delhi.2008
3. Lubert Stryer., "Biochemistry", Freeman and Company, New York.2002
4. Upadhyay & Upadhyay. "Biophysical Chemistry". 2010 Edition. Himalaya Publishing House.2010
5. Boyer, Rodney, F. Benjamin and Cummins, "Modern Experimental Biochemistry". 2nd Edition.1993

Web Resources

https://www.brainkart.com/subject/Biochemistry_302//>

Pedagogy : Chalk & Talk, Exercise, Assignments & ppts.

Rationale for Nature of the Course:

- Interdisciplinary course provides adequate supplementary knowledge in Biochemistry for Microbiology students

Activities to be given

- Poster presentation

Course Learning Outcomes

CLOs	On Completion of the Course, the students should be able to	K - Level
CLO1	Define and deduce the principle of buffer system and acid base balance	Upto K4
CLO2	Illustrate metabolic pathways and bioenergetics	Upto K4
CLO3	Categorize the properties, physiological functions and deficiency of vitamins and minerals	Upto K4
CLO4	Identify the hormonal imbalance and analyze their physiological effects	Upto K4
CLO5	Analyze bioinstrumentation techniques	Upto K4


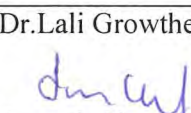
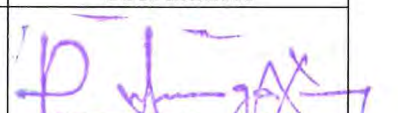
Mapping of Course Learning Outcomes (CLOs) with Programme Outcomes (POs)

CLOs	Programme Outcomes						
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CLO 2	2	2	1	3	3	3	3
CLO 3	2	3	2	3	3	3	2
CLO 4	2	2	1	3	3	2	3
CLO 5	3	3	2	3	3	3	2

3 – Advance Application

2 – Intermediate Level

1 – Basic Level

Course Designed by	Verified by HOD	Approved by CDC Coordinator
Ms.T.Krithika  Name & Signature of the Staff	Dr.Lali Growther  Name & Signature	 Name & Signature

37
HEAD
Department of Microbiology
Hindusthan College of Arts & Science
Coimbatore- 641 028

Co-ordinator
Curriculum Development Cell
Hindusthan College of Arts & Science,
Coimbatore-641 028.

DEPARTMENT OF MICROBIOLOGY				CLASS: I B.Sc MICROBIOLOGY				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours / Week	CIA	Ext	Total
II	GE	22MBU10	Allied IV-Practical V - Biochemistry	2	3	50	50	100

Nature of Course		
Knowledge and Skill Oriented	Employability Oriented	✓
	Entrepreneurship Oriented	✓
	Skill Development	✓

Course Objectives

1. To understand the concepts of mole, mole fraction, molarity, etc. and to apply them in preparations of solutions of desired strengths.
2. To understand the concepts of preparation of buffers
3. To identify the pH in solutions
4. To use and analyze the results of photometry
5. To analyze various biomolecules quantitatively.

S.No.	Course Contents	Hours	K Level
1	Preparation of Solutions (Molar and Normal Solutions)	3	Up to K4
2	Preparation of Buffers – Acids and Alkaline Range	3	Up to K4
3	Measurement of pH	3	Up to K4
4	Quantitative determination of Carbohydrate by Anthrone method	4	Up to K4
5	Estimation of protein by Lowry method	4	Up to K4
6	Quantitative determination of protein by Bradford method	4	Up to K4
7	Estimation of Carbohydrate by DNS method	4	Up to K4
8	Estimation of Ascorbic acid by DNPH method	4	Up to K4
9	Determination of Maximum absorption (λ_{max}) spectra of dyes.	4	Up to K4
10	Study of Proteins-Primary, Secondary and Tertiary structures with the help of models	3	Up to K4

Note: The Questions should be asked in the ratio of 100% practical

Book for Study

Wilson, E., Walker, J., "Practical Biochemistry-Principles and techniques", Cambridge University press (2010).

Books for Reference

1. R.Sowndravally, D.Pooja, "Biochemistry Practical Manual", 2019, Elsevier India.
2. "Valleys practical clinical biochemistry", 2006, Heineman medical books, NewDelhi
3. Benjamin F. Lasseter. "Biochemistry in the Lab", 2010, CRC Press, 2019
4. Biochemical methods – S.Sadasivam, V.A Manickam 2 ed New Age International Publishers, 2006.
5. Biochemical Tests – Principles and Protocols. Anil Kumar, Sarika Garg and Neha Garg. Vinod Vasishtha Viva Books Pvt Ltd, 2012.

Web Resources

<https://www.researchgate.net/publication/313745155_Practical_Biochemistry_A_Student_Companion>
<https://skyfox.co/wp-content/uploads/2020/12/Practical-Manual-of-Biochemistry.pdf>

Pedagogy : Chalk & Talk, Exercise, Assignments & ppts.

Rationale for Nature of the Course:

- Qualitative and quantitative analysis of biomolecules and the knowledge gained in Bioinstrumentation help students to apply this in their mini/major projects

Activities to be given

- Model presentation

Course Learning Outcomes

CLOs	On Completion of the Course, the students should be able to	K - Level
CLO1	Experiment with pH meter	Upto K4
CLO2	Apply and analyze the concepts of molarity and normality for solution preparation	Upto K4
CLO3	Experiment with Proteins, Vitamins and carbohydrates	Upto K4
CLO4	Analyze the properties of lipids	Upto K4
CLO5	Infer the absorption maxima of standard proteins with UV spectrophotometer	Upto K4


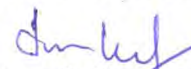

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CLOs	Programme Outcomes						
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CLO 4	2	2	1	3	3	3	3
CLO 5	3	3	2	3	3	3	3

3 – Advance Application

2 – Intermediate Level

1 – Basic Level

Course Designed by	Verified by HOD	Approved by CDC Coordinator
Ms.T.Krithika  Name & Signature of the Staff	Dr.Lali Growther  Name & Signature	 Name & Signature

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 Hindusthan College of Arts & Science
 Coimbatore- 641 028

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 Curriculum Development Cell
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