MAHATMA GANDHI UNIVERSITY School of Biosciences

Priyadarsini Hills P. O., Kottayam – 686560



Learning Outcomes based Curriculum Framework (LOCF) for Post Graduate Programme

MSc Biochemistry

Under the CSS scheme for University (EFFECTIVE FROM 2021 ADMISSIONS)

Preface

Mahatma Gandhi University

Mahatma Gandhi University is an Indian collegiate public University based in Kerala, established in 1983, approved by UGC, and accredited with NAAC "A" Grade, 3.24 CGPA. With its academic excellence, the University has bagged Chancellor's Award twice for the best University (2015-16 and 2017-18) within the state of Kerala. It has also secured 30th position in NIRF ranking (April 2019) and 11th position in India Today-MDRA ranking, 2018. CSIR has ranked the University 13th for its intellectual productivity and NISTADS has rated it as 19th in terms of h-index.

At present, Mahatma Gandhi University offers research programs in forty disciplines through its own Schools and approved Research Centers. It has close collaboration for academic, research and extension programs with a number of national agencies and institutions including the UGC, DST-FIST, DRS, ISRO, COSIT, DIT, DST (Nano Mission), CSIR, DAAD, STEC, ICMR, BARC and MOEF. The University is also involved in active collaboration with research institutions of international reputation such as the Max Planck Institute of Technology, Germany; Brown University, USA; University of Nantes, France; California Institute of Technology, USA; University of Toronto, Canada; Catholic University, Belgium; Heidelberg University, Germany; the Institute of Political Studies, Rennes, France; Trent University, Canada; IPF Dresden, Germany; University of Paris and University of Strasbourg.

Mahatma Gandhi University has made immense strides in the fields of inter disciplinary teaching and research. The faculty comprises of outstanding scholars, many of whom have made original contributions in their respective fields of specialization. The faculty and research scholars of several departments have gained widespread recognition for the commendable quality of their research publications. The web enabled University library has large collection of books, journals, e-journals and online theses. The digital library provides open access to its enviable collection of digitized Ph.D dissertations. All these work in tandem with the academic business transacted by the University, making the whole experience a holistic one. The University has a well established instrumentation facility with many sophisticated equipments functioning at the various departments and also at the platform provided by the common Inter University Instrumentation Centre (IUIC).

The University has well established and internationally reputed facility and academic expertise in various areas like Nanoscience, Environmental science, Bioscience, Chemical science, Physics, Arts and Humanities. The Centre for Nanoscience and Nanotechnology focus on the enhancement of research and higher studies in the cutting edge areas of Nanoscience and Nanotechnology. The Centre is motivated to thrust its research and development focusing on developing novel materials and devices prospering the outrage of Nanoscience. With a vision to consolidate the existing and to pay focus attention to the frontier areas of Environmental Science, the University has established the School of Environmental Sciences as a Centre of learning for advanced studies in different branches of environmental science. The major mandate of the School is to develop appropriate technologies and skilled human resource for sustainable utilization, management and conservation of natural resources. The school has established a Centralized Remote Sensing and GIS facility, the first of its kind in a University in the state, with the support of Indian Space Research Organization (ISRO). It has also established a regional center, the Highrange Environmental Research center (HERC) at Nedumkandam, Idukki district. The School has a live laboratory named as "Jeevaka" which consists of areas with rich biodiversity within the Mahatma Gandhi University Campus.

Vision and Mission of MGU

Vision of Mahatma Gandhi University

"Mahatma Gandhi University envisions to excel in the field of higher education and cater to the scholastic and developmental needs of the individual, through continuous creation of critical knowledge base for the society's sustained and inclusive growth."

Mission of Mahatma Gandhi University

- To conduct and support undergraduate, postgraduate and research-level programmes of quality in different disciplines
- To foster teaching, research and extension activities for the creation of new knowledge for the development of society
- To help in the creation and development of manpower that would provide intellectual leadership to the community
- To provide skilled manpower to the professional, industrial and service sectors in the country so as to meet global demands
- To help promote the cultural heritage of the nation and preserve the environmental sustainability and quality of life
- To cater to the holistic development of the region through academic leadership

Preamble

OUTCOME BASED EDUCATION (OBE)FROM THE ACADEMIC YEAR 2020-21 MAHATMA GANDHI UNIVERSITY SCHOOL OF BIOSCIENCES

Introduction

A high priority task in the context of education in India is improvement of quality of higher education for equipping young people with skills relevant for global and national standards and enhancing the opportunities for social mobility. Mahatma Gandhi University has initiated an Outcome Based Education (OBE) for enhancing employability of graduates through curriculum reforms based on a learning outcomes-based curriculum framework, upgrading academic resources and learning environment.

Learning outcomes specify what graduates completing a particular programme of study are expected to know, understand and be able to do at the end of their programme of study. The fundamental premise underlying the learning outcomes-based approach to curriculum development is that higher education qualifications are awarded on the basis of demonstrated achievement of outcomes, expressed in terms of knowledge, understanding, skills, attitudes and values. Outcomes provide the basis for an effective interaction among the various stakeholders. It is the results-oriented thinking and is the opposite of input-based education where the emphasis is on the educational process.

Benefits of OBE

1. The OBE Framework is a paradigm shift from traditional education system into OBE system where there is greater focus on programme and course outcomes. It guarantees that curriculum, teaching and learning strategies and assessment tools are continuously enhanced through a continuous improvement process. All decisions including those related to curriculum, delivery of instruction and assessment are based on the best way to achieve the predetermined outcomes. Traditionally, educators have measured learning in terms of standardised tests. In contrast, outcome-based education defines learning as what studentscan demonstrate that they know.

Benefits of OBE:

*More directed & coherent curriculum.

*Graduates will be more "relevant" to industry & other stakeholders (more well-rounded Graduates)

*Continuous Quality Improvement is in place.

*OBE shifts from measuring input and process to include measuring the output (outcome)

Outcome Based Education (OBE) process

OBE is a comprehensive approach to organise and operate a curriculum that is focused onand defined by the successful demonstrations of learning sought from each learner. The term clearly means focusing and organising everything in an education system around "what is essential for all learners to be able to do successfully at the end of their learning experiences".

OBE is an approach to education in which decisions about the curriculum and instruction are driven by the exit learning outcomes that the students should display at the end of aprogramme or a course. By the end of educational experience, each student should have achieved the outcomes.

Learning Outcomes based Curriculum Framework (LOCF) for Post Graduate Programmes-

IQAC MG University

One of the main objectives of OBE is to ensure continuous improvement of programmes in terms of maintaining the relevance in curriculum as well as responding to the requirements of the stakeholders. In other words, it ensures that Post graduate programme next year is better than Post graduate programme this year, offered by a department.

An OBE system has been proposed and to be implemented at various Departments of Mahatma Gandhi University, as a quality-assurance approach to improve teaching and learning outcomes and processes. This OBE plan incorporates the "outcomes assessment" process to be followed in the departments. OBE should be a key driver of the curriculum management in allthe departments of the university.

The OBE is a 6 step process as shown in the figure

Figure: OBE Process

The process is presented as a cycle or a loop. The cycle represents the continuous nature of assessing learning outcomes.



As envisaged by the IQAC of Mahatma Gandhi university, an OBE based curricular framework has been proposed for the School of Biosciences from the academic year 2020-2021 which is presented hereafter.

School of Biosciences

The Life Science research of the University is carried out under the School of Biosciences, which is another prestigious department of the University and it provides academic expertise to students in advanced areas of Biochemistry, Microbiology, Biotechnology and Biophysics. The established research areas at School of Biosciences specifically include the Bioprocess technology, toxicology, ethnopharmacology, inflammation. ecology, ecotechnology, agricultural microbiology, immunobiology, medicinal plant research, probiotic development, microbial and natural product research, molecular microbiology etc. The department harbours a state -of-the-art instrumentation facility, animal maintenance facility and animal cell culture facility as well. The institute has been a successful aspirant in producing a large number of PhDs, and has completed several funded projects with significant number of publications.

Our Vision

* An Institution of excellence developing professional competence, ambition and determination in students to face new challenges and find new opportunities in the field of Biological Sciences and facilitating the wellbeing and prosperity of mankind especially our Mother Land by utilising the opportunities in advanced Biological research.

Key points

- 1. Institution of excellence
- 2. Professional competence, ambition and determination
- 3. New challenges and new oppurtunities
- 4. Well being and prosperity of nation and humanity
- 5. Utilise opportunities in research

Our Mission

- * To provide advanced knowledge and technological knowhow to the students in the field ofBiological sciences.
- * To utilise the expertise of faculty in diverse areas of biology for benefitting the students inachieving their career goals.
- * To conduct cutting-edge research in areas of life Sciences and to extend the knowledge gained from lab to land and benchtop to bedside.

Key points

- 1. provide advanced knowledge and technological knowhow
- **2.** To utilise the expertise of faculty
- **3.** benefitting the students in achieving their career goals.
- 4. conduct cutting-edge research
- 5. extend the knowledge gained from lab to land and benchtop to bedside.



	Critical thinking and analytical reasoning	Capability to analyze, evaluate and interpret evidence, arguments, claims, beliefs on the basis of empirical evidence; reflect relevant implications to the reality; formulate logical arguments; critically evaluate practices, policies and theories to develop knowledge and understanding; able to envisage the reflective thought to the implication on the society.
d h b	Scientific reasoning and Problem solving	Ability to analyze, discuss, interpret and draw conclusions from quantitative/qualitative data and experimental evidences; and critically evaluate ideas, evidence and experiences from an unprejudiced and reasoned perspective; capacity to extrapolate from what one has learned and apply their competencies to solve problems and contextualize into researchand apply one's learning to real life situations.
	Multidisciplinary/ Interdisciplinary/ Transdisciplinary approach	Acquire interdisciplinary /multidisciplinary/ transdisciplinary knowledge base as a consequence of the learning they engage with their programme of study; develop a collaborative- multidisciplinary/interdisciplinary/transdisciplinary- approach for formulate constructive arguments and rational analysis for achieving common goals and

		objectives.			
	Intra and Interpersonal skills	Ability to work effectively and respectfully with diverse teams;facilitate collaborative and coordinated effort on the part of a group,and act			
		together as a group or a team in the interests of a common cause and work efficiently as a member of a team; lead the team to guide people to the right destination, in a smooth and efficient way.			
88	Digital literacy	Capability to use ICT in a variety of learning situations, demonstrate ability to access, choose, collect and evaluate, and use a variety of relevant information sources; structure and evaluate those data for decision making.			
	Global Citizenship	Building a sense of belonging to a common humanity and to become responsible and active global citizens. Appreciation and adaptation of different sociocultural setting and embrace and promote equity.			
	Social competency	Possess knowledge of the values and beliefs of multiple cultures, appreciate and adapt to a global perspective; and capability to effectively engage in a multicultural society and interact respectfully, manage and lead with diverse groups.			
 	Equity, Inclusiveness and Sustainability	Appreciate and embrace equity, inclusiveness and sustainability and diversity; acquire ethical and moral reasoning and values of unity, secularism and national integration to enable to act as dignified citizens; able to understand and appreciate diversity			
Ĵ	Lifelonglearning	Continuous acquisition of knowledge and skills. Learn, unlearn and re-learn based on changing ecosystem. "Learning how to learn", that are necessary for participating in learning activities throughout life, through self-paced and self- directed learning aimed at personal development, meeting economic, social and cultural objectives, and adapting to changing trades and demands of work place through knowledge/skill development/reskilling.			



Mahatma Gandhi University Programme Outcome

Programme Outcomes (PO)

PO 1: Critical Thinking and Analytical Reasoning

Capability to analyse, evaluate and interpret evidence, arguments, claims, beliefs on the basis of empirical evidence; reflect relevant implications to the reality; formulate logical arguments; critically evaluate practices, policies and theories to develop knowledge and understanding; able to envisage the reflective thought to the implication on the society.

PO 2 : Scientific Reasoning and Problem Solving

Ability to analyse, discuss, interpret and draw conclusions from quantitative/qualitative data and experimental evidences; and critically evaluate ideas, evidence and experiences from an unprejudiced and reasoned perspective; capacity to extrapolate from what one has learned and apply their competencies to solve problems and contextualise into researchand apply one's learning to real life situations.

PO 3: Multidisciplinary/Interdisciplinary/Transdisciplinary Approach

Acquire interdisciplinary /multidisciplinary/transdisciplinary knowledge base as a consequence of the learning they engage with their programme of study; develop a collaborative-multidisciplinary/interdisciplinary/transdisciplinary-approach for formulate constructive arguments and rational analysis for achieving common goals and objectives.

PO 4: Communication Skills

Ability to reflect and express thoughts and ideas effectively in verbal and nonverbal way; Communicate with others using appropriate channel; confidently share one's views and express herself/himself; demonstrate the ability to listen carefully, read and write analytically, and present complex information in a clear and concise manner and articulate in a specific context of communication.

PO 5: Leadership Skills

Ability to work effectively and lead respectfully with diverse teams; setting direction, formulating a goal, building a team who can help achieve the goal, motivating and inspiring team members to engage with that goal, and using management skills to guide people to the right destination, in a smooth and efficient way.

PO 6: Social Consciousness and Responsibility

Ability to contemplate of the impact of research findings on conventional practices, and a clear understanding of responsibility towards societal needs and reaching the targets for

attaining inclusive and sustainable development.

PO 7: Equity, Inclusiveness and Sustainability

Appreciate equity, inclusiveness and sustainability and diversity; acquire ethical and moral reasoning and values of unity, secularism and national integration to enable to act as dignified citizens; able to understand and appreciate diversity, managing diversity and use of an inclusive approach to the extent possible.

PO 8: Moral and Ethical Reasoning

Ability to embrace moral/ethical values in conducting one's life, formulate a position/argument about an ethical issue from multiple perspectives, and use ethical practices in all work. Capable of demonstrating the ability to identify ethical issues related to one's work and living as a dignified person in the society.

PO 9: Networking and Collaboration

Acquire skills to be able to collaborate and network with scholars in an educational institutions, professional organizations, research organizations and individuals in India and abroad.

PO 10: Lifelong Learning

Ability to acquire knowledge and skills, including "learning how to learn", that are necessary for participating in learning activities throughout life, through self-paced and self-directed learning aimed atpersonal development, meeting economic, social and cultural objectives, and adapting to changing trades and demands of work place through knowledge/skill development/reskilling.

Programme Outcome of MSc courses in School of Biosciences (PO)

To develop competent personnel in applied branches of life sciences with good academic standards, skill, technical knowhow, research aptitude, scientific ethics and societal consciousness.

Programme specific outcomes of M. Sc Biochemistry (PSO)

Program specific outcomes for M. Sc. Biochemistry: On completion of the program, the studentshould be able to

- PSO1: Acquire the knowledge and skills necessary for understanding the basic structural and functional aspects of various biochemical processes in the complex living system.
- PSO2: Apply the knowledge and skills to solve research problems in Biochemistry and allied areas.
- PSO3: Develop awareness on maintaining quality assurance in various practical areas of Biochemistry.
- **PSO4:** Generate the ability to use modern tools and methods to work in related industry andhealth sectors.

Rubrics selected for OBE implementation

1.Overall performance in each course of the semester on a continuous basis

2. Response to critical theoretical questions in each course

3. Procedural approach adopted towards **lab oriented critical questions** in each practical course

4. Response to socially relevant issues and recent trends in each course

5.Aptitude to research and specific research problem in each course

PART 1<u>Task Description</u>

- 1. Written Examination
- 2. Assignment
- 3. Seminar
- 4. Practical Exam
- 5. Viva voce

PART II Scale-Continuous mode

Excellent, Satisfactory, Needs improvement (remedial practices recommended)

PART III Dimensions

Written Examination-Content, Communicating

Assignment -Content, level of Comprehension

Seminar-Content, Performance

Practical exam- Conduct of practical, Observation and recording

Viva voce -Response to questions, Attitude

PART IV Description of the dimensions

Content-Brief and meaningful

Comprehension- Precise and effective

Communicating-Direct and orderly

Procedure adopted- Scientific Suitability and easiness

Conduct of practical-Accuracy and reproducibility

Observation and recording- Sharp and systematic

Response to questions- Analyitical approach and level of accuracy

Attitude- Positive and self-inspiring

SCHEME OF MSc BIOCHEMISTRY PROGRAMME

FIRST SEMESTER SCHEME

Course Code	Course Title	Credits
BSM 21C 01	Biochemistry	3
BSM 21C 02	Microbiology	3
BSM 21C 03	Cell Biology, Genetics & Evolution	3
BSM 21C 04	Biophysics & Biostatistics	3
BSM 21C 05	Physiology	3
	Entry level orientation programme in applied life sciences	0
BSM 21C 06	Laboratory Course – 1	2
BSM 21C 07	Laboratory Course – 2	2
Total credits of I ser	nester program	19

SECOND SEMESTER SCHEME

BSM 21C 08	Immunology	3
BSM 21C 09	Molecular Biology and Genetic Engineering	3
BSM 21C 10	Metabolism and Bioenergetics	3
BSM 21C 11	Biophysical Techniques and Bioinstrumentation	3
BSM 21C 12	Laboratory Course–3	2
BSM 21C 13	Laboratory Course–4	2
	Two elective Courses to be selected from the options given below	3 + 3
BSM 21E 14	Microbial Technology	3
BSM 21E 15	Ecology and Environment	3
BSM 21E 16	Neurobiology	3
BSM 21E 17	Environment Science	3
BSM 21E 18	Molecular Microbiology	3
BSM 21E 19	Developmental Biology	3
Total credits of II semester program		

SCHEME OF THIRD SEMESTER BIOCHEMISTRY				
Course No	Subject of the Course	Credit		
BSM 21C 20	Enzymology	4		
BSM 21 C 21	Clinical Biochemistry	4		
BSM 21 C 22	Pharmaceutical Biochemistry	4		
BSM 21 C 23	Laboratory Course 5 Biochemistry	2		
BSM 21 C 24	Laboratory Course 6 Biochemistry	2		
Course taken by the student	Open course	4		
from other department				
Total Credits of the 3 rd Semester Programme in M Sc Biochemistry				

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SCHEME OF FOURTH SEMESTER BIOCHEMISTRY

Course No Subject of the Course		Credit	
BSM 21C 51	Plant Biochemistry	3	
BSM 21C 52	Lab Course 7 Biochemistry	4	
BSM 21C 53	Major Research Project	6	
Elective 1	To be selected from the options given below	3	
Elective 2	ve 2 To be selected from the options given below		
	Internship Programme of 1-2 weeks	0	
Total Credits of the 4	th Semester Programme in M Sc Biochemistry	19	

SCHEME OF FOURTH SEMESTER ELECTIVE COURSES Students need to select any two of the following elective courses			
BSM 21E 61	Quality Control in Herbal Drugs	3	
BSM 21E 62	Environment Biotechnology	3	
BSM 21E 63	IPR and Patenting	3	
BSM 21E 64	Omics in Biotechnology	3	
BSM 21E 65	Molecular Phylogeny	3	
BSM 21E 66	Human Virology	3	
BSM 21E 67	Advanced Techniques in Diagnostic Microbiology	3	
BSM 21E 68	Radiation Biophysics	3	
BSM 21E 69	Good Laboratory Practices	3	
BSM 21E 70	Health and Nutrition	3	
BSM 21E 71	Neutrophil Biology	3	
BSM 21E 72	Plant Microbe Interactions	3	
BSM 21E 73	Sustainable Agriculture	3	



MAHATMA GANDHI UNIVERSITY

BSM 21C 01: BIOCHEMISTRY

SchoolName	School of Biosciences	School of Biosciences				
Programme	M.Sc. Biochemistry/Microbiology/Biotechnology/Biophysics					
Course Name	BIOCHEMISTRY	BIOCHEMISTRY				
Type of Course	Core	Core				
Course Code	BSM 21C 01	BSM 21C 01				
Course Summary & Justification	The course is designed to get a clear idea on the basic biomolecules and their importance in the various biochemical processes in life so that the course builds a base for the students to comprehend and articulate the advanced concepts in life sciences					
Semester			First			
Total StudentLearningT ime (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total LearningHours
	Eg. Authentic learning Collaborative learning Independent learning	60	20	0	40	120
Pre-requisite	Basic understanding of chemical groups and bonding; basics of cell biology and physiology					

O No.	Expected Course Outcome	Learning Domains	PSO No.
1	To identify the different types of biomolecules such as lipids, carbohydrates, proteins and nucleic acids	U	1
2	To differentiate the structural and functional characters of different biomolecules	A	1
3	To narrate the coordinated functions of different biomolecules in a complex living system	A/Ap	1
4	To compare the structure and functions of biomolecules in plants, animals and microbes	A	1
5	To describe the structure and functions of vitamins and	U	1

	hormones		
*Remem and App	ber (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Crea reciation (Ap)	ute (C), Skill (S),	Interest (I)

COURSE CONTENT

Module	Module Content	CO	Hours
No	Carbohydrates: Classification of Carbohydrates with examples- monosaccharides, disaccharides and oligosaccharides; their structure and functions; Polysaccharides - occurrence, structure, isolation, properties and functions of homoglycans- starch, glycogen, cellulose, dextrin, inulin, chitins, xylans, arabinans, galactans. Occurrence, structure, properties, and functions of heteroglycans – bacterial cell wall polysaccharides, glycoaminoglycans, agar, alginic acid, pectins, amino sugars and deoxv sugars, blood group substances and sialic acids. Glycolipids and Glycoproteins and their biological applications. Lectin- structure and functions.	1, 2, 3, 4	10
2	Lipids: Classification of lipids with examples; their structure and functions Complex lipids- phospholipids -classification, structure and functions. Ceramides and sphingomyelins. Eicosanoids, structure and functions of prostaglandins, thromboxanes, leukotrienes Types and functions of plasma lipoproteins. Amphipathic lipids -membranes, micelles, emulsions and liposomes. Steroids -cholesterol structure and biological role -bile acids, bile salts. Sterols in Plant system: Phytohormones: Brassinosterroids (functions); Sterols in microbial system: mycosterols.	1, 2, 3,4	10
3.	Proteins: Amino acids- Structure and properties, Classification of proteins on the basis of solubility and shape, structure, and biological functions. Isolation, fractionation and purification of proteins. Denaturation and renaturation of proteins. Primary structure -determination of amino acid sequence of proteins. Ramachandran plot, Secondary, tertiary and quartenary structures of proteins. Detailed study on structure and function with an example: Fibrous Protein (Collagen) Globular protein (Hemoglobin)., Enzymes- Different classes and functions.	1, 2, 3,4	10
4	Nucleic Acids: Components of nucleic acids, Watson -Crick model of DNA structure. A, B and Z DNA Cruciform structure in DNA, miscellaneous alternative conformation of DNA. Higher order organization of DNA. Methods for nucleic acid sequence determination, isolation and purification of DNA, molecular hybridization, Cot value curve, Reassociation kinetics, RNA Structure: Types of RNA; structure of mRNA, tRNA and rRNA, ,Si RNA, micro RNA with emphasis on importance of structure	1, 2, 3, 4	10

	to its function		
5	Vitamins and Hormones: Vitamins -water soluble -thiamine, riboflavin, niacin, pyridoxine, folic acid, ascorbic acid-source, structure, biochemical functions, deficiency diseases, daily requirements; fat soluble -vitamin A, vitamin D2, vitamin E and vitamin K -sources, structure, biochemical functions, deficiency diseases, daily requirements. Hormones: different types, structures, their biological role and disorders. Mechanism of action of peptide and steroid hormones.	5	20
	Total Credits of the Course	3	60
~	Books for Reference		
1. Princi Scrim 978-0 2. Bioch Publi 71676 3. Lu C	iples Of Biochemistry, 4/e (2006) by Robert Horton H , Laurence ngeour K Publisher: Pearsarson ISBN: 0131977369, ISBN-13: 9 0131977365 nemistry 6th Edition (2007) by Jeremy M.berg John L.tymoczko isher: B.i.publicationsPvt.Ltd ISBN: 071676766X ISBN-13: 97807 67664 ehninger Principles of Biochemistry, Fourth Edition by David L. Nel ox Publisher: W. H. Freeman; Fourth Edition edition (April 23, 2 716743396 ISBN-13: 978-0716743392	A Mora 97801319 0 Lubert 1676766 lson Mic 2004) IS	n, Gray 977365, t Stryer 54, 978- hael M. BN-10:
Further	Reading: iochemistry: A Students survival Guide by Hiram. F. Gilbert (20 IcGraw-Hill ISBN 0-07-135657-6 atroduction to Biophysics by Pranab Kumar Banerjee (2008) Publish	002) Put ers: S. C	olishers: Thand &
• E B • B W • Pr E IS • M M	 S. West, W.R. Todd, H.S. Mason and J.T. van Bruggen, A iochemistry, Oxford and IBH Publishing Co., New Delhi, 1974 iochemistry [with Cdrom] (2004) by Donald Voet, Judith G. Voet I viley & Sons Inc ISBN: 047119350X ISBN-13: 9780471193500, 97 rinciples Of Biochemistry (1995) by Geoffrey L Zubay, William W Vance Publisher: Mcgraw-hill Book Company – Koga ISI SBN-13: 9780697142757, 978-0697142757 Iolecular Biology of the Cell by Bruce Alberts, Alexander Johnson Iartin Raff, Keith Roberts, Peter Walter Publisher: Garland Science; 	Text E Publishe 8-04711 Parson, BN:0697 n, Julian 5 editior	Book of er: John 93500 Dennis 142752 Lewis, n ISBN-
10 • G 9' • M P IS • C IS Molecula	0: 0815341059 ISBN-13: 978-0815341055 enes IX by Benjamin Lewin (2008) Publisher: J&b ISBN:076375 780763752224, 978-0763752224 folecular Biology Of The Gene 5/e (s) by James D Watson, Tania A Bell (2008) Publisher: Dorling Kindersley (India) Pvt Ltd ISB SBN-13: 9788177581812, 978-8177581812 cell and Molecular Biology, 3e (2003) by Karp SBN: 0471268909 ISBN-13: 9780471268901, 978-0471268901 ar Cell Biology (2002) by H.S. Bhamrah Publisher: Anmol Pub	Baker, S Baker, S N: 8177 Publishe lications	BN-13: Stephen 581813 r: Jw ISBN:

8126111429 ISBN-13: 9788126111428, 978-8126111428

Assessment Types Mode of Assessment A. Continuous Internal Assessment (CIA) Internal Test -20 marks Assignment – Every student needs to write an assignment on a given topic based on the available published literature – 10 marks Seminar Presentation – A topic needs to be	Teachingand LearningApp roach	Classroom Procedure (Mode of transaction) Direct Instruction, Explicit Teaching, E-learning, interactive Instruction:, Active co-operative learning, Seminar, Group Assignments, Authentic learning, Library work and Group discussion, Presentation by individual student/ Group representative						
marks B. Semester End examination – 60 marks	Assessment Types	Mode of Assessment A. Continuous Internal Assessment (CIA) Internal Test -20 marks Assignment – Every student needs to write an assignment on a given topic based on the available published literature – 10 marks Seminar Presentation – A topic needs to be presented and discussed with the class- 10 marks B. Semester End examination – 60 marks						

Approval Date	
Version	
Approval by	
Implementation Date	

	MAHATMA GANDHI UNIVERSITY
विद्यया अमुलमाउन्हे	BSM 21C 02: MICROBIOLOGY

SchoolName	School of Biosciences
Programme	Msc Biochemistry/ Microbiology/ Biotechnology/ Biophysics
Course Name	MICROBIOLOGY
Type of Course	Core

Course Code	BSM 21C 02					
Course Summary	s course on Microbiology introduces the milestones of Microbiology key					
& Justification	components and their functions.					
	objective of the course content is to impart Knowledge on Landmark					
	discoveries in Microbiology and different domains classification of					
	living organisms.	0.				
	develop a very good und	derstandi	ng of the	characte	ristics of	fdifferent
	types of microorganisms, methods to organize/classify these into and					
	hasic tools to study these in the laboratory					
Comoston	Eirct					
Semester	FIISt					
Total						
StudentLearningT	Learning Approach	Lecture	Tutorial	Practical	Others	Total
ime (SLT)						LearningHours
	Authentic learning Collaborative learning Independent learning	60	20	0	40	120
Pre-requisite	Basics of General microbiology					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.		
1	mmarize the contributions made by prominent scientists in microbiology and bacterial taxonomy	E	1		
2	derstanding of basic microbial structure and similarities and differences among various groups of microorganisms	U/ An	1		
3	Exemplify basic tools to study these in the laboratory	S	2, 3, 4		
4	Explain various factors affecting the microbial growth and nutritional requirements and will be acquainted with methods of measuring microbial growth	U/R	1, 4		
5	alyse various methods for identification and sterilization of isolated microorganisms.	An	1,4		
6	Create an insight to the interactions and characteristics of microorganisms	An/ C	1		
*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)					

COURSE CONTENT

Module	Module Content	Credits	Hrs
No			

1	History and scope of microbiology: The historical foundations	1, 2	10
	and development of microbiology. An overview of microbial		
	world. The bacteria and the archae. Classification of bacteria and		
	Archaea according to the Bergey's Manual of Systematic		
	Bacteriology. Tools for Systematics: Numerical taxonomy,		
	Phylogenetic analysis, Polyphasic approach; Modern methods of		
	studying microbial diversity; Microbial culture collections.		
2	Microbial Diversity: Prokaryotic and eukaryotic microbial	1, 2, 3	20
	diversity.General characteristics of various groups of prokaryotes:		
	bacteria including, Rickettsiae, Chlamydiae and Actinomycetes,		
	Cyanobacteria and Mycoplasmas. Morphology and structure of		
	bacteria. Viruses unique properties, morphology, structure and		
	cultivation; Viroids and Prions. Viral replication. Viral diversity-		
	bacterial, plant and animal viruses; Fungi - properties and		
	classification. Microorganism in extreme environments		
3.	Microbial physiology: Factors influencing microbial growth.	4	20
	Environmental and nutritional factors. Nutritional types of		
	bacteria. Microbial growth curve. Mathematical expression of		
	growth- continuous and batch cultures. Diauxic and synchronous		
	growth. Measurement of bacterial growth. Cultivation of bacteria-		
	culture media and methods. Aerobic and Anaerobic culture		
	methods. Culture preservation techniques. Microbial locomotion –		
	flagellar motility, gliding motility and amoeboid motion.		
	Chemotaxis, Phototaxis and other taxes. Microbial photosynthesis.		
4	Identification of bacteria and Sterilization methods:	5	10
	Identification of bacteria. Staining reactions. Cultural,		
	physiological and biochemical properties. Molecular methods for		
	identification. Sterilisation – Principles and methods, physical and		
	chemical methods. Disinfectants - modes of action. Testing of		
	disinfectants. Antibiotics - mechanism of action. Drug resistance		
	in bacteria. Antibiotic sensitivity tests		
	Total Credits of the Course	3	60

Teachingand LearningApp	Classroom Procedure (Mode of transaction)				
roach	Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning, interactive Instruction: Active co-operative learning, Seminar, Group Assignments Authentic learning: Library work and Group discussion, Presentation by individual student/ Group representative				
Assessment Types	Mode of Assessment				
- J F - 2	C. Continuous Internal Assessment (CIA)				
	1. Internal Tests of maximum 20 marks				
	2. Seminar Presentation – a theme is to be				
	discussed and identified to prepare a paper and				
	present in the seminar Maximum marks 10				
	3. Write a detailed report on a given topic based on				
	research findings and literature search -10				

marks D. Semester End examination – 60 marks

References

Compu	ulsory Reading:
1.	Prescott, L. M., Harley, J. P. and Klein, D. A.2014. <i>Microbiology</i> . 9 th Edition. Edition, McGraw Hill Higher Education.
2.	. Pelczar, M. J. Jr., Chan, E. C. S. and Krieg, N. R. 1993. <i>Microbiology</i> , 5 th Edition, Tata MacGraw Hill Press.
Furthe	er Reading:
1.	Jeffrey C. Pommerville .2016. Alcamos fundamentals of microbiology. Tenth Edition.
	Jones and Bartlett Learning.
2.	Tortora G. J., Funke B. R. and Case C. L. 2015. <i>Microbiology: An Introduction</i> . 12 th
	Edition. Pearson Education Inc.
3.	Madigan, M. T. and Martinko, J. M. 2015. Brock's Biology of Microorganisms. 14th
	Edition. Pearson Education Inc.
4.	.Willey, J. M., Sherwood, L. M. and Woolverton, C. J. 2013. Prescott's Microbiology.
	8 th Edition, McGraw-Hill Higher Education.
5.	Stanier, R. Y., Adelberg, E. A. and Ingraham, J. L. 1987. General Microbiology, 5th
	Edition. Macmillan Press Ltd.
6.	Russell, A. D., Hugo, W. B., and Ayliffe, G. A. J. 2013. Principles and practice of
	disinfection, preservation and sterilization, 5 th Edition. Blackwell Science, Oxford.
7.	Black, J. G. 2013. <i>Microbiology: Principles and Explorations</i> . 6 th Edition, John Wiley
	and Sons, Inc.
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	MAHATMA GANDHI UNIVERSITY						
रिहारा अमृतम्पवन्ते	BSM 21C 03: CELL BIOLOGY, GENETICS & EVOLUTION						
SchoolName	School of Biosciences						
Programme	Msc Biochemistr	Msc Biochemistry/ Microbiology/ Biotechnology/ Biophysics					
Course Name	CELL BIOLOG	Y, GEN	ETICS &	& EVOLU	UTION		
Type of Course	Core						
Course Code	BSM 21C 03						
Course Summary & Justification	is course on Cell Biology and Genetics deals with the frontier areas of basic biology e objective of the course content is to create a sound awareness about the current developments taking place in different fields of cell biology and genetics The course content is designed with a view to augment CSIR/UGC syllabus						
Semester	First						
Total StudentLearning (SLT)Learning ApproachLectureTutorialPracticalOthersLearning Learning ApproachLectureTutorialPracticalOthersLearning Learning						Total LearningHours	
Dro roquisito	Authentic learning Collaborative learning Independent learning	60	20	0	40	120	
Pre-requisite	Basics of cell biology and genetics						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1	ild a perspective on current developments in the fields of cell biology, genetics and evolution and the cellular level organization of organisms	Е	1
2	mpare and analyze the processes of cell cycle, cell division, cell differentiation and cell death and analyze the relationship between cell cycle, ageing, cell death and cancer	U/ An	1

3	Explain the processes, laws, and theories related to inheritance and evolution	R	1, 2
4	Perform genetic mapping based on data supplied	S	2, 4
5	aluate the behavior of genotypes and alleles in natural populations	Е	2, 4
6	Communicate effectively about a given topic in cellbiology/ genetics/ evolution both verbally and in writing	An/ C	1
*Reme and Ap	mber (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Crea preciation (Ap)	tte (C), Skill (S),	Interest (I)

COURSE CONTENT

Module	Module Content	Credits	Hrs
No		0100105	
<u>No</u> 1	Cell and its constituents: Cell constituents - Mitochondria, Chloroplast, Endoplasmic Reticulum Golgi complex, Peroxisomes, Lysosome, Ribosome, Nucleus, Nucleolus, Chromosomes, Nucleosomes, Histones, Genome, Genomics, Proteomics. Cell cycle and Cancer: Cell cycle- Different stages, variations, checkpoints, regulations of cell cycle, maturation Promoting factor, cells, cyclins, ubiquitin, protein ligases, Anaphase Promoting complex, inhibitors of CdK, growth factors and D cyclins. Rb protein and E2F transcription factors. Cancer - Stages in cancer development, causes, properties of cancerous cells, tumor Viruses, oncogenes, functions of oncogene	1,2,6	10
	cancerous cells, tumor viruses, oncogenes, functions of oncogene products, oncogene and signal Transduction, oncogene and G proteins, oncogene and cell survival, Tumor Suppressor gene, functions of tumor suppressor gene products, Diagnosis ,prevention and treatment of cancer		
2	 Cell Differentiation-Stages of development, regulation of development, cascade control/ Differentiation in Drosophila, maternal, Segmentation and homeotic Genes, Genetic control of embryonic development, Bi thorax mutant, Antennapediac mutant ,Hemeobox Aging Process of aging, theories of aging, Arking's contribution Oxidative stress, Telomere problem, DNA repair defects. Cell Death Necrosis and Apoptosis, Differences between necrosis and Apoptosis, stages in Apoptosis, mitochondrial damage DNA ladders, transglutaminase activity, programmed cell death in <i>Ceanorhabdtis elegans</i> CED 3, CED 4, CED 9 and their roles in Apoptosis Bax, Bid, Bcl2 protein 	1,2,6	10
3.	Classical Genetics: Genetics, the evolution of the subject through pre mendelian, Mendelian and post Mendelian Peroids. Mendelism – the basis principles of inheritance, gene interactions – allelic and no allelic. Environment and gene expression, penetrance and expressivity. Multiple alleles and polygenic inheritance, Heritability and genetic advance	3, 6	20

	Evolution: Origin of the universe and origin of life; concept of Oparin, Miller-Urey Experiments; Evolution of Prokaryotes - origin of eukaryotic cells - Margulis Endosymbiotic theory; Geological Timescale: Tools and techniques in estimating evolutionary time scale; Theories of evolution of life : Pre-Darwinian concepts – Lamarkism, Darwinism – major concepts - variation, adaptation, struggle, fitness and natural selection, Neo-Darwinian theories – theories of speciation – allopatric and cumpatria speciation – Rose Mary and Pater Grapt (Molacular		
	evolution in Darwinian finches) - Neutral Theory of Molecular		
	Evolution.		
4	Chromasome genetic mapping ,Organelle Genetics and Population Genetics: Linkage and linked genes with special reference to inheritance, Chromosome mapping with three - point test crosses. Organelle Genetics and cytoplasmic inheritance. Population Genetics – types of gene variations, Measuring genetic variations, Hardy Weinberg principle and its deviations. Medical genetics - an introduction	4,5,6	10
5	Genetic System in Microbe, Yeast and Neurospora: Plasmids & bacterial sex. Types of plasmids. Plasmids copy number and incompatibility, Replication of plasmid. Plasmid a cloning vector. Episomes. Transposable element-IS element and transposon, Integrons and Antibiotic resistance cassettes, Multiple antibiotic resistant bacteria, Mu-virus. Gene mapping in Bacteria. Bacteriophage genetics-Plaque formation & phage mutants, genetic recombination in lytic cycle. Genetic system in Yeast & Neurospora.	4,5,6	10
	Total Credits of the Course	3	60
1		1	

TeachingandLearningApproach	Classroom Procedure (Mode of transaction)
	Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning, interactive Instruction:, Active co-operative learning, Seminar, Group Assignments Authentic learning, , Library work and Group discussion, Presentation by individual student/ Group representative
Assessment Types	Mode of Assessment
	 A. Continuous Internal Assessment (CIA) 1. Internal Tests of maximum 20 marks 2. Seminar Presentation – a theme is to be discussed and identified to prepare a paper
	 and present in the seminar Maximum marks 10 3. Write a detailed report on a given topic based on research findings and literature search - 10 marks
	B. Semester End examination – 60 marks

REFERENCES

Compulsory Reading:

1. Jonathan B (2016) Principles of Evolution, Garland Science, Taylor and Francis

2. Strickberger M W (2015) Genetics 3rd Edition, Pearson

3. Genetics a conceptual approach. 6th edition. Benjamin Pierce, Macmillan Learning, New York

4.The Cell-A Molecular approach, Fifth edition, Geoffrey M Cooper and Robert E .Hausman. , ASM Press ,Washington DC

Further Reading:

- 1. Principles of Genetics, Snustad, Simmons and Jenkins, John Wiley And Sons Inc
- 2. Genetics, Robert Weaver and Philip Hendricks, WH.C. Brown Publishers, Iowa
- 3. Introduction to Genetic Analysis, Griffiths, Wessler, Lewontin, Gelbart, Suzuki and Miller, Freeman's and Co, New York
- 4. REA's Problem Solvers in Genetics, Research Education Association,61, Ethel Roadwest, New Jersey
- 5. Cell and Molecular Biology by Gerald Karp,7th Edition,
- 6. Cell and Molecular Biology by De Robertis E.D.P, 8th Edition

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MAHATMA GANDHI UNIVERSITY

BSM 21C 04: BIOPHYSICS AND BIOSTATISTICS

SchoolName	School of Biosciences					
Programme	Msc Biochemistry/ Microbiology/ Biotechnology/ Biophysics			sics		
Course Name	BIOPHYSICS AND BIOSTATISTICS					
Type of Course	Core					
Course Code	BSM 21C 04					
Course Summary & Justification	 This course is to introduce interdisciplinary Biophysics area, its scope and its importance The objective of the course is to give an insight into the basic concepts of thermodynamics, importance of basic biophysical phenomena, conformation and conformational changes, interaction of protein with other molecules and basic knowledge about radiation, its interaction with matter and its applications. The course content is to familiarize the basic concepts of biostatistics and its importance in research area of Life sciences 					
Semester	synabus		First			
Total StudentLearning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Authentic learning Collaborative learning Independent learning	60	20	0	40	120
Pre-requisite	Basics of Biophysics	s and Bio	statistics			

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1	plain the scope and importance of biophysics	Е	1
2	scribe the concepts of thermodynamics and applications of	U/ An	1, 2

	basic biophysical phenomena.		
3	Narrate the conformation and interaction of proteins and nucleic acids	R	1
4	Explain the electromagnetic radiation, its interaction with matter and applications.	S	1, 2
5	form the retrieval of biological information by using structural and sequence databases	Ε	1, 2, 4
6	Explain the basic concept of biostatistics and analyze, interpret statistical softwares and to do statistical design for their research	An/ C	1, 2, 4
*Remem and App	ber (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Crea reciation (Ap)	te (C), Skill (S),	Interest (I)

COURSE CONTENT

Module	Module Content	CO	Hrs
No			
1	Biophysical phenomena and Thermodynamics of biomolecular	2	10
	interactions: Scope and definition of Biophysics, Principle and		
	biological importance of Osmosis, Electroosmosis, osmotic		
	pressure, osmotic equilibrium, Donnan equilibrium, Diffusion,		
	Sedimentation, Filtration, Surface tension, Dialysis, Adsorption and		
	Colloids. Laws of thermodynamics, Enthalpy, Entropy, Free energy,		
	Redox reactions, Redox potential and its calculation by Nernst		
	equation, examples of redox reactions in biological system.		
2	Structural Biophysics and computational biology: The molecular	1, 3,	10
	interactions between proteins and nucleic acids: DNA- protein	5	
	interaction and RNA- protein interactions, DNA-binding motifs:		
	Helix-turn-Helix motif, Zn fingers, Helix-loop helix motifs and		
	Leucine zippers. Molecular forces: Hydrogen bonding, hydrophobic		
	interactions, Dipole interactions: charge-dipole interactions, induced		
	dipoles, steric repulsion, Vander waals force in biomolecules,		
	Structural and Sequence databases, Alignment algorithms; Retrieval		
	of biological information from widely used resources: NCBI and		
2	PDB, Molecular modelling and Structure based drug designing.	1 4	20
з.	Radiation Biophysics : Electromagnetic spectrum, ionizing and non	1,4	20
	rediction infrance and microwaya redictions. Dedicactivity		
	Interaction of radiation with matter Units of Padiation Biological		
	effects of radiation Applications of ionizing and non-ionising		
	radiations in industry, agriculture and research. Radiation hazards.		
4	Introduction to Biostatistics: Scope of Biostatistics, probability	5	10
-	and probability distribution analysis. Variables in biology-	C .	10
	collection, classification and tabulation of data- graphical and		
	diagrammatic representation- scatter diagrams, histograms-		

	frequency polygon- frequency curve-logarithmic curves. Descriptive statistics- measures of central tendency, Arithmetic mean, median, mode, geometric mean, harmonic mean. Measures of dispersion, standard deviation, standard error, variance, coefficient of variation. Correlation and Regression		
5	Test of significance: Basic idea of significance test- hypothesis testing, levels of significance. Testing of single mean, double mean, single proportion, double proportion in large sample. Testing of single mean, double mean and Paired- t in small sample. ANOVA-One way and Two way; Chi-square test of goodness of fit and Chi-square test of independence, comparison of means of two samples, three or more samples. Fundamentals of field experiments-randomization, replication and local control. CRD and RBD. Statistical packages	5	10
	Total Credits of the Course	3	60

Teachingand LearningApp roach	Classroom Procedure (Mode of transaction) Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning, interactive Instruction:, Active co-operative learning, Seminar, Group Assignments Authentic learning, , Library work and Group discussion, Presentation by individual student/ Group representative
Assessment Types	 Mode of Assessment A. Continuous Internal Assessment (CIA) Internal Tests of maximum 20 marks Seminar Presentation – a theme is to be discussed and identified to prepare a paper and present in the seminar Maximum marks 10 Write a detailed report on a given topic based on research findings and literature search – 10 marks B. Semester End examination – 60 marks

REFERENCES

Compulsory Reading:

- 1. Proteins, Structure and molecular properties, Thomas E Creighton
- 2. Fundamentals of Biostatistics: Irfan.A. khan, Atiya Khanum, Ukaaz publications
- 3. Principles of Biostatistics: Marcello Pagano, Kimberlee Gauvreau, Duxbury Press
- 4. Biochemistry: Donald Voet and Judith G Voet, Wiley Publications

Further Reading:

- 5. Biophysics-Hoope W etal
- 6. Biophysics-Volkenstain M.V

7. Molecular Biophysics- Volkenstain M.V

8. Introduction to thermodynamics of irreversible process-John Wiley

9. Statistical methods in Biology- Briley N.J.T

10. Introduction to Biophysics-Sokal R.R & Rohl F.J

11. Biostatistics: Pardeep.K.Jasra, Gurdeep Raj, Krishna prakashan Media.(P) Ltd

12. Bloomfield, V. (2009) Computer Simulation and Data Analysis in Molecular Biology and Biophysics. Springer

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MAHATMA GANDHI UNIVERSITY

BSM 21C 05: PHYSIOLOGY

SchoolName	School of Biosciences					
Programme	MSc Biochemistry/ Microbiology/ Biotechnology/ Biophysics					
Course Name	PHYSIOLOGY					
Type of Course	Core					
Course Code	BSM 21C 05					
Course Summary & Justification	is course is designed to provide an overview of human physiology. Course topics will include the various systems of the body, functions of each system, and interrelationships to maintain the internal environment. The course also provides inputs to physiological stress and adaptive strategies to overcome stress					
Semester			First			
Total StudentLearning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Authentic learning Collaborative learning Independent learning	60	20	0	40	120
Pre-requisite	Basics Knowledge in	Biology				

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1	Idents should be capable of effectively communicating how the human body works	U	1
2	idents should be able to explain interrelationships among molecular, cellular, tissue, and organ functions in each system	E	1, 2
3	Students should be able to describe the interdependency and interactions of the systems	A	1
4	Students should be able to explain contributions of organs and systems to the maintenance of homeostasis	А	1, 2
5	idents should be able to identify causes and effects of	Е	1, 2

	homeostatic imbalances		
6	Able to gain the approaches used to study various	Ι	1, 2, 4
	functional systems of the human body and physiologic		
	adaptation		
*Remem and App	ber (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Crea reciation (Ap)	ute (C), Skill (S),	Interest (I)

COURSE CONTENT

Module No	Module Content	CO	Hrs
1	The system as a basic unit in physiology: different systems in physiological process, interaction of different systems in normal and stress conditions, homeostasis, Neuro-Musculo-Skeletal systems: brain and peripheral nervous systems, neurotransmitters, synapse, neuro-muscular junction, musculoskeletal systems	1	10
2	Cardio-Pulmonary & Renal Physiology: Anatomy and general function of heart, blood and hemodynamic, blood pressure, heart rate, cardiac cycle, cardiac output, electrocardiography, echocardiography; anatomy of the respiratory system, principles of respiratory mechanisms, respiratory rate, lung volumes, oxygen uptake, lung function tests, gas transport; anatomy of the excretory system, nephron, glomerular filtration rate, urine formation, renal clearance test, renal regulation of electrolytes, dialysis	1, 2, 3	20
3.	Principles of endocrinology: Role of hormones for maintenance of the internal environment, hormone transport in blood, mechanism of hormone action, hormone metabolism and excretion, types of endocrine disorders, hypothalamus and pituitary, thyroid, adrenal glands, endocrine control of growth, sex hormones, pancreatic hormones, neurohormones	1, 4, 5	10
4	Gastrointestinal Physiology & Nutrition: Gastrointestinal structure, food digestion, and absorption, gastrointestinal hormones, central control of gastrointestinal functions, pathological situations of gastrointestinal functions. role of liver and bile in gastrointestinal functions.	3, 6	10
5	Stress physiology: Stress-responses, the role of the hypothalamic- hypophyseal-adrenal axis, oxidative stress and mechanism, effect of stress-inducing and anti-stress agents, cardio-respiratory responses during high altitude acclimatization, stress-induced diseases, and remedy, Hum an tolerances to stresses in space including space flight: Physiological adaptation to space flight, physiology in deep-sea diving and other high-pressure operations	6	10
	Total Credits of the Course	3	60

Teachingand LearningApp roach	Classroom Procedure (Mode of transaction) Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning, interactive Instruction:, Active co-operative learning, Seminar, Group Assignments Authentic learning, , Library work and Group discussion, Presentation by individual student/ Group representative				
Assessment Types	 Mode of Assessment A. Continuous Internal Assessment (CIA) Internal Tests of maximum 20 marks Seminar Presentation – a theme is to be discussed and identified to prepare a paper and present in the seminar Maximum marks 10 Write a detailed report on a given topic based on research findings and literature search – 10 marks B. Semester End examination – 60 marks 				
	B. Semester End examination – 60 marks				

REFERENCES

Compulsory Reading

- 1. Vander's Human Physiology- The mechanism of body function. Widmaier, Raff & Strang
- 2. Textbook of Medical Physiology. Arthur.C. Guyton& John.E. Hall
- 3. Physiological basis of Medical Practice. John.B. West
- 4. Endocrinology- Mac E Hadley

Further Reading:

Review of Medical Physiology- Ganong, William F

Biochemistry and Physiology of the cell. An introductory text second edition- Edwards, N. A Hassall, K.A

Notebook of medical physiology: endocrinology, with aspects of maternal, fetal and neonatal physiology- Hawker, Ross Wilson

Iuman Physiology: an integrated approach- Silverthorn, Dee Unglaub

rinciples of anatomy and physiology- Tortora, Gerald J Derrickson, Bryan

6.Textbook of Endocrine Physiology- Griffin, James E; Ed. Ojeda, Sergio R;Ed

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MAHATMA GANDHI UNIVERSITY
BSM 21C 06: LABORATORY COURSE-1

SchoolName	School of Biosciences						
Programme	M.Sc. Biochemistry/Microbiology/Biotechnology/Biophysics						
Course Name	LABORATORY COURSE- 1 (GENERAL BIOCHEMISTRY)						
Type of Course	Core	Core					
Course Code	BSM 21C 06	BSM 21C 06					
Course Summary & Justification	The course is designed the basic biochemical techniques for the separ- abilities of the students t	The course is designed to develop in students the essential skills to perform the basic biochemical assays, qualitative analysis of biomolecules and techniques for the separation of biomolecules. This will enhance the practical abilities of the students to carry out the analysis of biomolecules					
Semester			First				
Total StudentLearning Time (SLT)	Learning Approach	Learning Approach Lecture Tutorial Practical Others Total Learning Hours					
Due negoticite	Eg. Authentic learning Collaborative learning102012030180Independent learningImage: state of the state o						
Pre-requisite	General luea on reager	nts and so	orvents				

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1	To prepare reagents, buffers and other solutions in required concentrations and required pH.	Ар	3, 4
2	To extract and estimate different bio-molecules (sugar, cholesterol, and proteins) in biological samples	Ap/S	3, 4
3	To identify the different components in a mixture of carbohydrates	S	3, 4
4	To detect the presence of albumin, casein and gelatin in biological samples	S	3, 4
5	To perform separation by Paper and Thin layer chromatography	S	3, 4
*Remem and App	ber (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Crea reciation (Ap)	ute (C), Skill (S),	Interest (I)

COURSE CONTENT

Module	Module Content	CO	Hours	
NO	Dregenstion of achiticnes Dependence achiticnes Malan achiticnes	1	15	
1	Preparation of solutions: Percentage solutions, Molar solutions,	1	15	
	Normal solutions, Dilution of Stock solutions, Preparation of			
	butters using the Henderson Hasserbach equation			
2	Spectrophotometric experiments: Verification of Beer Lambert's	2	45	
	law, Determination of UV-Visible spectrum of compounds,			
	Determination of Concentration of molecules from Molar			
	Extinction Coefficient values			
	Extraction of Polysaccharides (Starch/Glycogen), Proteins, and			
	Lipids from appropriate sources and their estimations.			
	Estimations: Estimation of reducing sugars by Dinitrosalicylic			
	acid method, Estimation of proteins (Biuret and Lowry's			
	methods), Estimation of Methionine by Nitroprusside method,			
2	Estimation of Cholesterol by Zak's method.	2.4	45	
3.	Qualitative analysis of Carbonydrate mixtures (a combination of nolygoscharida, disascharida, and managascharida) following	3,4	45	
	porysaccharide, disaccharide and monosaccharide) following			
	glucose fructose vylose galactose sucrose maltose lactose)			
	Qualitative analysis of proteins- Albumin casein gelatin			
	Quantative analysis of proteins "Atounini, cusein, genatin			
4	Chromatographic techniques:	5	15	
	Separation of amino acids by Paper chromatography (Descending			
	or Ascending), Separation of Plant pigments by Thin layer			
	chromatography			
	Total Credits of the Course	2	120	
Books for Reference				
Compulsory Reading:				
1. Introductory Practical biochemistry, S. K. Sawhney & Randhir Singh (eds) Narosa				
Publ	 Publishing House, New Deini, ISBN 81-7319-302-9, p 195 – 303 Standard Methods of Biochemical Analysis S K Thimmaiah (ed) Kalyani Publishers 			
Ludhiana ISBN 81-7663-067-5, p 12 - 182.				
Further Reading:				
3. Hawk's Physiological Chemistry, Bernard L. Oser (ed) TATA McGRAW Hill Publishing				
Com	Company LTD, New Delhi, p 60 – 127, 1317-1334 4 Experimental Biochemistry: A Student Companion Basely Sociabor Base & Viiov			
4. Expe	perimental Biocnemistry: A Student Companion, Beedu Sasidhar Rao & Vijay			
49 -	49 - 72			
5. Prac	5. Practical Biochemistry, R.C. Gupta & S. Bhargava (eds) CBS Publishers and Distributors,			
New	New Delhi, ISBN 81-239-0124-0 p 9 – 27			
6. Practical Clinical Chemistry, Harold Varley, CBS Publishers and Distributors, New				
 Company LTD, New Delhi, p 60 – 127, 1317-1334 4. Experimental Biochemistry: A Student Companion, Beedu Sasidhar Rao & Vijay Deshpande (ed), I.K International Pvt. LTD, New Delhi ISBN 81-88237-41-8, p 13-17, p 49 - 72 5. Practical Biochemistry, R.C. Gupta & S. Bhargava (eds) CBS Publishers and Distributors, New Delhi, ISBN 81-239-0124-0 p 9 – 27 6. Practical Clinical Chemistry, Harold Varley, CBS Publishers and Distributors, New Delhi 				
TeachinganuLearningApproach	Laboratory Procedure (Mode of transaction)			
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	Direct Instruction: lecture, Explicit Teaching, Demonstration, Hands on experimental sections, Skill acquisition by laboratory training			
Assessment Types	Mode of Assessment			
	 C. Continuous Internal Assessment (CIA) Internal Laboratory Skill Tests of maximum 20 marks 2. Seminar Presentation – Laboratory material and methods Maximum marks 3. Write a detailed report on instrumentation – 10 marks D. Semester End Practical examination – 60 marks 			

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BSM 21C 07: LABORATORY COURSE-2

SchoolName	School of Biosciences					
Programme	MSc Biochemistry/ Microbiology/ Biotechnology/ Biophysics					
Course Name	LABORATORY CO	URSE-2	(PHYSI	OLOGY)	
Type of Course	Core					
Course Code	BSM 21C 07					
Course Summary & Justification	e purpose of this laboratory course is to provide the student with the opportunity to observe many physiological principles. The course is designed to understand the mechanisms related to cardiovascular and respiratory functions.					
Semester			First			
Total StudentLearning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Authentic learning Collaborative learning Independent learning	5	5	120		130
Pre-requisite	Basics Knowledge in	Biology				·

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.		
1	ply appropriate safety standards in laboratory	А	2		
2	quire laboratory skills in haematology, cardiovascular and respiratory physiology	S	3, 4		
3	Appropriately utilize laboratory equipment, such as microscopes, dissection tools, general labware, physiology data acquisition systems	S	2, 3, 4		
4	mmunicate results of scientific investigations, analyse data, and formulate conclusions	С	3, 4		
5	idents should be able to identify cell structure	U	1		
6	Work collaboratively to perform experiments	Ι	2		
*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I)					

and Appreciation (Ap)

	Module Content	CO	Hrs
Module No			
1	Haematology	1, 2,	60
	i) Determination of haemoglobin concentration	5, 6	
	ii) Enumeration of formed elements- red blood cells & white blood		
	cells		
	iii) Study of blood smear for the differential count and cell		
	morphology		
	iv) Erythrocyte sedimentation rate		
	v) Determination of the bleeding time		
	vi) Determination of clotting time		
2	Respiratory physiology- Pulmonary function testing	1, 3,	30
	i) Demonstration on the recording of tidal volume	0	
	ii) Demonstration on the recording of vital capacities		
	iii) Demonstration on the recording of inspiratory & expiratory		
	flow rates		
3.	Cardiovascular physiology- Electrocardiography	1, 3,	30
	i) Demonstration on ECG recording- human or animal model	4,0	
	ii) Identification of ECG waves		
	iii) Calculation of heart rate from ECG		
	Total Credits of the Course	2	120

Teachingand	Laboratory Procedure (Mode of transaction)
LearningApp	Direct Instruction: lecture, Explicit Teaching, Demonstration, Hands on
roach	experimental sections, Skill acquisition by laboratory training
Assessment Types	Mode of Assessment F. Continuous Internal Assessment (CIA) 1. Internal Laboratory Skill Tests of maximum 20

marks
2. Seminar Presentation – Laboratory material and
methods Maximum marks 10
3. Write a detailed report on instrumentation -10
marks
G. Semester End Practical examination – 60 marks

1	•	Medical	Laboratory	Technology-A	Procedure	Manual	for	Routine	Diagnostic
		Tests- K	anai L Mukł	nerjee					

- 2. Pocket Guide to Spirometry- David P Johns and Rob Pierce
- 3. Spirometry in Practice- A practical guide to using spirometry in primary care- Dr. David Bellamy, British Thoracic Society COPD consortium.
- 4. ECGs made easy- Barbara J Aehlert

Further Reading:

CG Assessment and Interpretation- Cascio, Toni ntroduction to medical laboratory technology- Baker, F J Silverton, R E ractical haematology- Dacie, John V Lewis, S.M

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	MAHATMA GANDHI UNIVERSITY
विद्यया अमुतमवन्ते	Entry level orientation programme in applied life sciences

SchoolName	School of Biosciences
Programme	M.Sc. Biochemistry, Biotechnology, Microbiology, Biophysics
Course Name	Entry level orientation programme in applied life sciences
Type of Course	Noncredit course
Course Code	SBSNCC 1
Course Summary & Justification	The proposed course is offered as a noncredit mandatory course at the

	entry level for all the	entry level for all the PG students of school of Biosciences. The course				
	content is inclusive of the scope and opportunities in various branches of					
	applied life sciences along with suitable discussion on the preliminary					
	aspects of lab training. It gives an orientation to the students coming					
	from different discipli	from different disciplines of life science graduation and brings them to a				
	common platform fo	r further	learning	. This is a	two -	week long
	bridging course					
Semester			First			
Total Student Learning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Authentic learning Collaborative learning Independent learning	60		0		60
Pre-requisite	Fundamental Knowled	lge in Life	e Science	S		

COURSEOUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1.	The students from various branches of life sciences are brought to a common platform	R/U	1
2.	The students will be getting a clear understanding of the different opportunities in their subject	R/U	1
3.	The course focusses on the requirement of awareness on good laboratory practices	U/ An	1
4.	The proposed entry stage training offers a good exposure to the field of research	U/An	1
5.	The students will be exposed to certain preliminary requirements for initiating startups, getting into QC, R&D	C/S	1
6.	The students on completing this entry stage course will be able to get along with the two-year course with a defined objective	A/S	1
*Reme	mber (R), Understand (U), Apply (A), Analyse (An), Evalua	te (E), Create	(C), Skill

Modu	Module Content	СО	Hrs
le No			
1	Scope of the subject Introducing the subject of Biochemistry, Biotechnology, Microbiology, Biophysics. Importance and recent trends, Opportunities. Method of teaching, learning and evaluation. Outcome based Education, Credit and semester system.	1	10
2	Good laboratory practices Laboratory instructions , Handling of Chemicals, Basics of weights and measureents, handling of equipment, Lab procedure, keeping of Lab record, Personal qualities and scientific conduct.	3	20
3.	Basic Chemistry for Lab Work Preparation of solutions, Methods for expressing concentration of solution, Colligative properties, Normality, Molarity, Molality, Mole fraction. pH, Buffering system, Examples Henderson Hasselbalch Equation.	5	10
4	Research opportunities Introduction to research, research aptitude, experimental design and research conduct, research problems, recent trends, Concept of research paper and review writing, plagiarism, Grammar editing softwares Regulatory bodies in life sciences, Patents and patent rules, Ethical Concepts-Research ethics, Bioethics. CSIR, UGC, GATE, DBT, DST, ICMR, ICAR, KSCSTE, fellowships, Projects, Opportunities.	1, 2, 4	10
5	Job opportunities Introduction to Entrepreneurial process and types of Business, opportunities, Startups, Basics of marketing, Quality control and management, R and D management, Innovation and knowledge management, Knowledge economy, Upskilling, Project preparation, team building,	1, 5, 6	10
	Total Credits	0	60

Teaching And Learning Approach	Classroom Procedure (Mode of transaction) Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning, interactive Instruction, Active co-operative learning, Seminar, Group Assignments Authentic learning, Library work and Group discussion, Presentation by individual student/ Group representative
Assessment Types	 Mode of Assessment A. Continuous Internal Assessment (CIA) B. Write a detailed report on a given topic based on research findings and literature search (Graded as very good, satisfactory and not satisfactory)

Compulsory Reading: 1.Principles and techniques of Biochemistry and Molecular biology, Andreas Hofmann and Samuel Clokie, Cambridge University Press, 8 th edition,2018 2.Holmes D ., Moody P and Dine D.(2010).Research methods for the Biosciences,2 nd Editions, Oxford University Press,Oxford, UK. 3.Smith D (2003).Five Principles for research ethics, Monitor on Psychology 34. 56. Further Reading: 4.Taylor P.L.(2007).Research sharing, ethics and public benefit. Nature Biotechnology, 25,398-401. 5.Duke C.S. and Porter J.H (2013).The ethics of data sharing and reuse in Biology, Bioscience 63,483-489.

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SECOND SEMESTER



BSM 21C 08: IMMUNOLOGY

School Name	School of Discoinness					
School Name	School of Biosciences					
Programme	M.Sc. Microbiology/Biotechnology/Biochemistry/Biophysics					
Course Name	IMMUNOLOGY					
Type of Course	Core	Core				
Course Code	BSM 21C 08					
Course Summary	Course Summary s course on Immunology deals with various mechanisms and			d processes		
& Justification	involved in the defense	e respons	es. This c	ourse is an	importar	nt branch of
	life science. Human b	ody has c	lifferent l	ines of defe	ense to fi	ight against
	pathogens. The cont	ent in th	is course	e has been	designe	ed with an
	objective to provide detailed understanding on the process and					
	mechanisms involved in the defense responses. Understanding on the					
	functioning of immune system is highly essential for a student to					
	explore its theoretical and practical aspects for the benefit of society.					
Semester	Second					
Total Student						
Learning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total LearningH ours
	Authentic learning Collaborative learning Independent learning	60	20	0	40	120
Pre-requisite	E Knowledge in any bra	Basic unde	erstanding Te science	g on defense	response	es

COURSEOUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1.	Students will able to understand and explain basic principles of immunology	R/U	1
2		D/U	1.0
2.	Students will able to learn the recent advances in	R/U	1, 2
	immunology		
3.	Students will able to analyse the clinical importance of	U/ An	2
	immunological reactions		
4.	Students will become able to identify the correlation	U/An	2, 4
	between immunological abnormalities and health status		7
	of humans		
5.	Students will get theoretical and technical know-how for	C/S	1, 2, 3, 4
	the laboratory diagnosis of infectious diseases		
6.	Students can apply the knowledge and skills for clinical	A/S	1, 2
	and diagnostic applications		
*Remer (S), Inte	nber (R), Understand (U), Apply (A), Analyse (An), Evalua erest (I) and Appreciation (Ap)	te (E), Create	(C), Skill

Modu	Module Content	CO	Hrs
le No			
1	Infection, Source and methods of transmission, Immunity- Types	1	10
	of immunity. Mechanisms of innate immunity, PAMPs, pattern		
	recognition receptors, types, scavenger receptors and toll - like		
	receptors, Phagocytes and Phagocytosis, Organs and cells with		
	immune functions. Lymphocytes and lymphocyte maturation.		
	PAMPs and PRRs in plants		
2	Antigens, Epitopes and paratopes, B-cell and T-cell epitope,	1, 2	20
	Antigenicity and Immunogenicity, Antibodies, Immunoglobulin -		
	structure, classes and functions. Genetic basis of antibody		
	diversity, Organization and Expression of Immunoglobulin Genes,		
	V(D)J rearrangements; recombination signal sequences and their		
	role, somatic hypermutation and affinity maturation Antigen-		

	antibody reactions, Agglutination, Precipitation,		
	Immunoflourescence, Complement fixation, Radioimmuno assay,		
	ELISA, Western blotting		
3.	Immune response- Humoral and cell mediated, Receptors on T and	2, 3, 4	10
	B cells for antigens, MHC, TCR- mediated signalling, Signal		
	transduction pathways associated with T-cell activation, Signal		
	transduction by activated B- cell receptor, Antibody production,		
	Primary and secondary immune response, Factors influencing		
	antibody production, Clonal selection theory, Monoclonal		
	antibodies - production and application, Antibody engineering.		
	Complement system, Complement activation, Biological effects of		
	complements, Antigen processing and presentation, Activation of		
	T-cells, T cell function, Cytokines. Human microbiome and		
	immunity		
4	Immunology of organ and tissue transplantation, Allograft reaction	2, 4, 5	10
	and GVH reaction, Factors influencing allograft survival,		
	Immunology of malignancy, Tumor antigens, Immune response in		
	malignancy, Immunotherapy of cancer, Immunohematology, ABO		
	and Rh blood group system, Immunology of blood transfusion,		
	Hemolytic disease of new born		
5	Immunological Tolerance, Autoimmunity, Mechanisms of	2, 6	10
	autoimmunization, Autoimmune diseases. Inflammation,		
	Hypersensitivity – immediate and delayed reactions, Clinical types		
	of hypersensitivity, Immunodeficiency diseases,		
	Immunoprophylaxis, Vaccines -types of vaccines, DNA vaccine,		
	recent trends in vaccine development.		
	Total Credits	3	60

Teaching And	Classroom Procedure (Mode of transaction)
Learning	Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning,
Approach	interactive Instruction, Active co-operative learning, Seminar, Group
	Assignments Authentic learning, Library work and Group discussion,
	Presentation by individual student/ Group representative

Assessment Types	Mode of Assessment
Types	C. Continuous Internal Assessment (CIA)
	1. Internal Tests of maximum 20 marks
	2. Seminar Presentation – a theme is to be discussed
	and identified to prepare a paper and present in
	the seminar - Maximum marks 10
	3. Write a detailed report on a given topic based on
	research findings and literature search -10
	marks
	D. Semester End examination – 60 marks

Compulsory Reading:
1. Immunology - Thomas J. Kindt, Barbara A. Osborne, Richard A. Goldsby, and Janis Kuby, W H Freeman and Co., 2013
2. Immunobiology - Charles A. Janeway Jr., Paul Travers, Mark Walport and Mark J.

2. Immunobiology - Charles A. Janeway Jr., Paul Travers, Mark Walport and Mark J. Shlomchik, Garland Publishing., 2016

Further Reading:

3. Essential Immunology - Ivan M. Roitt and Peter J delves, Blackwell Publishing, 2016

4. Essential Clinical Immunology – Helen Chappel and Mansel Haeney, ELBS/Blackwell Scientific Publications, 2014

5. Introduction to Immunology – John W, Kimball Maxwell, Mac Millan International Edition, 1990

6.Text book of Microbiology – R. Ananthanarayanan and C K Jayaram Panicker. Orient Longman,2013

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BSM 21C 09: MOLECULAR BIOLOGY AND GENETIC ENGINEERING

School Name	School of Biosciences					
Programme	Msc Biochemistry/ Microbiology/ Biotechnology/ Biophysics					
Course Name	Molecular Biology ar	Molecular Biology and Genetic Engineering				
Type of Course	Core					
Course Code	BSM 21C 09					
Course Summary & Justification	 Molecular Biology and Genetic Engineering is one of the most dynamic and attractive courses in all branches of applied life sciences The syllabus content in this paper is designed with an objective to train the students in both theoretical and practical aspects of the subject This will also enable the students to get an idea about the latest developments taking place in this subject 					
Semester		1	Second		1	
Total StudentLearning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Authentic learning Collaborative learning Independent learning	60	20	0	40	120
Pre-requisite	Basics of cell and molecular biology, Basics of tools and techniques of genetic engineering					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1	completing this course the students will be able to plain the processes of replication, transcription and translation and analyse the importance of these processes in health and disease	E	1
2	plain the concepts of gene regulation in prokaryotes and RNA world	R/E	1
3	alyse the use of different tools and techniques of gene cloning in E coli and explain the applications of DNA technology	U	2, 3, 4
4	ility to develop a protocol for cloning a gene from a selected	А	2, 3

	organism						
5	ility to explain verbally and orally the concepts of molecular	Е	1				
	biology and genetic engineering						
6	Ability to write a research proposal based on the concepts	An/ C	1, 2				
	discussed in the course						
*Remem and App	*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)						

Module	e Module Content		Hrs
No			
1	Replication – Process of DNA replication, Semiconservative,	1,	10
	discontinuous uni and bidirectional, Okazaki fragments, DNA	5,6	
	polymerases in eukaryotes and prokaryotes, Klenov fragment, modes		
	of replication, theta, rolling circle, d-loop replication, Primasome,		
	SSB, Helicase, Ligase, methylation and control, repetitive DNA		
	sequences, minisatellite, microsatellite, DNA protein interation DNA		
	Linking number and topoisomerase, Inhibition of replication.		
2	Transcription. Process of transcription, stages in transcription, RNA	1,	15
	polymerases in prokaryotes and enkaryotes, signafactor in	2,	
	prokaryotes, Rho dependant and Rho independent termination.	5,6	
	Enhancers, Transcription factors in Eukaryotes, Differences in	-	
	transcription between prokaryotes and Eukaryotes, post transcriptional		
	modifications-Polyadenylation, capping, r-RNA processing, Splicing-		
	Spliceosome, lariat structure, Group 1, II and III Introns Rihozyme,		
	Importance of ribozyme, properties, application, RNase P. RNAse III.		
	RNAse H. monocistonic and polysistronic m-RNA. Joint transcript of		
	r-RNA and t-RNA in prokarvotes and their processing. Transplicing		
	alternate splicing inhibitors of Transcription		
	Molecular mechanism of gene regulation in prokarvotes-		
	Transcriptional regulation in prokarvotes: Inducible & repressible		
	system.+ & -ve regulation: Operon concept, structure of operon. Lac.		
Trp, Arc operon, Catabolic repression, Atteunation. Role of Horm			
	in gene regulation.		
	RNA World, RNA based technology- Molecular mechanism of		
	Ribozyme, Antisense RNA, SiRNA, MicroRNA, Ribozwitches & their		
	applications: Telomerase structure and function. Nucleic acid as		
	therapeutic agent		
3.	Translation: Process of translation. Stages in translation, genetic	2,	10
	code, properties, wobble hypothesis, eukaryotes and prokaryotes	5,6	
	ribosomes, m-RNAs, t-RNAs, aminoacyl t-RNA synthatases, protein	· ·	
	factors initiation complex, peptidyl transferase, releasing factors,		
	differences between prokaryotic and eukaryotic systems, inhibition of		
	translation. Post translation modification by cleavage, self assembly		
	assisted self assembly chaperones, acylation, phosphorylation,		
	acetylation and glycosylation, Histone acetylation and deacetylases,		
	chromosome remodeling complex. Intein splicing. Protein targeting,		
	cotranslational import, post translational import, SRP- structure an		
	function, Blobel's concept, Lysosome targeting, M6P address		

	Glycosylation core glycosylation terminal glycosylation, Dolichol phosphate.		
4	Tools and techniques for genetic Engineering: History of rDNA Technology ,Cohen And Boyer Patents, Isolation of DNA and RNA from different sources, enzymes used in genetic engineering with special reference to restriction enzymes, ligases, and other DNA modifying enzymes. End modification of restriction fragments, vaccinia topoisomerases mediated ligation of DNA, TA cloning, and homopolymer tailing Vectors for E coli with special reference to plasmid vectors (pSC101, pBR322,pUC,their development, features and selection procedures),direct selection plasmid vectors, low copy number plasmid vectors, runaway plasmid vectors, Bacteriophages (λ and M13) with special reference to Charon phages, λ EMBL, λ WES λ B', λ ZAP- their development, features, selection procedures, <i>in vitro</i> packaging mechanisms for phage vectors, cosmids, features, advantages and cosmid cloning schemes, phagemids with special reference to pEMBL, pBluescript, pGEM3Z, pSP64, pcDNA, pLITMUS Construction of genomic libraries and cDNA libraries, procedures for recombinant selection and library screening, PCR enzymes, types of PCR, primer design, real time PCR, RTPCR, Nested PCR, Inverse PCR, Assymmetric PCR, applications of PCR Cloning, Chemical synthesis of DNA, DNA sequencing:- plus and minus sequencing, Sangers dideoxy sequencing, Maxam and Gilberts method. Advanced sequencing procedures: – pyrosequencing, Illumina, ABI / SOLiD and their applications	3, 4, 5, 6	20
5	Appications of Genetic Engineering: Applications of transgenic Technology Improving quality, quantity and storage life of fruits and vegetables. Plants with novel features, Engineering metabolic pathways, Pharming. Animal cloning, Ethics of cloning. Applications of Molecular Biology in forensic sciences, medical science, archeology and paleontology	3, 4, 5, 6	5
	Total Credits of the Course	3	60

Teachingand LearningApp	Classroom Procedure (Mode of transaction)			
roach	Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning, interactive Instruction:, Active co-operative learning, Seminar, Group Assignments Authentic learning, , Library work and Group discussion, Presentation by individual student/ Group representative			
Assessment Types	Mode of Assessment			
	H. Continuous Internal Assessment (CIA)			
	1. Internal Tests of maximum 20 marks			
	2. Seminar Presentation $-$ a theme is to be			
	discussed and identified to prepare a paper and present in the seminar Maximum marks 10			
	3. Write a detailed report on a given topic based on			
	research findings and literature search -10			

	I.	marks Semester End examination – 60 marks

Compulsory Reading:

- 1. Principles of gene manipulation Old and Primrose, Blackwell Scientific publishers, Edn.5th
- 2. Cell and Molecular Biology by Cooper

Further Reading:

- 1. Principles of gene manipulation Old and Primrose, Blackwell Scientific publishers, Edn.5th
- 2. Principles of gene manipulation Old, Primrose, and Twyman, Blackwell Scientific publishers, Edn. 6th
- 3. Principles of gene manipulation Old, Primrose, and Twyman Blackwell Scientific publishers, Edn 7th
- 4. Molecular biotechnology, Principles and Applications of Recombinant DNA, Glick Pasternak and Patten, 4th edition ISBN 978-1-55581-498-4 Wiley International Publishers
- 5. From gene to genomes Concepts and applications of DNA technology Jeromy W Dale and Malcom von Shantz , John Wiley and sons
- 6. Principles of plant biotechnology: An introduction to genetic engineering in plants SH Mantell
- 7. Cell and Molecular Biology by Gerald Karp, Academic Press
- 8. Cell Biology by DeRobertis
- 7. Genes-Benjamin Lewin

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	MAHATMA GANDHI UNIVERSITY
विद्याया अस्प्रतमारम्ल	BSM 21C 10: METABOLISM AND BIOENERGETICS

SchoolName	School of Biosciences
Programme	M.Sc. Biochemistry/Microbiology/Biotechnology/Biophysics
Course Name	METABOLISM AND BIOENERGETICS
Type of Course	Core
Course Code	BSM 21C 10

Course Summary & Justification Semester	The course is designed to get a deep knowledge of metabolic processes taking place in the biological systems and their regulation, which is needed to understand the more specialised areas of Biochemistry. Second					
Total Student Learning Time (SLT)Learning ApproachLectureTutorialPracticalOthers					Total Learning Hours	
	Eg. Authentic learning Collaborative learning Independent learning	60	20	0	40	120
Pre-requisite	Basic understanding of chemical groups and bonding; basics of cell biology and physiology					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.			
1	be able to categorize, differentiate and predict the fates of different biomolecules via the metabolic pathways.	U/A	1, 2			
2	To draw conclusions on the energetics of the metabolic pathways and to find out the variations in ATP generation during physiological and pathological conditions	A	1, 2			
3	analyse different methods of regulation of the metabolic pathways.	A/An	1, 2			
4	Describe the different steps involved and the importance of metabolomics in toxicity analysis and health management	A	1, 2, 3			
*Remem and App	*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)					

Module No	Module Content	CO	Hours
1	Metabolic Pathways: Detailed study on the catabolic pathways & anabolic Pathways -Carbohydrate, Protein, Amino acid and Nucleic acid and lipid metabolic pathways.	1	20

-						
2	Bioenergetics: Functional significance of the mitochondrial	1, 2	15			
	respiratory chain and oxidative phosphorylation, Electron					
	transport chain: structural components of the chain, complexes,					
	free elements: Structure and functional properties of					
	cytochromes ferro-sulphurated proteins and CoO. Generation of					
	the electrochemical proton gradient. Chemiosmosis ATP					
	une electrochemical proton gradient. Chemiosinosis Arr					
	synthesis- Floton now unough ATF synthase, Kotauonai					
	catalysis. Inmotors and uncouplers	2	10			
3.	Regulation of metabolism: Hormonal and Allosteric regulation	3	10			
	of pathways in carbohydrate, lipid, nucleotide, amino acid and					
	protein metabolism; Coordinated regulation of opposing					
	metabolic pathways; Regulation of mitochondrial electron					
	transport and oxidative phosphorylation.					
4	Signal Transduction: intracellular receptor and cell surface	3	10			
	receptors signaling: Cyclic AMP-dependent protein kinase:					
	Cyclic GMP-dependent protein kinase: Protein kinase C C^{2+} -					
	calmodulin-dependent protein kinases : AMP-dependent protein					
	kingsa : Recentor tyrosina kingsas: Protei\n kingsa B: Cytokina					
	activation of the IAK'/STAT nothway: Call evale control:					
	activation of the JAR/STAT pathway, Cen cycle control,					
	Receptor serine/uneonine kinases; Other protein kinases;					
	Phosphoprotein phosphatases; Cancer Pathways: MAPK, P13K,					
	TP53 network, NFkB pathways; Signalling by TGF β factor,					
	STAT factor					
5	Metabolomics: Introduction to origins of metabolomics; define	4	5			
	terms: Metabolite, Metabolome, Metabonomics; Analytical					
	techniques in study of Metabolomics (Principle & Methodolgy):					
	Separation methods: Gas Chromatography, HPLC, Capillary					
	Electrophoresis; Detection Methods: Mass spectroscopy, NMR.					
	Applications of Metabolomics in toxicity assessment/ toxicology,					
	diagnostics and health Screening					
	Total Credits of the Course	3	60			
	Books for Reference					
Compuls	sory Reading:					
1. Princ	iples Of Biochemistry, 4/e (2006) by Robert Horton H , Laurence	A Mora	n, Gray			
Scrim	ngeour K Publisher: Pearsarson ISBN: 0131977369, ISBN-13:	9780131	977365,			
978-0	0131977365					
2. Bioch	nemistry 6th Edition (2007) by Jeremy M.berg John L.tymoczko	o Lubert	t Stryer			
Publi	sher: B.i.publicationsPvt.Ltd ISBN:071676766X ISBN-13: 97807	1676766	54. 978-			
71676	57664		,			
3. L	ehninger Principles of Biochemistry, Fourth Edition by David L. Ne	lson Mic	hael M			
	ox Publisher: W H Freeman: Fourth Edition edition (April 23	2004) IS	RN_10.			
	7167/3396 ISBN-13: 978-07167/3392	2001) 15	D 1 1 10.			
0	107+5570 ISD 10-15. 770-07107+5572					
Further	Pooding:					
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• E.	S. West, W.K. 1000, H.S. Wason and J.I. van Bruggen, Alext Book	OT BIOCH	emistry,			
0	xiora and IBH Publishing Co., New Delhi, 19/4					
• B	• Biochemistry [with Cdrom] (2004) by Donald Voet, Judith G. Voet Publisher: John					
W	Wiley & Sons Inc ISBN: 047119350X ISBN-13: 9780471193500, 978-0471193500					
• P1	• Principles Of Biochemistry (1995) by Geoffrey L Zubay, William W Parson, Dennis					

• Principles Of Biochemistry (1995) by Geoffrey L Zubay, William W Parson, Dennis

- E Vance **Publisher:** Mcgraw-hill Book Company Koga **ISBN:**0697142752 **ISBN-13:** 9780697142757, 978-0697142757
- Biochemistry (2008) by Rastogi Publisher: Mcgraw Hill ISBN:0070527954 ISBN-13: 9780070527959, 978-0070527959

Teachingand LearningApp roach	Classroom Procedure (Mode of transaction) Direct Instruction, Explicit Teaching, E-learning, interactive Instruction:, Active co-operative learning, Seminar, Group Assignments, Authentic learning, Library work and Group discussion, Presentation by individual student/ Group representative			
Assessment Types	Mode of Assessment J. Continuous Internal Assessment (CIA) Internal Test -20 marks Assignment – Every student needs to write an assignment on a given topic based on the			
	available published literature – 10 marks Seminar Presentation – A topic needs to be presented and discussed with the class- 10 marks K. Semester End examination – 60 marks			

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BSM 21C 11: BIOPHYSICAL TECHNIQUES AND BIOINSTRUMENTATION

SchoolName	School of Biosciences						
Programme	MSc Biochemistry/ Microbiology/ Biotechnology/ Biophysics						
Course Name	BIOPHYSICAL TECHNIQUES AND BIOINSTRUMENTATION						
Type of Course	Core						
Course Code	BSM 21C 11						
Course Summary & Justification	This course is designed to introduce different techniques used in life sciences This course gives knowledge of the principle of operation and design of scientific instruments It attempts to render a broad and modern account of scientific						
Semester			Secon	d			
Total StudentLearning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total LearningHou rs	
	Authentic learning Collaborative learning Independent learning	60	20	0	40	120	
Pre-requisite	Basics of Biophysics and Biostatistics						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1	To explain the methods used for gaining information	E	1, 4
	about biological systems on an atomic or molecular level.		
2	To describe different spectroscopic techniques	U/ An	4
3	To perform various biophysical fractionation and separation of biomolecules	R	4
4	To describe how to perform electrophoretic techniques	S	2,4

5	To describe the procedures and applications of	E	1			
	hydrodynamic techniques					
6	To perform different microscopic techniquesAn/ C2, 3, 4					
*Reme (S), Int	*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)					

Module	Module Content	CO	Hrs
1 N0	Supervise techniquese Desis principles poture of	1.2	10
1	electroscopic techniques. Basic principles, nature of electromagnetic radiation, Interaction of light with matter, Absorption and emission of radiation; Atomic & Molecular Energy levels, Electronic, vibrational and Rotational spectroscopy of molecules, transition and selection rules; Atomic & Molecular spectra. Principle, Instrument Design, Methods & Applications of UV- Visible spectroscopy, Infrared spectroscopy, Raman Spectroscopy, Fluorescence spectroscopy, Nuclear magnetic Resonance Spectroscopy.	1, 2	10
2	Physicochemical Fractionation techniques : Principle, Instrument Design, methods and Applications of all types of Adsorption and Partition Chromatography- Paper chromatography, Thin layer chromatography, High Performance Thin layer Chromatography, Gel filtration chromatography, Affinity chromatography, Ion- exchange chromatography, High Pressure Liquid Chromatography. Reversed phase chromatography, Hydrophobic interaction chromatography, Chiral chromatography, Counter current chromatography, Fast protein liquid chromatography, Two dimensional chromatography.	1, 3	10
3.	Electro analytical techniques and Hydrodynamic Techniques: Principle, Electrophoretic mobility (EPM) estimation, factors affecting EPM, Instrument design & set-up, Methodology & Applications of Free and zone Electrophoresis – Paper electrophoresis, Gel electrophoresis, Poly Acrylamide gel electrophoresis, SDS PAGE, Capillary electrophoresis, Isoelectric focusing, Potentiometry, pH meter, Conductometry. Centrifugation & Ultracentrifugation-Basic principles, Forces involved, RCF Centrifugation, techniques- principles, types and applications. Viscometry- General features of fluid flow and nature of viscous drag for streamlined motion	1, 4, 5	20

4	Optical & Diffraction Techniques. Principle, Instrument Design,	6	10
	Methods & Applications of Polarimetry, Refractometry, Circular		
	Dichroism and optical rotatory dispersion: Plain, circular and		
	elliptical polarization of light, Relation between CD and ORD,		
	application of ORD in conformation and interactions of		
	biomolecules. Flow cytometry		
5	Microscopic techniques: Principle and working of Compound	6	10
	microscope, Phase contrast microscope, Interference microscope,		
	Fluorescence microscope, Polarizing microscope, Scanning and		
	Transmission Electron Microscopy, CCD camera, Introduction to		
	Atomic force microscopy, Confocal microscopy.		
Total Credits of the Course			60

Teachingand LearningApp	Classroom Procedure (Mode of transaction)						
roach	Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning, interactive Instruction:, Active co-operative learning, Seminar, Group Assignments Authentic learning, , Library work and Group discussion, Presentation by individual student/ Group representative						
Assessment Types	Mode of Assessment						
- 5 P - 5	A. Continuous Internal Assessment (CIA)						
	1. Internal Tests of maximum 20 marks						
	2. Seminar Presentation $-a$ theme is to be						
	discussed and identified to prepare a paper and						
	present in the seminar Maximum marks 10						
	3. Write a detailed report on a given topic based						
	on research findings and literature search – 10 marks						
	B. Semester End examination – 60 marks						

Compulsory Reading:

1.Principles and techniques of practical biochemistry: Keith Wilson and John walker, Cambridge 2. Modern Experimental Biochemistry. Rodney F Boyer. Nenjamin/ Cummings publishing company Inc. Redwood city, California

Further Reading:

- 1. Practical Biochemistry- Principles and techniques. Keith Wilson and John walker (Eds), University press, Cambridge UK.
- 2. Principles and Techniques of electron microscopy- Biological applications. M.A Hayat., Mac Millan Press, London UK.
- 3. Biophysical Chemistry: UpadhyayUpadhyay and Nath, Himalaya Publishing House
- 4. Chromatographic methods. A Braithwate and F J Smith. Chapman and hall, NewYork.
- 5. Gel Electrophoresis of Nucleic acids- A Practical approach. Rickwood D and BD Hames. IRL Press, New York. 53
- 6. Spectrophotometry and Spectrofluorimetry: A Practical Approach. Harris DA and CL Bashford (Ed.) IRL Press, Oxford.
- 7. Introduction to Spectroscopy. Donald L. Pavia Gary M Lipman, George S Kriz. Harcourt brace College Publishers, Orlands, Florida
- 8. Gradwohls Clinical Laboratory Techniques. Stanley s. Raphael. W.E. Company, London, UK
- 9. Fundamentals of molecular Spectroscopy: C N Banwell, Tata Mc Graw hill publishing Company Ltd.
- 10. Spectroscopic methods and analyses: Christopher Jones, Barbara Mulloy Adrian H.Thomas.
- 11. Methods in Modern Biophysics: Bengt Nolting, Springer.
- 12. Bio separations Science and Engineering: Roger G Harrison, Paul Todd, Scott .R. Rudge, Oxford University Press.

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SchoolName	School of Biosciences					
Programme	MSc.Microbiology/Biochemistry/Biophysics/Biotechnology					
Course Name	LABORATORY COURSE-3 (MICROBIOLOGY AND IMMUNOLOGY					
Type of Course	Core					
Course Code	BSM 21C 12					
Course Summary & Justification	course includes training on sterilization and disinfection techniques, morphological, cultural and biochemical study of microbes and antibiotic sensitivity tests. The content of the course also include serological techniques. The technical knowhow of basic microbiological and serological methods is essential for post graduate programmes in all branches of Biosciences.					
Semester			Second			
Total StudentLearning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Authentic learning Collaborative learning Independent learning	5	5	120		130
Pre-requisites	Theoretical knowledge Basic laboratory skills	Theoretical knowledge inMicrobiology and Immunology Basic laboratory skills				

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.		
1	idents will acquire skills on practice of sterile and safety precautions in a Microbiology laboratory.	А	2		
2	idents will be able to prepare and sterilize media and to culture bacteria and fungi in laboratory	S	2, 3, 4		
3	Students will be able to examine morphological, physiological and biochemical properties of bacteria	S/E	2, 3, 4		
4	Students will be able to perform and interpret antibiotic sensitivity tests	S/E	2, 3, 4		
5	idents will be able to test and analyse the efficacy of disinfectants	S/An	2, 3, 4		
6	Students will be able to perform and interpret the various serological tests in a diagnostic laboratory	S/E	2, 3, 4		
*Remem and App	*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)				

Modu	Module Content	CO	Hr
le No			S
1	Microscopic examination of bacteria in living conditions Testing of motility Staining procedures	1, 2, 3	30
2	Sterilisation methods Cultivation of bacteria and fungi Study of cultural characteristics and biochemical reactions of bacteria Testing of disinfectants Antibiotic sensitivity tests	1, 2, 4, 5	30
3.	Serological tests for the diagnosis of microbial infecdtions Agglutination and precipitation tests Immunodiffusion in gel ELISA	1, 6	60
	Total Credits of the Course	2	120

Teachingand LearningApp	Laboratory Procedure (Mode of transaction)						
roach	Direct Instruction: lecture, Explicit Teaching, Demonstration, Hands or experimental sections, Skill acquisition by laboratory training						
Assessment Types	Mode of Assessment						
- 5 F - 2	A. Continuous Internal Assessment (CIA)						
	1. Internal Laboratory Skill Tests of maximum 20 marks						
	2. Seminar Presentation – Laboratory material and methods Maximum marks 10						
	3. Write a detailed report on instrumentation -10						
	marks						
	B. Semester End Practical examination – 60 marks						

Compulsory Reading:

1. Medical Laboratory Manual for Tropical Countries Vol.2 Monica Cheesbrough ELBS, 2009 2.Mackie& McCartney Practical Medical Microbiology Churchil Livingstone, 1996

Further Reading:

1.Clinical Laboratory Methods Vol.2 Gradwohl The C.V.Mosby Company, 1981

2.London Practical Microbiology Dubey R.C.andMahaswari D.K. S.Chand& Company Ltd. New Delhi, 2002

3.Experiments in Microbiology, Plant pathology and Biotechnology, K.R.Aneja, New Age International (P) Limited, New Delhi, 2003

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BSM 21C 13: LABORATORY COURSE-4

SchoolName	School of Biosciences						
Programme	MSc.Microbiology/Biochemistry/Biophysics/Biotechnology						
Course Name	LABORATORY COU GENETIC ENGINE	LABORATORY COURSE- 4 (MOLECULAR BIOLOGY AND GENETIC ENGINEERING)					
Type of Course	Core						
Course Code	BSM 21C 13						
Course Summary & Justification	The course is intended to provide experience to students in handling protein and DNA, its isolation, quantification and separation using electrophoresis. Also, the course focusses on the technique of PCR technology and proposes a training in PCR technique to equip the students for the present demand in the modern diagnostic methods.						
Semester			Second				
Total StudentLearning Time (SLT)	Learning ApproachLectureTutorialPracticalOthersTotal LearningHours						
	Authentic learning Collaborative learning Independent learning	5	5	120		130	
Pre-requisites	Theoretical knowledge in Molecular Biology and Genetic Engineering, Basic laboratory skills						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1	On completing the course, the students will be able to isolate nucleic acids and proteins from tissues/microorganisms	А	2, 3, 4
2	On completing the course, the students will be able to evaluate quantity and quality of nucleic acids	S	2, 3, 4
3	The students will be able to conduct PAGE and will be able to separate proteins using PAGE	S/E	2, 3, 4

4	e students will be able to amplify a DNA fragment	S/E	2, 3			
	selectively using the PCRtechnique					
*Remem and App	*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)					

Modu	Module Content	CO	Hr
	Wodule Content	co	111
le No			S
1	PAGE- Protein separation	1, 3	45
	Native PAGE-Reagent preparation. Apparatus handling.		
	gel casting electrophoresis and staining		
	ger eusting, electrophoresis and stammig		
2		1.0	(0)
2	• DNA isolation	1, 2	60
	Estimation of DNA		
	RNA isolation		
	• Estimation of RNA		
	Constraint of RIVA		
	• Separation of DNA and RNA by Agarose get		
	electrophoresis		
3.	Selective PCR amplification of a desired fragment	1, 2, 4	15
	Total Credits of the Course	2	120

Teachingand LearningApp roach	Laboratory Procedure (Mode of transaction) Direct Instruction: lecture, Explicit Teaching, Demonstration, Hands on experimental sections, Skill acquisition by laboratory training						
Assessment Types	Mode of Assessment						
	L. Continuous Internal Assessment (CIA)						
	1. Internal Laboratory Skill Tests of maximum 20						
	marks						
	2. Seminar Presentation – Laboratory material and						
	methods Maximum marks 10						
	3. Write a detailed report on instrumentation -10						
	marks						
	M. Semester End Practical examination – 60 marks						

Compulsory Reading:

- 1. Molecular cloning by Sambrook, Fritsch and Maniatis, Cold Spring harbour laboratories
- 2. Biochemical Methods Sadasivam and Manickam

3. Gel electrophoresis of proteins : A practical approach(second edition)B D H Ames and Rickwood D(eds) Oxford University press

4. Practical skills in Biomolecular Sciences, Weyers Jonathan, Reed Rob, Jones Allen, Holmes A D, Pearson publications

Further Reading:

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	MAHAT	MAHATMA GANDHI UNIVERSITY				
विद्यापा अप्रुतमञ्चल	BSM 21.	E 14: M	ICROBI	IAL TEC	HNOL	JGY
School Name	School of Bioscienc	es				
Programme	MSc Biotechnolog	gy				
Course Name	MICROBIAL TE	CHNOI	LOGY			
Type of Course	Elective					
Course Code	BSM 21E 14					
Course Summary & Justification	 The course describe the application of microbes in various sectors The course content explains the role of microbes and its utilization/application in various sectors especially in industrial & pharmaceutical area. The course content also illustrates the various methods & process for production of bioactive compounds & products using microbes. 					
Semester	Second					
Total StudentLearningTime (SLT)	Learning ApproachLectureTutorialPracticalOthersTotal LearningHours					
	Authentic learning Collaborative learning Independent learning	60	20	0	40	120
Pre-requisites	Basics of Microbiology					

COURSE OUTCOMES (CO)

СО	Expected Course Outcome	Learning	PSO No.
No.		Domains	
1	On completing this course, the student will be able to explain the methods for studying microbial genome and describe how metabolic & protein engineering help to enhance the production of microbial metabolites	U/A	1
2.	Describe the methods , process & production of various microbial based food and dairy products also students have able to explain microbes are food for animal and human	U/An	1
3.	Students should explain the role of microbes as biofertilizer, biopesticide, fungicide, and herbicide and also able to describe the various plant microbe interactions	U/A	1
4.	Students have able to explain the methods and mechanism of microbes apply to protect various environmental sector.	An/A	1
5.	Illustrate the utilization of microbes in the production of industrial and pharmaceutical products	S/C	1
6.	Communicate effectively about a chosen topic in microbial technology both verbally and orally		1
*Remem and App	bber (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Crea reciation (Ap)	tte (C), Skill (S),	Interest (I)

Module	Module Content	CO	Hrs
No			
1	Microbial Genomics: Introduction to Microbial genomics.		10
	Structural Genomics, Functional genomics, Comparative	,	
	Genomics, Meta Genomics - Genome analysis of		
	extremophiles, Metabolic engineering and protein engineering		
	for optimization of microbial products		
2.	Microbes in food & dairy industry: Fermented foods-	2,6	15
	Introduction, Role & Advantages of fermented foods.		
	Production of cheese, yoghurt, koji & Idli. Knowledge of other		
	fermented dairy products. Single cell proteins-algae, bacteria,		
	fungi, yeast & actinomycetes. Alcoholic beverages-Distilled		
	and non distilled, Production of beer, wine & ethanol. Microbe		
	as animal feed additives. Probiotics, Prebiotic & Synbiotics		
3.	Microbes in Agriculture: Nitrogen fixation; Symbiotic & Non	3,6	10
	symbiotic Mechanism;Biofertilizers-Rhizobium, Azolla,		
	Azospirillum, Algal Biofertilizers; Phosphate solubilizing		
	microorganisms; Microbial biopesticide, biofungicide and		
	herbicide; Micorrhiza; Plant – Microbe Interactions. Mushroom		
	cultivation		
4	Microbes & Environment: Biotechnology and pollution	4,6	10
	control; Use of immobilized microbial cell & enzyme in waste		
	water treatment. Microbial biotransformation-Steroid,		
	Microbial degradation of Herbicides, Insecticides & Pesticides;		

	Bioremediation & Bioleaching		
5.	Industrial & Pharmaceutical Applications: Methanogens &	5 <i>,</i> 6	15
	Biogas Production; Microbial Hydrogen production; Microbes		b1
	in plastic industry - Bioplastics; Microbial biosensors- Micro		
	oxygen electrode. Biochips; Biofilm; Bioactive compounds		
	from microbes. Bioethanol & biodieseal production.		
	Microorganism for Bioassay & as Bio weapon		
Total Credits of the Course			

TeachingandL earningAppro	Classroom Procedure (Mode of transaction)			
ach	Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning, interactive Instruction:, Active co-operative learning, Seminar, Group Assignments Authentic learning, Library work and Group discussion, Presentation by individual student/ Group representative			
Assessment Mode of Assessment				
Types	NOUL OF ASSESSMENT			
	N. Continuous Internal Assessment (CIA)			
	1. Internal Tests of maximum 20 marks			
	2. Seminar Presentation – a theme is to be discussed and identified			
	to prepare a paper and present in the seminar Maximum marks 10			
	3. Write a detailed report on a given topic based on research			
	findings and literature search – 10 marks			
	O. Semester End examination – 60 marks			

Compulsory Reading: 1.Biotechnology Fundamentals and Applications, S.S. Purohit and S.S. Mathur; Agro Botanical Publishers India. 2. Microbial Biotechnology, Alexander N Glazer & Hiroshi Nikaido Cambridge University Press. 3. Microbial Biotechnology, Farshad Darvishi harzevili Hongzhang Chen. CRC Press. 4. Microbial Biotechnology Principle & Applications Lee Yuan Kein.World Scientific Press. Further Reading: 1. Microbial Technology-Fermentation Technology Vol 1 & 11 Peppler Perinas Elsiver. 2. Biofertilizers in Agriculture, N.S.Subha Rao; Oxford & IBH Publishing Co.Pvt.Ltd New Delhi. 3. Essentials of Biotechnology, R.C.Sobti & Suparna.S.Pachauri. Ane Books Pvt.Ltd. 4. Fermentation Technology Vol I&II. 5. Soil Microbiology - N.S. Subha Rao, 1999 6. Agriculture Microbiology – Rangaswamy 7. Microbial control and pest Management – S. Jayaraj. 8. Food Microbiology - Frazier W.C and Westhoff D.C., Tata Mc Graw-Hill

9. Food Microbiology - Rose A.H. in Economic Microbiology, Academic Pr

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BSM 21E 15: ECOLOGY AND ENVIRONMENT

School Name		School of Biosciences					
Pro	gramme	M.Sc. Biochemistry/Microbiology/Biotechnology/Biophysics					
Cou	urse Name ECOLOGY AND ENVIRONMENT						
Type of Course		Elective					
Cou	irse Code	BSM 21E 15					
Names of Academic Staff & Ouglifications		Dr J G RAY					
Cou	irse Summary	The course is designed to equip students in perceiving, understanding and					
& J	ustification	analyzing environmenta	al probler	ns from a	n ecolog	gical perspe	ctive, and a
		critical analysis of the existing control measures from a holistic					
	perspective.						
Semester		First					
Total Student Learning Time (SLT)		Learning Approach	Lecture	Tutorial	Practica	al Others	Total Learning Hours
		Eg: Authentic learning Collaborative learning Independent learning	60	18	0	28	106
Pre	Pre-requisite Knowledge in Biology at Graduate level						
N 0.		Expected Course Ou	tcome			Learning Domains	PSO No.
1	Students will be able to understand and communicate the			te the	R/U/A	1	
	sustenance of natural biological systems on the earth effectively						
2	They will acquire skills in explaining all kinds of interrelationships				nships	U/A	1, 2
	in natural biological systems						

3	Stude	ents will be able to explain environmental degradation and	U/An/Ap	1
	pollu	tion as outcomes of ignorant and irresponsible human actions		
4	Students will be able to understand the significance of biodiversity		An/Ap	1
	and 1	s conservation in the sustenance of natural ecosystems		
5	Overa	all, students will be skilful in analyzing as well as designing	R/U/A/An	2
	and a	maintaining of environmental sustainability of all kinds of opmental activities	/Ap	
*Rer Appi	nember reciation	(R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Sk	ill (S), Interest	(I) and
Mo	odule	Module Content	СО	Hours
I	No			
1		Introduction to Ecology and different ecological object Basic concept of the environment – components of the environment, the definition of ecology, ecological thing Autecological and Synecological concepts:	s: 1, 2 le s.	10 hrs
		A.Population Ecology (Autecological concepts): (a Characteristics of populations (b) Genecology - ecad ecotypes, ecospecies, coenospecies; k-selection and r-selection populations	i) s, n	
		B. Synecological concepts(a) Ecological processes of community formation, ecotone, edge effect. Classification of communities - criteria of classification, dynamic system of classification by Clement (b) Special plant communities quantitative, qualitative and synthetic characteristics of plan communities, (c) Dynamic community characteristics - cycli replacement changes and cyclic no-replacement changes	of of - nt c	
2		Ecological succession -(a) The concept – autogenic an allogenic succession, primary and secondary, autotrophic an heterotrophic (b) Retrogressive changes or the concept of degradation, concept of climax or stable communitie resilience of communities, ecological balance and surviv thresholds Biosphere and Ecosystem - (a) Significance of habitat biodiversity, ecological niche, trophic level, primary and secondary productivity, food chains, food webs, ecological pyramids, energy flow and nutrient cycles (b) Comparative study of the significant world ecosystems: Different aquatic and terrestrial ecosystems concerning their productivity, 0.5 5 biodiversity, energy flow, food chains and trophic levels	d 1, 2, 4 d of s, al t, d al t, d d 7	10 hrs

3.	Natural Resources: Soil, water and air Resources – soils and parent materials – ecology of soil fertility; Fresh water and marine resources – global distribution of water resources – surface and groundwater resources – water conservation – prevention of marine pollution – conservation of marine resources; Atmospheric resources – the structure of atmosphere – climate and weather – climatic factors – precipitation, wind temperature, aerosols	1, 2	10 hrs	
4	Environmental pollution : (a) Definition and classification (b) Water pollution: Water quality parameters and standards, different types of pollutants and their consequences. Types of water pollution, prevention and control - watershed management, different kinds of wastewater treatments; Phyto and bioremediation (c) Air pollution: Air quality standards and index, ambient air monitoring using high volume air sampler, types and sources of air pollutants, air pollution and human health hazards, control of air pollution (d) Noise pollution (e) Radioactive and thermal pollution: Causes and hazardous effects, effective management (f) Concept of solid wastes (g) Pollution Control - Bioremediation, Phytoremediation, bioaugmentation, biofilms, biofilters, bioscrubbers and trickling filters. Use of bioreactors in waste management	3	20 hrs	
5	Factors responsible for climate change, Climate change mitigation – global conventions and protocols on climate change - El-Nino and La Nina phenomenon and its consequences; Environmental laws, environmental monitoring and bioindicators, environmental safety provisions in the Indian constitution, major ecological laws in free India; UNEP and its role in climate change control– IPCC, UNFCC, annual environment summits – 1973 Stockholm conference to 2015 Paris Conference – new developments of annual UNFCC meetings in the coming years - Future Earth Programme	2	10 hrs	
	Books for Reference	3	00 1115	
Compulso	ory Reading:			
1. MC Dash (1993) Fundamentals of Ecology, Tata McGraw Hills				
2. Odum EP 3rd Edition (1991) Fundamentals of ecology, Saunders and Com				
Optional Further Reading				
 Barbour MD et al. (1980) Terrestrial plant ecology. The Benjamin-Cummings Pub. Com 2. Benton AH and Werner WE (1976) Field biology and Ecology, Tata McGraw Hill 				
3. Blanco-Canqui and Humberto LR (2008) Principles of Soil Conservation and Management, Springer				
4. Molles MC (2012) Ecology – Concepts and applications, 6th Edition, Mc Graw Hill				
Course evaluation:				
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Assignments & Seminar (10 marks each); Two internal test papers (20 effects) end semester examination (60 marks)				



BSM 21E 16: NEUROBIOLOGY

SchoolName	School of Biosciences					
Programme	MSc Biochemistry/ Microbiology/ Biotechnology/ Biophysics					
Course Name	NEUROBIOLOGY	NEUROBIOLOGY				
Type of Course	Elective	Elective				
Course Code	BSM 21E 16					
Course Summary & Justification	is course is designed to provide an overview of Neurobiology. Stress will be placed on methods and concepts rather than facts alone. The course will proceed from the basic biophysical properties of neurons and glia to the physiological basis of learning, memory, and sensory processing					
			Second	[
Total StudentLearning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total LearningH ours
	Authentic learning Collaborative learning Independent learning	60	20	0	40	120
Pre-requisite	Basics Knowledge in	ı Physiol	ogy			

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1	idents should be capable of effectively communicating	U	
	how neural system works		1
2	idents should be able to explain electricity and the biophysics of cell	E	1
3	Students should describe how do neurons talk to one- another	А	1
4	idents should be able to explain how neural circuits	А	1

	organize information		
5	idents should be able to narrate how is information stored	Е	1
6	stly, students should gain a general understanding how is information collected and processed.	Ι	1
*Remen and App	hber (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Crea reciation (Ap)	ute (C), Skill (S),	Interest (I)

Module	Module Content	CO	Hrs		
No					
1	Introduction to neurobiology, the structure and distinguishing	1,6	10		
	features of neurons, how is a neuron recognized? The architecture				
	of nervous systems. Neuronal model systems. Chemical/electrical				
	synapses. Recording/monitoring techniques.				
2	Ionic basis of the resting potential. Maintenance of resting	2, 6	10		
	membrane potential, passive and active mechanisms, channels and				
	pumps, ionic permeability				
3.	Action potentials and ion channels, Mechanism of nerve action	3, 6	20		
	potential: Characteristics of action potential, initiation and				
	propagation of action potential, voltage dependent sodium channels,				
	mechanism of action potential propagation, factors affecting the				
	speed of action potential propagation, molecular properties of				
	voltage sensitive sodium channels, molecular properties of voltage				
	dependent potassium channels, calcium dependent action potentials,				
	voltage- clamp analysis of action potentials				
4	Synaptic transmission: Chemical and electrical synapse,	4, 6	10		
	transmission between neurons, excitatory neurotransmitters,				
	inhibitory synaptic transmission, inhibitory neurotransmitters,				
	neurotransmitter gated ion channels, presynaptic inhibition and facilitation neuronal integration synaptic transmission at				
	neuromuscular junction				

5	Synaptic plasticity, language and cognition: Short term changes in synaptic strength, long term changes in synaptic strength, modification of synaptic strength in reflex circuits, learning, language function and cortical areas involved in language, cognition, dementia and loss of cognitive abilities	5, 6	10
	Total Credits of the Course	3	60

Teachingand LearningApp roach	Classroom Procedure (Mode of transaction) Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning, interactive Instruction:, Active co-operative learning, Seminar, Group Assignments Authentic learning, , Library work and Group discussion, Presentation by individual student/ Group representative		
Assessment Types	 Mode of Assessment A. Continuous Internal Assessment (CIA) Internal Tests of maximum 20 marks Seminar Presentation – a theme is to be discussed and identified to prepare a paper and present in the seminar Maximum marks 10 Write a detailed report on a given topic based on research findings and literature search – 10 marks B. Semester End examination – 60 marks 		

REFERENCES

Compulsory Reading

Basic Neurochemistry- Molecular, cellular and medical aspects. George J Siegel, Bernard W Agra noff R, Wayne Albers, Stephen K Fisher & Michael D Uhler Neurobiology: Molecules, cells and systems. Gary G Mattews From Neuron to Brain- John G Nicholls, A Robert Martin, Bruce G Wallace & Paul A Fuchs Further Reading: Neuroscience, edited by Purves, Augustine, Fitzpatrick, Hall, LaMantia, Mooney, Platt and White. Sinauer (2018) Sixth Edition.

Foundations of Neurobiology, Delcomyn, F. 1st edition W. H. Freeman and Company (1998)

Behavioral Neurobiology: An Integrative Approach, Zupanc, G. K. H. Oxford University Press.

2nd edition (2010)

Neurobiology: molecules cells and systems Gary G. Mathews 2nd edition. Blackwell Science Inc. (2001).

Neuroscience: exploring the brain. Bear, M., Connors, B.W. and Paradiso, M.A. 2nd edition Lippincott, Williams and Wilkins (2001)

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MAHATMA GANDHI UNIVERSITY

BSM 21E 17: ENVIRONMENT SCIENCE

SchoolName	School of Biosciences					
Programme	Msc Biochemistry/ Microbiology/ Biotechnology/ Biophysics					
Course Name	ENVIRONMENT SCIENCE					
Type of Course	Elective	Elective				
Course Code	BSM 21E 17					
Course Summary & Justification Semester	is course on environmental Science deals with principles and scope of environment science. The objective of the course content is to create a sound awareness about the environment impact and its monitoring and Predict the consequences of human actions on the web of life, global economy and quality of human life The course content is designed with a view to augment CSIR/UGC syllabus					
Total StudentLearning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total LearningH ours
	Authentic learning Collaborative learning Independent learning	60	20	0	40	120
Pre-requisite	Basics of cell biology	and gen	etics			

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1	in in-depth knowledge on natural processes that sustain	U/A	1
	life and govern economy.		
2	le to describe the principles of ecology	U/ C	1
3	velop critical thinking for shaping strategies (scientific,	R/An	2, 3
	social, economic and legal) for environmental protection		
	and conservation of biodiversity, social equity and		
	sustainable development.		

4	Acquire values and attitudes towards understanding	U/R	1	
	complex environmental-economic social challenges			
5	derstand the current environmental problems and preventing the future ones.	U/R	1	
6	Create an insight to the strategies and methodologies of environmental impact assessment	An/ C	3	
*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)				

Module	Module Content	CO	Hrs
1	Definition, principles and scope of environmental science, Earth, Man and environment, ecosystem, pathways in ecosystem. Physic- Chemical and Biological factors in the environment Geographical classification and Zones. Structure and functions of ecosystem, Abiotic and biotic components, energy flows, food chains, Food, web, Ecological pyramids, types and diversity Terrestrial (Forest, grass land) and Aquatic (Fresh water, marine, eustarine) ecosystems. mineral cycling. Habitat and niche. Major terrestrial biomes. Impact of microorganisms on global ecology, microorganisms in extreme environment	1, 2, 3	10
2	Definition, Principles and scope of ecology, Human ecology and Human settlement, evolution, origin of life and speciation Population ecology characteristics and regulation. Community ecology structure and attributes. Levels of species diversity and its management, Edges and ecotones. Ecological succession. Concept of climax. Common Flora and fauna in India. Endangered and Threatened Species	2, 3	10
3.	Biodiversity status, monitoring and documentation Biodiversity management approaches. Conservation of biological diversity, methods and strategies for conservation. Natural resources, conservation and sustainable development. Hotspots of biodiversity, National parks and Sanctuaries	3, 4	10
4	Environmental pollution- Air: Natural and anthropogenic source of pollution, Primary and Secondary pollutants , Methods of monitoring and control of air pollution, effects of pollutant on human beings, plants animals, material and on climate, Acid rain, Air Quality standards Water: types, Sources and consequences of water pollution, Physio-chemical and Bacteriological sampling and analysis of water quality, Soil: Physio-chemical and Bacteriological sampling as analysis of soil quality, Soil pollution- control, Industrial waste effluents, and heavy metals Their interaction with soil components, Noise: Sources of noise pollution, Noise control and battement measures. Impact of noise on human health, Radioactive and thermal Pollution. Bioremediation- Strategies for bioremediation, Biosensors, biological indicators of pollution and	5	20

	monitoring. Detoxification of hazardous chemicals, mycotoxins. Biological weapons		
5	Introduction to environmental impact analysis, Impact Assessment Methodologies Generalized approach to impact analysis, Guidelines for Environmental Audit Introduction to environmental Planning, Environmental priorities in India and Sustainable development, Environment protection-issues and problems, International and national efforts for environment Protection. Global environmental problems-Ozone depletion, global warming, climatic change, desertification, green movement, ecofeminism. Current environmental issues in India	6	10
	Total Credits of the Course	3	

TeachingandLearningApproach	Classroom Procedure (Mode of transaction)				
	Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning, interactive Instruction:, Active co- operative learning, Seminar, Group Assignments Authentic learning, , Library work and Group discussion, Presentation by individual student/ Group representative				
Assessment Types	Mode of Assessment				
	P. Continuous Internal Assessment (CIA)				
	1. Internal Tests of maximum 20				
	2. Seminar Presentation – a theme				
	is to be discussed and				
	identified to prepare a paper				
	and present in the seminar				
	Maximum marks 10				
	5. While a detailed report of a given topic based on research				
	findings and literature search				
	-10 marks				
	Q. Semester End examination – 60 marks				

REFERENCES

Compulsory Reading:

- 1. Jonathan B (2016) Principles of Evolution, Garland Science, Taylor and Francis.
- 2. Odum E. P and Barret G W. Fundamentals of ecology. W. B Saunders company, Philadelphia

2. Chapman and Reiss, Ecology principles and applications. Cambridge University

Further Reading:

- 1. Jobes A. M., Environmental biology, Routledge, London.
- 2. Odum E. P. Basic ecology. Saunders College.
- 3. A textbook of environmental sciences, Arvind kumar.
- 4. Alleby M.Basics of environmental science. Routledge, Newyork
- 5. Cunningham, W. P and Siago, B. W, Environmental science.
- 6. Kewin T. P and Owen C. A., Introduction to global environmental issues. Routledge, London.
- 7. Chiras, D.D, Environmental science Cell and Molecular Biology by De Robertis E.D.P, 8th Edition

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BSM 21E 18: MOLECULAR MICROBIOLOGY

SchoolName	School of Biosciences					
Programme	M.Sc. Microbiology/Biotechnology/Biochemistry/Biophysics					
Course Name	MOLECULAR MICROBIOLOGY					
Type of Course	Elective					
Course Code	BSM 21E 18					
Course Summary & Justification	This course on Molecular Microbiology deals with the applications of various molecular biological techniques in Microbiology. This course is an important branch of Microbiology. Rapid identification of microorganisms is very important for the clinical, diagnostic and research purposes and the methods used for the same have developed significantly with the advances in Molecular biology. The content in this course has been designed with an objective to provide detailed understanding on the techniques, principle and applications of molecular biology for the microbial identification, production of recombinant proteins and also for studying the unculturable microorganisms through metagenomics. This will enable the students to identify the research, learning and job opportunities based on the latest developments in this cubicat					
Semester			Second			
Total Student Learning Time (SLT)	Learning Approach Lecture Tutorial Practical Others Total LearningHours Others Total Description Description Description					
	Authentic learning Collaborative learning Independent learning	60	20	0	40	120
Pre-requisite	Basic u Knowledge in any bra	nderstan nch of L	ding on n bi ife scienc	nicroorgani iology e	sms and r	nolecular

CO	Expected Course Outcome	Learning	PSO No.
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No.		Domains		
1.	Students will able to understand and explain molecular	R/U	1,2	
	biological applications in microbiology			
2.	Students will able to learn rapid methods used for the	R/U	1	
	microbial identification			
3.	Students will able to understand the functioning of	U/ An/E	1	
	human microbiome and its beneficial role			
4.	Students will become able to understand molecular basis	U/An/A	1	
	of microbial virulence			
5.	Students will able to apply the knowledge for advanced	C/S	2,	
	microbiological applications			
6.	Students will able to identify the research and technical	A/S	2	
	opportunities in molecular microbiology			
*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)				

Modu	Module Content	CO	Hrs
le No			
1	Molecular biology of Microbial evolution, rRNA sequence and	1, 2	20
	cellular evolution, Signature sequence and phylogenetic probe.		
	Identification and characterization of microorganisms, Molecular		
	methods for microbial identification, Molecular typing methods:		
	Bacterial strain typing, Pulsed Field Gel Electrophoresis, PCR-		
	based microbial typing, Genotyping by Variable Number Tandem		
	Repeats, Multilocus Sequence Typing, Automated Ribotyping		
2	Unculturable bacteria and Metagenomics, Methods used in	3	20
	metagenomics, New generation sequencing technologies for		
	metagenome study, Human microbiome, Importance of human		
	microbiome in relation to human health and disease.		
3.	Molecular basis of microbial virulence. Bacterial adherence: basic	4	10
	principles, effects of adhesion on bacteria and host cells. Bacterial		
	invasion of host cells; mechanism. Bacterial toxins: classification		
	based on molecular features, Molecular detection and		

	characterisation of bacterial pathogens, detection of bioterrorism.		
4	Microbial production of recombinant proteins: expression,	5,6	10
	purification and applications, Microbes in plant transformation,		
	Agrobacterium tumefaciens T-DNA transfer process, Application		
	of microorganisms for combinatorial and engineered biosynthesis,		
	Engineering <i>E.coli</i> for the production of curcumin		
	3	60	

Teach	Classroom Procedure (Mode of transaction)							
ing And	Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning,							
Learn ing Appro ach	interactive Instruction, Active co-operative learning, Seminar, Group Assignments Authentic learning, Library work and Group discussion, Presentation by individual student/ Group representative							
Assess ment Types	Mode of Assessment A. Continuous Internal Assessment (CIA)							
- 3 P 05	1 Internal Tests of maximum 20 marks							
	2. Seminar Presentation – a theme is to be discussed and							
	identified to prepare a paper and present in the seminar -							
	Maximum marks 10							
	3. Write a detailed report on a given topic based on research							
	findings and literature search – 10 marks							
	B. Semester End examination – 60 marks							

REFERENCES

Compulsory Reading:

1. Molecular Microbiology – Diagnostic Principles and Practice, David H. Persing, Fred C. Tenover, James Versalovic, Yi-Wei Tang, Elizabeth R. Unger, David A. Relman, Thomas J.

, ASM Press., 2016

2. Brock Biology of Microorganisms- Michael T. Madigan and John M.Martinko, Prentice Hall, 2015

Further Reading:

3. Microbial Physiology – Albert G. Moat, John W. Foster and Michael P. Spector , 2002

4. Metagenomics for Microbiology, Jacques Izard Maria Rivera , 1st edition, Academic Press Published Date: 12th November 2014

5. Production of Recombinant Proteins: Novel Microbial and Eukaryotic Expression Systems, Gerd Gellissen, May 2005Longman, 2013

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BSM 21E 19: DEVELOPMENTAL BIOLOGY

Scho	ool Name School of Biosciences							
Program	mme	M.Sc. Biochemistry/Microbiology/Biotechnology/Biophysics						
Course	e Name DEVELOPMENTAL BIOLOGY							
Type of	f Course	Elective						
Course	Code	BSM 21E 19						
Names	of Academic	Dr J G RAY						
Qualifi	cations							
Course	Summary	The course is designed	to equip s	students in	perc	eiving	g, unders	tanding, and
& Justi	fication	analyzing reproductive	and em	bryologica	al de	velop	mental p	processes in
		plants to apply the p	rinciples	towards	incre	easing	g plant	productivity
		through breeding.						
Semest	er	First						
Total Student Learning Time (SLT)		Learning Approach	Lecture	Tutorial	Prac	Practical Others		Total Learning Hours
		E.g., Authentic learning Collaborative learning Independent learning	60	18		0	28	106
Pre-req	luisite	Knowledge in Botany	at the Gr	aduate le	vel			
No.	No. Expected Course Outcome Learning Domains PSC				PSO No.			
1	1 Students will be able to understand and communicate the reproductive and developmental events in plants effectively R/U/A					1		
2	They will acquire the skills to explain all kinds of U/A 1, 2 reproductive parts and seed developmental processes, including seed storage in plants					1, 2		
3	They will be able to explain how developmental processes U/An/Ap 1 initiates and proceeds in plants 1							

4	Students will be able to explain the specific developmental	An/Ap	1	
	process and its ultimate impact on the productivity or			
	successful completion of lifecycle in plants			
	· · · · · · · · · · · · · · · · · · ·			
*Rememb Appreciati	er (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C) on (Ap)), Skill (S), Intere	st (I) and	
Module No	Module Content	СО	Hours	
1	Introduction: Basic concepts of developmental Biology;	1, 2, 3	20 hrs	
	An overview of plant and animal development, Potency,			
	Commitment, Specification, Induction, Competence,			
	Determination and Differentiation morphogenetic			
	gradients; cell fate and cell lineages; stem cells; genomic			
	equivalence and the cytoplasmic determinants; imprinting;			
	mutants and transgenics in the analysis of development			
2	Development in flowering plants: (a) Angiosperm life	1, 2, 3	10 hrs	
	cycle (b) Anther: Structure and development,	, ,		
	microsporogenesis, male gametophyte development.			
	Palynology: Pollen morphology, exine sculpturing, pollen			
	kit, NPC formula. Applications of palynology- palynology			
	concerning taxonomy. Viability of pollen grains			
	Pollination, pollen germination, growth and nutrition of			
	pollen tube. (c) Ovule: Structure, ontogeny and types.			
	Megasporogenesis. Embryosac - development, classes,			
	ultrastructure, and nutrition of embryosac. Female			
	gametophyte development.			
3.	Fertilization in Plants: Double fertilization; embryo	1, 2, 3	10 hrs	
	development - different types. Endosperm development,			
	types of endosperm, haustorial behaviour of endosperm.			
	Xenia and metaxenia. Polyembryony – types and causes.			
	Seed formation, dormancy and germination. Apomixis,			
	Parthenogenesis.			
4	Morphogenesis and organogenesis in plants: Shoot and	4	20 hrs	
	root development; Leaf development and Phyllotaxy.			
	Transition to flowering, floral meristems and floral			
	development; Homeotic genes in plants; Senescence,			
	programmed cell death and hypersensitive response in			
	plants Total Credits of the Course	3	60hrs	
Books for Reference				

Comp	pulsory Reading:	
1.	Maheswari P. 1950. An introduction to the embryology of Angiosperms.	
	McGraw Hill	
2.	Wolpert L, C Tickle and AM Arias (2015) Principles of development	
Option	onal Further Reading	
1.	Krishnamurthy KV (2015) Growth and Development in Plants	
2.	Raghavan V (2000) Developmental Biology of Flowering Plants	
3.	Gilbert SF (2000) Developmental Biology	
4.	Developmental Biology, 8th Ed, Gilbert	
5.	Developmental Biology Paperback – 2008 by Werner A. Muller	
Cours	se evaluation:	
Assignments, 1 Seminar, and one assignment (10 marks each) Two internal test papers (20 marks) end semester examination (60 marks)		

THIRD SEMESTER



BSM 21C 20: ENZYMOLOGY

SchoolName	e School of Biosciences					
Programme	M.Sc. Biochemistry/Microbiology/Biotechnology/Biophysics			sics		
Course Name	ENZYMOLOGY	ENZYMOLOGY				
Type of Course	Core	Core				
Course Code	BSM 21C 20					
Course Summary & Justification Sleadester	The course is designed to get a deep knowledge of the mechanisms by which cellular reactions are accelerated. The course builds a base for the students to understand and predict the metabolism of all living things and provide basics of drug development process related to enzyme targets and enzyme therapy Third					
Total StudentLearning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Eg. Authentic learning Collaborative learning Independent learning	80	20	0	40	140
Pre-requisite	Basic idea about pro	Basic idea about protein structure and function				

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.	
1	To give details of different characteristics of enzymes,	U	1	
	enzyme classification and nomenclature.			
2	To describe the different factors that affect their activity and their mechanisms of action	U/An/Ap	1, 2	
3	To differentiate the regulatory mechanism of enzymes	U/An	1	
4	To contrast different modes of enzyme inhibition and to describe the various applications of enzymes	U/An/E	1, 2	
*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)				

Module	Module Content	CO	Hours
1	Introduction to enzymes: Holoenzyme, apoenzyme, and prosthetic group; Interaction between enzyme and substrate- lock and key model, induced fit model, Features of active site, activation energy. Enzyme specificity and types; Enzyme Commission system of classification and nomenclature of enzymes (Class and subclass with one example) Mechanisms of enzyme action- Rate Enhancement Through Transition State Stabilization, Acid-base catalysis, covalent catalysis, metal ion catalysis (eg: Serine Proteases: cystenyl protease, aspartyl protease, metalloprotease, Lysozyme). Coenzymes and their functions - NAD, NADP+, FAD, FMN, lipoic acid, TPP, pyridoxal phosphate, biotin and cyanocobalamin Isolation and characterization of enzymes: Isolation of enzymes and the criteria of purity; Characterization of enzymes- active site mapping, Measurement and expression of enzyme activity, enzyme assays. Definition of IU, katals, enzyme turnover number and specific activity.	1	20
2	Enzyme kinetics: Factors affecting the velocity of enzyme catalyzed reaction- enzyme concentration, temperature, pH, substrate concentration, inhibitors and activators (explanation with graphical representation). Derivation of Michaelis -Menten equation and Km value determination and its significance, Definition of V_{max} value of enzyme and its significance, Lineweaver- Burk plot, Eadie-Hofstee and Hanes plots.Bi-substrate reactions: Classification, Reaction mechanisms.	2	20
3.	Enzyme inhibition: Reversible and irreversible – examples. Reversible- competitive, noncompetitive, uncompetitive inhibition and mixed inhibition, Irreversible inhibition- mechanism based inactivators, affinity labels, group specific inhibitors; Graphic Determination of Inhibitor Type; Dose—Response Curves of Enzyme Inhibition; Mutually Exclusive Binding of Two Inhibitors; Structure—Activity Relationships and Inhibitor Design; Tight Binding Inhibitors: Identifying Tight Binding Inhibition, examples; Time-Dependent Inhibition: examples; Distinguishing between modes of inhibitor interaction with enzyme	4	20
4	Regulation of Enzyme activity: Different covalent modifications,; Zymogen form of enzyme and zymogen activation; Multienzyme complexes and their role in regulation of metabolic pathways; Allosteric regulation: example Aspartate trascarbamoylase, Sigmoidal kinetics of allosteric enzymes, Models of Allosteric Behavior, Effects of Cooperativity on Velocity Curves. Isoenzymes- Lactate dehydrogenase and creatine phosphokinase.	3	10

5	Application of enzymes: Applications of enzymes in industry (eg: in food industry, paper and leather industry, detergent industry and waste management).Diagnostic and therapeutic enzymes; Applications of enzymes in life science research, Ribozymes, Abzymes, Immobilised enzymes, Biosensors, synthetic enzymes, Enzyme engineering	4	10
	Total Credits of the Course	4	80
	Books for Reference		
Compu	ilsory Reading:		
1.	Fundamentals of Enzymology: The Cell and Molecular Biology of C by Nicholas C. Price, Lewis Stevens, and Lewis Stevens (2000) Pu University Press, USA ISBN: 019850229X ISBN-13: 978019 0198502296	atalytic 1blisher: 98502290	Proteins Oxford 6, 978-
2.	Enzyme Kinetics: A Modern Approach Book: Enzyme Kinetics: A M by Alejandro G. Marangoni (2003) Publisher: Wiley-Interscience ISE ISBN-13: 9780471159858, 978-0471159858	odern A 3N: 0471	pproach 159859
3.	Principles Of Biochemistry, 4/e (2006) by Robert Horton H , Lau Gray Scrimgeour K Publisher: Pearsarson ISBN: 013197 13: 9780131977365, 978-0131977365	rence A 77369,	Moran, ISBN-
4.	Biochemistry 6th Edition (2007) by Jeremy M.berg John L.tymoczk Publisher: B.i.publicationsPvt.Ltd ISBN: 071676766X ISBN-13 : 9 978-716767664	to Luber 9780716	rt Stryer 767664,
5.	Lehninger Principles of Biochemistry, Fourth Edition by David L. N Nelson (Author)	Nelson E	David L.
Furthe	r Reading:		
•	Enzyme Kinetics and Mechanisms by Taylor Publisher: Spring ISB ISBN-13: 9788184890471, 978-8184890471	SN: 8184	1890478
•	Enzyme Mechanism by P.K. Shivraj Kumar (2007) Publisher: R ISBN: 8176114235 ISBN-13: 9788176114233, 978-8176114233	BSA Pu	lblishers
•	Enzymes and Enzyme Technology by Kumar (2009) Anshan Pub ISB ISBN-13: 9781905740871, 978-1905740871	N: 1905	740875,
•	Enzymes in Industry: Production And Applications by Aehle W (2 John Wiley & Sons Inc ISBN: 3527316892 ISBN-13: 978352 3527316892	2007) Pu 2731689	ublisher: 2, 978-
•	Enzymes: Biochemistry, Biotechnology, Clinical Chemistry (seco Trevor Palmer, Philip Bonner (2007) Publisher: Horwood Publishing 1904275273 ISBN-13: 9781904275275, 978-1904275275	nd Edit g Limited	ion) by d ISBN:

Teachingand LearningApp roach	Classroom Procedure (Mode of transaction) Direct Instruction, Explicit Teaching, E-learning, interactive Instruction:, Active co-operative learning, Seminar, Group Assignments, Authentic learning, Library work and Group discussion, Presentation by individual student/ Group representative			
Assessment Types	Mode of AssessmentR. Continuous Internal Assessment (CIA)Internal Test -20 marksAssignment – Every student needs to write an assignment on a given topic based on the available published literature – 10 marksSeminar Presentation – A topic needs to be presented and discussed with the class- 10 marksS. Semester End examination – 60 marks			

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BSM 21 C 21: CLINICAL BIOCHEMISTRY

SchoolName	School of Biosciences					
Programme	M.Sc. Biochemistry	M.Sc. Biochemistry				
Course Name	CLINICAL BIOCH	CLINICAL BIOCHEMISTRY				
Type of Course	Core					
Course Code	BSM 21 C 21					
Course Summary & Justification	This course provides a strong foundation to the students in understanding the nuances of disease biology and helps them to be competent in pursuing clinical research or a job in clinical laboratories.					
Semester		Third				
Total Student Learning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Eg. Authentic learning Collaborative learning Independent learning	60	20	0	40	120
Pre-requisite	Basic idea about huma	n physio	logy			

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1	Explain the pathogenesis of diseases	An/E	1
2	To compare and contrast the symptoms, causes, treatment and management of in born errors of metabolism, life style and other diseases.	A/ An	1,4
3	To elaborate the functioning of major organs and different methods to asses their functioning	An/I	2, 3,4

4.	To elaborate the principles of different diagnostic methods and to identify their pros and cons.	U/E	2, 3, 4		
*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)					

Module	Module Content	CO	Hours
1	Biochemistry of metabolic disorders: Disorders of carbohydrate metabolism: Diabetes, galactosemia, pentosuria, fructosuria, Glycogen storage diseaseTs. Abnormalities of proteins in plasma, Urea cycle disorders; Disorders of amino acid metabolism: Phenylketonuria, alkaptonuria, albinism, tyrosinosis, maple syrup urine disease, Histidinemia. hymocystineuria, aminoacidurias Disorders of plasma lipids and lipoproteins, Lipid profile, hyperlipidemia, hyperlipoproteinemia Abetalipoproteinemia diagnostic tests for apolipoproteins HDL-cholesterol, LDL- cholesterol and triglycerides disorders. Gaucher's disease, Tay- Sach's and Niemann-Pick disease, Faber's diseas, Krabbe disease, Goucher's disease Disorders of nucleic acid metabolism: Disorders associated with purine and pyrimidine metabolism	1, 2, 4	10
2	Disorders of Electrolyte balance, acid-base balance, clotting and erythrocyte metabolism: Regulation of electrolyte content of body fluids and maintenance of pH, acid base balance and acid base disorders. Disturbances in blood clotting mechanisms – haemorrhagic disorders – haemophilia, von Willebrand's disease, purpura, thrombotic thrombocytopenic purpura, disseminated intravascular coagulation, acquired prothrombin complex disorders, circulating anticoagulants. Disorders of erythrocyte metabolism, hemoglobinopathies, thalassemias, and anaemias, laboratory test to measure coagulation and thrombolysis porphyria	1, 2, 4	10
3.	Biochemistry of life style Diseases- Cancer– Cellular differentiation, carcinogens, Tumor biomarkers- definition, classification, biochemistry, and distribution of tumor markers, eg:prostate-specific antigen, calcitonin, human chorionic gonadotropin, α - fetoprotein, and carcinoembryonic antigen. Recent developments in identifying proteomic patterns for cancer detection cancer therapy. Diabetes Melllitus- types, diagnosis, glycohemoglobins, hypoglycemias, ketone bodies, Glucose tolerance tests (GTT) Insulin tolerance test, treatment. Atherosclerosis and coronary artery diseases; atherogenesis, fatty liver, and lipotrophic factors-, diagnosis, treatment.	1, 2, 4	15

4	Organ function tests: Liver function tests-Functions of liver, Bile pigment metabolism and Pathophysiology of jaundice, VDB test, urine-serum bilirubin, urobilinogen, A:G ratio, changes in plasma proteins, Detoxification and excretory functional analyses of liver, Liver enzymes. Renal function tests- Clearance tests, Renal tubular functions, urinalysis. Gastric function tests- Resting and test meal gastric content analysis, stimulation tests, Tubeless gastric analysis. Pancreatic and thyroid function tests.	3	15
5	 Diagnosis of diseases: Collection and preservation of biological fluids. Diagnostic Enzymes –biochemical diagnosis of diseases by enzyme assays – SGOT, SGPT, CPK, cholinesterase, LDH. Molecular diagnosis of diseases- PCR methods, FISH, molecular karyotype, microarray. Biosensors Prenatal diagnosis and newborn screening sample collection, diagnostic methods and ethical issues. 	4	10
	Total Credits of the Course 3		
	Books for Reference		
Comp 1. 2.	Notes on Clinical Biochemistry by John K. Candlish (1992) Publisher: Publishing Company ISBN: 9810210663 ISBN-13: 9789810210663, 978 Clinical Biochemistry: Metabolic And Clinical Aspects by William J. M K. Bangert, Elizabeth S.m. Ed. S.m. Ed. Marshall (2008) Publisher: Health Science Div ISBN: 0443101868 ISBN-13: 9780443101861, 978-0	World S 3-9810210 Iarshall, Elsevier 04431018	cientific 0663 Stephen Science 861
Furth •	er Reading: Biochemistry by John K. Joseph (2006) Publisher: Campus Books Int	ernationa	1 ISBN:
•	8180301109 ISBN-13: 9788180301100, 978-8180301100 Basic Medical Biochemistry: A Clinical Approach by Dawn B., PH.D. Marks Colleen M. Smith (1996) Publisher: Lippincott Williams & W edition ISBN-10: 068305595X ISBN-13: 978-0683055955 Clinical Chemistry, 6/e Ie by William J Marshall, Stephen K Bangert (Else ISBN: 0723434603, ISBN-13: 9780723434603, 978-0723434603 Tietz Fundamentals of Clinical Chemistry, 6/e by Carl A Burtis, Edw (2008) Publisher: Else ISBN: 8131213749, ISBN-13: 9788131213742, 9	Marks, A ilkins; ill 2008) Pu 2008) Pu 2008) A 2008) A	Allan D. ustrated ublisher: shwood 213742

Teachingand LearningApp roach	Classroom Procedure (Mode of transaction) Direct Instruction, Explicit Teaching, E-learning, interactive Instruction:, Active co-operative learning, Seminar, Group Assignments, Authentic learning, Library work and Group discussion, Presentation by individual student/ Group representative	
Assessment Types	Mode of Assessment T. Continuous Internal Assessment (CIA) Internal Test -20 marks Assignment – Every student needs to write an assignment on a given topic based on the available published literature – 10 marks Seminar Presentation – A topic needs to be presented and discussed with the class- 10 marks U. Semester End examination – 60 marks	

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	MAHATMA GANDHI UNIVERSITY
विद्याया अमृतमञ्जूते	BSM 21 C 22: PHARMACEUTICAL BIOCHEMISTRY

SchoolName	School of Biosciences					
Programme	M.Sc. Biochemistry					
Course Name	PHARMACEUTICAL BIOCHEMISTRY					
Type of Course	Core					
Course Code	BSM 21 C 22					
Course	The course is designed to get a basic knowledge in the area of therapeutics					
Summary &	and their mechanism of action and to create awareness about drug					
Justification	discovery process.					
Semester	Third					
Total StudentLearning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
2	Eg. Authentic learning Collaborative learning Independent learning	60	20	0	40	120
Pre-requisite	Basic understanding of	f drugs				

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1	To identify relationship between the chemical structure	U	1
	and biological activity of therapeutic drugs/chemical		
	compounds as a part of modern medical and		

	pharmaceutical research.		
2	To design and synthesis new drugs and to analyze how	С	2, 3, 4
	they interact with diseases and the human body to		
	develop methods to treat diseases. and functional		
	characters of different biomolecules		
3	To select suitable tools and its applications in drug	E/Ap	2, 3, 4
	discovery process.		
*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I)			
and App	reciation (Ap)		

Module	Module Content	CO	Hours
No			
1	Introduction to pharmacology: Sources of drugs, dosage forms	1	10
	& routes of drug administration. Physicochemical Properties of		
	Drugs- Acidity/Basicity, Solubility, Ionization, Hydrophobic		
	properties, Hydrophilic properties. Biological activity parameters-		
	LD 50, EC 50, ADMET properties.		
	Stereochemistry and Drug Action- Concept of Configuration and		
	Conformation with examples, Concept of stereochemistry with		
	respect to biological response with examples, Stereo chemically		
	pure drug and recemates. Drug targets.		
2	Pharmacodynamics: Mechanism of drug action, concept of	2	10
	receptors, combined effect of drugs, factors modifying drug		
	action, tolerance & dependence. Adverse responses and side		
	effects of drugs- allergy, Drug intolerance, Drug addiction, drugs		
	abuses and theirbiological effects.		
3.	Pharmacokinetics: The dynamics of drug absorption,	2	10
	distribution, biotransformation and elimination. Concepts of		
	linear and non-linear compartment models. Significance of		
	Protein binding. Role of kidney in elimination. Drug		
	metabolism: chemical pathways of drug metabolism Phase I and		
	Phase II reactions, role of cytochrome P450, non-microsomal		
	reactions of drug metabolism, drug metabolizing enzymes.		
4	Chemotherapy: General Principles of Chemotherapy:	1, 2	20
	Chemotherapy of Parasitic infectins, Fungal infections, Viral		
	diseases and Chemotherapy of Cancer.		
	Mode of action, uses, structure- activity relationship of the		
	following classes of Drug: Androgens and Anabolic steroids -		
	Testosterone, Stanazolol. Estrogens and Progestational agents -		
	Progesterone, Estradiol. Antibiotics- Penicillins, streptomycin,		
	tetracyclines.		
5	Databases of drugs: drug bank, Cambridge structural database	3	10
	(CSD). Concept of rational drug design; Structure activity		
	relationship, Drug-receptor understanding, Molecular modeling,		

Structure based drug design and molecular docking Application of bioinformatics in drug designing process.		
Total Credits of the Course		60
Books for Reference		

Compulsory Reading:

- 1. Delagado J N and Remers W A R, Eds., Wilson And Gisworld's Text book of Organic Medicinal and Pharmaceutical Chemistry, J. Lippincott Co., Philadelphia.
- 2. Foye W C, Principles of Medicinal Chemistry, Lea & Febiger, Philadelphia.
- 3. Singh Harkrishan and Kapoor, V.K., Organic Pharmaceutical Chemistry, Vallabh Prakashan, Delhi.
- 4. Finar I L, Organic Chemistry, Vol. I & II, ELBS/ Longman, London.

Further Reading:

- 5. Katzung, B.G. Basic & Clinical Pharmacology, Prentice Hall, International.
- 6. Rang MP, Dale MM, Riter JM, Pharmacology Churchill Livingstone.
- 7. Tripathi, K.D. Essentials of Medical Pharmacology, Jay Pee Publishers, New Delhi.

8. Ghosh, MN; Fundamentals of Experimental Pharmacology, Scientific Book Agency, Calcutta.

9. Kulkarni S.K., Hand Book of Experimental Pharmacology, Vallabh Prakashan, Delhi.

10.Barar F.S.K: Text Book of Pharmacology, Interpoint, New Delhi.

Suggested websites for Unit V

- 1. www.drugbank.ca
- 2. www.ccdc.cam.ac.uk/products/csd/

Teachingand LearningApp roach	Classroom Procedure (Mode of transaction) Direct Instruction, Explicit Teaching, E-learning, interactive Instruction:, Active co-operative learning, Seminar, Group Assignments, Authentic learning, Library work and Group discussion, Presentation by individual student/ Group representative,	
Assessment Types	 Mode of Assessment A. Continuous Internal Assessment (CIA) Internal Test -20 marks Assignment – Every student needs to write an assignment on a given topic based on the available published literature – 10 marks Seminar Presentation – A topic needs to be presented and discussed with the class- 10 marks B. Semester End examination – 60 marks 	

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S. A. N.D. HIT COL	MAHATMA GANDHI UNIVERSITY
विद्यापा अपूरतमञ्जूत	BSM 21 C 23: LABORATORY COURSE 5 BIOCHEMISTRY

SchoolName	School of Biosciences						
Programme	M.Sc. Biochemistry	M.Sc. Biochemistry					
Course Name	LABORATORY CO	URSE 5	BIOCHE	CMISTRY			
Type of Course	Core						
Course Code	BSM 21 C 23						
Course Summary & Justification	The course is designed to enzyme assays and relate to perform enzyme-relate process.	The course is designed to develop in students the essential skills to perform enzyme assays and related techniques. This will enhance the practical skills to perform enzyme-related methods and computational drug discovery process					
Semester			Third				
Total StudentLearning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total LearningH ours	
	Authentic learning Collaborative learning Independent learning	10	20	120	30	180	
Pre-requisite	General idea on reager	nts and so	olvents		•		

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1	To design and perform enzyme assays	C/S	2, 3

2	To extract and purify enzymes from different sources	A/An	2, 3, 4		
	and to examine their kinetic behavior				
3	To prepare and charaterise immobilized enzymes	А	2, 3, 4		
4	To assess the activity of enzymes by computational methods	Ε	2,4		
*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)					

Module	Module Content	CO	Hours
1	Enzyme assays: Practical concepts	1	15
2	 Extraction of enzymes and assay: Acid phosphatase from Fresh Potato (<i>Solanum tuberosum</i>) β- amylase from Sweet potato (<i>Ipomoea batates</i>) Urease from Jack bean (<i>Canavalia ensiformis</i>) Phytase from Seeds 	1	30
3.	 Enzyme Kinetics: Effect of Substrate Concentration on velocity of Enzyme catalyzed reaction: Determination of KM and Vmax using Line weaver- Burk plot Effect of Temperature on velocity of Enzyme catalyzed reaction: Determination of Q10 Effect of pH on velocity of Enzyme catalyzed reaction: Effect of activators on velocity of Enzyme catalyzed reaction: Determination of type of inhibition using Line-weaver Burk plot 	1, 2	45
4	 Immobilized enzyme: Immobilisation of α- amylase enzyme Assay of activity of immobilized enzyme Effects of Temperature and pH on Immobilized enzymes 	3	15
5	 Docking of Enzymes with ligand molecules using docking softwares Determine the drug likeliness of ligand molecules Determining Binding energies of ligand with receptors Determining Ki values 	3	15

	Total Credits of the Course	2	120
	Books for Reference		
Co	mpulsory Reading:		
	1. Introductory Practical biochemistry, S. K. Sawhney & Randhir Sing	gh (eds)	Narosa
	Publishing House, New Delhi, ISBN 81-7319-302-9, p 195 – 303		
	2. Standard Methods of Biochemical Analysis, S. K. Thimmaiah (ed), Ka	lyani Pul	blishers,
	Ludhiana ISBN 81-7663-067-5, p 12 - 182.		
Fu	rther Reading:		
7.	Hawk's Physiological Chemistry, Bernard L. Oser (ed) TATA McGRAW	Hill Pu	blishing
	Company LTD, New Delhi, p 60 – 127, 1317- 1334		
8.	Experimental Biochemistry: A Student Companion, Beedu Sasidhar	Rao &	z Vijay
	Deshpande (ed), I.K International Pvt. LTD, New Delhi ISBN 81-88237-4	41-8, p 1	3- 17, p
	49 - 72		
9.	Practical Biochemistry, R.C. Gupta & S. Bhargava (eds) CBS Publishers a	and Distr	ibutors,
	New Delhi, ISBN 81-239-0124-0 p 9 – 27		
10	Practical Clinical Chemistry, Harold Varley, CBS Publishers and Di	stributor	rs, New
	Delhi,		

Teachingand LearningApp roach	Laboratory Procedure (Mode of transaction) Direct Instruction: lecture, Explicit Teaching, Demonstration, Hands on experimental sections, Skill acquisition by laboratory training, journal Club	
Assessment Types	 Mode of Assessment V. Continuous Internal Assessment (CIA) Internal Laboratory Skill Tests of maximum 20 marks Seminar Presentation – Laboratory material and methods Maximum marks 10 Write a detailed report on instrumentation – 10 marks W. Semester End Practical examination – 60 marks 	

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BSM 21 C 24: LABORATORY COURSE 6 BIOCHEMISTRY

SchoolName	School of Biosciences	School of Biosciences					
Programme	M.Sc. Biochemistry	M.Sc. Biochemistry					
Course Name	LABORATORY CO	URSE 6	BIOCH	EMISTRY	ζ		
Type of Course	Core						
Course Code	BSM 21 C 24	BSM 21 C 24					
Course	This course is designe	This course is designed to equip students in performing tests important					
Summary & Justification	for clinical diagnosis.						
Semester			Third				
Total Student Learning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours	
	Eg. Authentic learning Collaborative learning Independent learning	10	20	120	40	190	
Pre-requisite	Basic understanding o laboratory practises in	Basic understanding of reagents and solvents. General idea of good laboratory practises in a biochemistry lab					

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1	To design and perform the estimation of enzymes and	S	2, 3

	other major metabolites from blood or body fluids during stress or diseased conditions					
2	To perform tests to assess blood coagulation	S	2, 3			
3	To perform organ function tests	S	2, 3			
4.	To design quality control chart	С	2, 3			
*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)						

Module	Module Content	CO	Hours			
No						
1	Protocol for blood collection and storage. Bleeding time, clotting time, Prothrombin time, Thrombin time, Euglobulin lysis time	1, 2	15			
2	Liver Function Tests: Assay of SGOT, SGPT, Estimation of Total Bilirubin, Conjugated Bilirubin, Total protein, A/G ratio Renal Function Tests: Estimation of blood urea, Urine urea, Urea clearance, Creatinine clearance, serum creatinine, urine creatinine, serum uric acid	1, 3	45			
3.	Cardiac function tests: Serum Lipid Profile, Estimation of serum LDH and Creatine Kinase, Estimation of fasting and post prandial blood sugars, GTT	1, 3	30			
4	Quality control chart	4	15			
5	Blood Electrolytes Estimation of Serum Na, K, Ca	1	15			
	2	120				
Books for Reference						

Compulsory Reading:

- Practical biochemistry, S. K. Sawhney & Randhir Singh (eds) Narosa Publishing House, New Delhi, ISBN 81-7319-302-9, p 195 – 303
- 2. Standard Methods of Biochemical Analysis, S. K. Thimmaiah (ed), Kalyani Publishers, Ludhiana ISBN 81-7663-067-5, p 12 182.

Further Reading:

- Hawk's Physiological Chemistry, Bernard L. Oser (ed) TATA McGRAW Hill Publishing Company LTD, New Delhi, p 60 127, 1317-1334
- Experimental Biochemistry: A Student Companion, Beedu Sasidhar Rao & Vijay Deshpande (ed), I.K International Pvt. LTD, New Delhi ISBN 81-88237-41-8, p 13-

17, p 49 - 72

- Practical Biochemistry, R.C. Gupta & S. Bhargava (eds) CBS Publishers and Distributors, New Delhi, ISBN 81-239-0124-0 p 9 27
- Practical Clinical Chemistry, Harold Varley, CBS Publishers and Distributors, New Delhi,

TeachingandLearningApproach	Laboratory Procedure (Mode of transaction)			
	Direct Instruction: lecture, Explicit Teaching, Demonstration, Hands on experimental sections, Skill acquisition by laboratory training			
Assessment Types	Mode of Assessment			
	 Y. Continuous Internal Assessment (CIA) Internal Laboratory Skill Tests of maximum 20 marks 2. Seminar Presentation – Laboratory material and methods Maximum marks 10 Write a detailed report on instrumentation – marks Z. Semester End Practical examination – marks 			

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FOURTH SEMESTER



BSM 21C 51: PLANT BIOCHEMISTRY

SchoolName	School of Biosciences							
Programme	M.Sc. Biochemistry							
Course Name	PLANT BIOCHEMISTRY							
Type of Course	Core							
Course Code	BSM 21C 51							
Course Summary &	The course is designed to give a brief understanding of the							
Justification	fundamentals of plant biochemistry with a view to provide key							
	knowledge about the plant biochemical processes.							
Semester	Fourth							
Total						Total		
StudentLearningTime (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	LearningHours		
	Eg. Authentic learning Collaborative learning Independent learning	80	20	0	40	140		
Pre-requisite	Basic understanding of biochemical processes							

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1	1. To demonstrate the organization and importance of	А	1
	photosynthetic mechanisms in plant and to contrast		
	the different mechanisms of carbon fixation in the		
	plant kingdom.		
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2	2. To identify the metabolic and hormonal responses	U	1
	in plants.		
3	3. To identify the class and functions of secondary	U	1
	metabolites.		
4	4. To inspect the stress and defense mechanisms in	А	1
	plants		
*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I)			
and App	reciation (Ap)		

Module	Module Content	СО	Hours
Nodule No 1	Photosynthesis: Photosynthetic apparatus, pigments of photosynthesis, role of carotenoids, photosystems I and II, <i>light harvesting antenna</i> <i>complex</i> photosynthetic electron transport and generation of NADPH & ATP, cyclic and non-cyclic photophosphorylations, complexes associated with thylakoid membranes. Calvin cycle: Biochemistry of RuBP carboxylase/oxygenase, activation of RUBISCO, oxygenation reaction, stereochemistry of RUBISCO, Hatch and slack pathway, CAM plants; productivity of C4 plants, photorespiration and compensation point, photosynthetic efficiency and plant productivity.	1	20
2	Nitrogen metabolism: Importance of nitrogen in biological systems, nitrogen cycle. Nitrogen fixation- symbiotic and non- symbiotic, nitrogenase complex, electron transport and mechanism of action of nitrogenase. energetics and regulation of nitrogen fixation. Biochemical and physiological role of hydrogenase. Assimilation of nitrate and ammonium ion. Plant growth regulators:Structure, functions synthesis and modes of action of plant hormones - ethylene, cytokininins, auxins (indole acetic acid), absicic acid, florigin and gibberellins. Compounds that inhibit phytohormones.	2	20
3.	 Plant stress physiology: Plant stress, plant responses to abiotic and biotic stresses, salinity, water, heat, chilling, anaerobiosis, heavy metals, radiations and their impact on plant growth and metabolism, mechanisms of resistance to biotic stress and abiotic stress, anti oxidative defense mechanism. Plant defense: Genetic basis of plant-pathogen interactions, antio R-Avr gene interactions and isolation of R genes, hypersensitive response (HR), systemic acquired resistance (SAR) and induced systemic resistance (ISR). 	2, 4	20

	Senescence: various levels of senescence, Mechanism of				
	different biochemical changes during senescence.				
4	Major chemical classes of secondary metabolites: A brief	3	10		
	account of the following classes: Alkaloids, terpenoids,				
	flavonoids, phenolics and phenolic acids, steroids, coumarins,				
	quinines, acetylenes, cyanogenic glycosides, amines and non-				
	protein amino acids, gums, mucilages, resins etc. (Structures not				
	necessary. Give examples of the compounds and the plants in				
	which present and their importance). Importance of secondary				
	metabolites.				
5	General biosynthetic pathways of the following classes of	2, 3	10		
	secondary metabolites (structures of intermediates not				
	necessary): Terpenoids: Isoprene as precurosor, hemi, mono,				
	sesqui, di, triperenes and polyterpenes with examples and				
	important members; their functions. Phenols: simple phenols,				
	phenol carboxylic acids, phenylpropanes, flavan derivatives, and				
	phenolic glycosides. Broad outline of their biosynthesis and				
	functions in plants and uses. Alkaloids: Definition of true and				
	pseudo alkaloids; phenylethylamines, pyrrolidone alkaloids,				
	piperidine alkaloids, pyridine alkaloids, tropane alkaloids,				
	quinoline and isoquinoline alkaloids, indole alkaloids, purine				
	alkaloids, isoprenoid alkaloids, steroidal alkaloids.				
	Total Credits of the Course	4	80		
	Books for Reference				
Compuls	sory Reading:				
1. Plant Metabolism by H.D. Kumar and H.N. Singh (1980) Publisher: Macmillan (Mar					
1980) IS	BN-10: 0333256387 ISBN-13: 978-0333256381		·		

2. Biotechnology: Secondary Metabolites by K.G. Ramawat, (2000) Publisher: Science Publishers, U.S. ISBN-10: 1578080576 ISBN-13: 978-1578080571

Further Reading:

3.Plant Biochemistry by P. M. Dey and J. B. Harborne (Editors) (1997) Publisher: Academic Press ISBN-10: 0122146743, ISBN-13: 978-0122146749

4. Plant Metabolism by Prof David T. Dennis, Prof David H. Turpin, Dr Daniel D. Lefebvre and Dr David B. Layzell (Editors) (1997) Publisher: Longman; ISBN-10: 0582259061, ISBN-13: 978-582259065

5. Plant Biochemistry by Hans-Walter Heldt Professor Em (3ed 2004) Publisher: Academic ISBN-10: 0120883910 ISBN-13: 978-0120883912

6. The Principles of Plant Biochemistry by Murield Wheldale Onslow (1931) Publisher: Cambridge University Press ASIN: B002BJMX1M

Teachingand LearningApp roach	Classroom Procedure (Mode of transaction) Direct Instruction, Explicit Teaching, E-learning, interactive Instruction:, Active co-operative learning, Seminar, Group Assignments, Authentic learning, Library work and Group discussion, Presentation by individual student/ Group representative		
Assessment Types	Mode of Assessment		
Types	BB.	Continuous Internal Assessment (CIA) Internal Test -20 marks Assignment – Every student needs to write an assignment on a given topic based on the available published literature – 10 marks Seminar Presentation – A topic needs to be presented and discussed with the class- 10 marks	
	CC.	Semester End examination – 60 marks	

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MAHATMA GANDHI UNIVERSITY

BSM 21C 52: LAB COURSE 7 BIOCHEMISTRY

SchoolName	School of Biosciences					
Programme	M.Sc. Bioche	emistry				
Course Name	LAB COUR	SE 7 BIO	OCHEM	ISTRY		
Type of Course	Core					
Course Code	BSM 21C 52					
Course Summary & Justification	The course is designed to develop in students the essential skills to perform biochemical analysis in plants. This will enhance the practical abilities of the students to perform the plant-based analyses and techniques.					
Semester	Fourth					
Total StudentLearningTime (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total LearningHours
	Eg. Authentic learning Collaborative learning Independent learning	10	10	210		230
Pre-requisite	Basic understanding of biochemical processes, General idea on reagents and solvents					

COURSE OUTCOMES (CO)

CO	Excted Course Outcome	Learning	PSO No.
No.		Domains	

1	To establish the preliminary screening of plant	Ap	2, 3	
	secondary metabolites			
2	To demonstrate the extraction and estimation of phytochemicals	Ap	2, 3	
3	To identify the plant genomic DNA and rbcL gene.	U	2, 3, 4	
*Remem and App	*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

Module	Module Content	CO	Hours
No			
1	Plant secondary metabolites-Qualitative Analysis	1	30
	1. Test for Tannins		
	2. Test for Saponins		
	3. Tests for Flavonoids		
	4. Tests for Glycosides		
	5. Test for Terpenoids		
2	Extractions, Isolation and Analysis of Phytochemicals:	2	60
	1. Different Extraction Protocols: Infusion, Decoction,		
	Maceration, Soxhletextraction		
	2. Extraction of TotalAlkaloids		
	3. Isolation and Colorimetric estimation of Solanine		
	IromPotato 4 Isolation and Spectrophotometric estimation of Tropane		
	alkaloids from Datura Species		
	5. Isolation and Spectrophotometric estimation of Cinchona		
	Alkaloids from Cinchona bark		
	6. Extraction of Oleoresins from black pepper and ginger		
	7. Isolation and spectrophotometric analysis of Tannins		
	8. Estimation of Total Phenols		
	9. Estimation of Flavanols		
	10. Estimation of Tannins		
3.	Extraction and assay of Enzymes	2	60
	1. Polyphenol oxidase		
	2. Peroxidase		
	3. Phenylalanine ammonia lyase		
4	Determination of Free radical scavenging activity of Plant	2	30
	extracts,		
	Bioactivity guided fractionation of Plant bioactive molecules		
5	Plant molecular Biology	3	30
	1. Isolation of plant genomic DNA		
	2. Identification of rbcL gene by PCR techniques		
	Total Credits of the Course	4	
	Books for Reference	<u>ı </u>	
Compuls	ory Reading:		
11. Introd	luctory Practical biochemistry, S. K. Sawhney & Randhir Sing	(eds)	Narosa
Publis	shing House, New Delhi, ISBN 81-7319-302-9, p 195 – 303		

12. Standard Methods of Biochemical Analysis, S. K. Thimmaiah (ed), Kalyani Publishers, Ludhiana ISBN 81-7663-067-5, p 12 - 182.

Further Reading:

- **13.** Hawk's Physiological Chemistry, Bernard L. Oser (ed) TATA McGRAW Hill Publishing Company LTD, New Delhi, p 60 127, 1317- 1334
- 14. Experimental Biochemistry: A Student Companion, BeeduSasidhar Rao & Vijay Deshpande (ed), I.K International Pvt. LTD, New Delhi ISBN 81-88237-41-8, p 13- 17, p 49 - 72
- **15.** Practical Biochemistry, R.C. Gupta & S. Bhargava (eds) CBS Publishers and Distributors, New Delhi, ISBN 81-239-0124-0 p 9 27
- 16. Practical Clinical Chemistry, Harold Varley, CBS Publishers and Distributors, New Delhi,

Teachingand LearningApp roach	Laboratory Procedure (Mode of transaction) Direct Instruction: lecture, Explicit Teaching, Demonstration, Hands on experimental sections, Skill acquisition by laboratory training		
Assessment Types	Mode of Assessment		FF.
	 DD. Continuous Internal Assessment (CIA) Internal Laboratory Skill Tests of maximum 20 marks Seminar Presentation – Laboratory material and methods Maximum marks 10 Write a detailed report on instrumentation – 10 marks 		
	EE.Semester End Practical examination – 60 marks	1	

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MAHATMA GANDHI UNIVERSITY

BSM 21E 61: QUALITY CONTROL IN HERBAL DRUGS

SchoolName	School of Biosciences					
Programme	M.Sc. Biochemistry/Microbiology/Biotechnology/Biophysics					
Course Name	QUALITY CONTROL IN HERBAL DRUGS					
Type of Course	Elective`					
Course Code	BSM 21E 61					
Course Summary & Justification	The course is designed to get a clear idea on quality control approaches in natural herbs and products and modern analytical techniques for the analysis of the herbal drugs.					
Semester	Fourth					
Total StudentLearning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total LearningH ours
	Eg. Authentic learning Collaborative learning Independent learning	60	20	0	40	120
Pre-requisite	Basic understanding of	f plant-ba	ased drugs			

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1	To estimate the quality assurance of herbal materials.	С	1, 2, 3
2	To isolate, purify and characterize the photochemical from medicinal plants.	А	1, 2, 3, 4
3	To interpret the structure of natural products	U/E	1, 2
*Remem and App	*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)		

Module	Module Content	CO	Hours	
No	WILD Critical for Orality Control of both a series and side	1	10	
1	Determination of pesticide residue, arsenic and heavy metals, afflatoxins and microbial contaminants	1	10	
2	Definition, principle of the various extraction techniques like maceration, percolation, hot continuous extraction, pilot scale extraction, microwave assisted extraction and supercritical fluid extraction. GMP for the production of quality botanicals.	2	20	
3.	General methods for isolation and purification of active principles from medicinal plants. Application of chromatographic techniques in isolation & characterisation of phytochemical constituents viz., paper chromatography, thin layer chromatography, column chromatography, gas chromatography (GC), high performance liquid chromatography (HPLC) and high performance thin layer chromatography(HPTLC).	2, 3	10	
4	Role of chemical and biological markers in standardization of herbal products	1, 3	10	
5	General methods for structural elucidation of natural products, Application of spectroscopy for characterization of phytoconstituents	2,3	10	
	Total Credits of the Course	3		
	Books for Reference	L		
Compu	lsory Reading:			
1. H	erbal Drug Technology, S. S. Agrawal, M. Paridhavi, Publisher Univ 2007, ISBN 8173715793, 9788173715792	versities	Press,	
Further	Reading:			
2. 1	Pharmaceutical Analysis Hiquchi, Bechmman, Hassan.			
3.]	3. Methods of Drug Analysis Gearien, Graboski.			
4. 7	4. Text Book of BioPharmaceutic Analysis Robert Smith and JamesStewart.			
5. 1	5. Pharmaceutical Analysis Modern methods Part A and B Munson James.W.			
6.	Quantitative Analysis of DrugsGarrot.			
7.	Quantitative Analysis of Drugs in Pharmaceutical Formulations P. D	.Sethi.		

TeachingandLearningApproach	Classroom	Procedure (Mode of transaction)
	Direct Ins interactive Seminar, C Library wo individual s	truction, Explicit Teaching, E-learning, Instruction:, Active co-operative learning, Group Assignments, Authentic learning, rk and Group discussion, Presentation by tudent/ Group representative
Assessment Types	Mode of As	sessment
	GG.	Continuous Internal Assessment (CIA)
		Internal Test -20 marks
		Assignment – Every student needs
		to write an assignment on a
		given topic based on the
		10 morks
		-10 marks Seminar Presentation $-$ A topic
		needs to be presented and
		discussed with the class- 10
		marks
	HH.	Semester End examination – 60 marks

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	MAHATMA GANDHI UNIVERSITY
विद्यया अमृतमइनुते	BSM 21E 62: ENVIRONMENT BIOTECHNOLOGY

School Name	School of Biosciences
Programme	Msc Biotechnology/ Biochemistry/ Biophysics/ Microbiology
Course Name	ENVIRONMENT BIOTECHNOLOGY
Type of Course	Elective

Course Code	BSM 21E 62					
Course Summary & Justification	Environmental Biotechnology is offered to train the students both in the theoretical and practical aspects of identifying environmental problem where a solution is possible through Biotechnological methods Enabling students in formulating ideal solution to environment problems based on green chemistry concept is the need of this time . Students have to earn a sense of Environmental concern and to get experience in the applications of Biotechnological methods for environmental protection.					
Semester	Fourth					
Total StudentLearningT ime (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Authentic learning Collaborative learning Independent learning	60	20	0	40	120
Pre-requisites	None					

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1	On completing this course, the student will be able to	U	1, 2
	Understand the effect of a specific environmental problem identified		
2	Analyse Apply the most suitable biological method for the effective treatment of the pollutant	An	2, 4
3	Compare Explore into the possibility of applying the developed method in the field.	U	2, 4
4	Aquiring awareness about the emerging challenges in environmental threats	U/An	1
5	Communicate effectively about a chosen topic of a current environmental issue	Ар	1
*Remen and App	*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)		

Module	Module Content	CO	Hrs
No			

1	Introduction Industrial pollution causes, problems: Air, Soil and Water pollutants, Types of pollutants characterization, Persistence and Biomagnification of Xenobiotics, recalcitrant molecules, nitroaromatic polychlorinated, biphenyls and dioxans, synthetic polymers, alkylbenzyl sulphonates, Hydrocarbons, Pesticides, Phenolics, Anilines, Inorganic pollutants, Heavy metals. Detection and Quantification of pollutants. Environmental laws	1, 5, 4	10
2	Biodegradation, Process and application: Microbial infallibility, types of biodegradation, factors affecting biodegradation, enzymes involved in biodegradation, catabolic plasmids, Molecular Approaches, Biogeochemical cycles, Bioleaching. Biodegradation of Hydrocarbons, cellulose, lignin, Phenoland pesticides. Application of TOC, FT/IR, GC-MS analysis in biodegradation studies	2,5	10
3.	Industrial wastewater: Types of industrial effluents, characterization of the wastewater. Chemical Oxygen Demand, Biological Oxygen Demand, Total organic carbon, Nitrogen contents, Suspended solids. Total heterotrophic bacterial population. Bacteriological analysis of drinking water, Presumptive, completed, and confirmed test. Treatment strategies primary, Secondary and tertiary treatment Physical, Chemical and Biological treatment. Floc based and film based strategies, aerobic and anaerobic methods	1, 2, 3, 5	20
4	Biological treatment of industrial wastewater: Activated sludge process, different stages, Types. Oxic/Anoxic, Extended aeration methods, Nitrification and denitrification. Trickling filter process, Different stages Types, Biofilm applications, Rotating Biological contactor,UASB, Submerged aerobic filters, Fluidized Bed Reactor, Packed bed reactor, Oxidation lagoons. Bioreactors for wastewater treatment. Advanced treatment strategies Teritiary treatment methods, Disinfection, Chlorination, Chlorination dosage chlorination derived byproducts	4,5	10
5	Solid waste management: Solid waste, Types, Problems, Characterization and sorting of wastes. Municipal and industrial waste management, Land fills composting, stages in composting, Types of composting vermicomposting. Methanogenesis, stages in anaerobic digestion, methanogens Anaerobic reactors Biogas generation, Household treatment strategies, Present problem and Possible remedies	4, 5	10
	Total Credits of the Course	3	

TeachingandL earningAppro ach	Classroom Procedure (Mode of transaction) Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning, interactive Instruction:, Active co-operative learning, Seminar, Group Assignments Authentic learning, , Library work and Group discussion, Presentation by individual student/ Group representative
Assessment Types	 Mode of Assessment I. Continuous Internal Assessment (CIA) 1. Internal Tests of maximum 20 marks 2. Seminar Presentation – a theme is to be discussed and identified to prepare a paper and present in the seminar Maximum marks 10 3. Write a detailed report on a given topic based on research findings and literature search – 10 marks JJ. Semester End examination – 60 marks

Compulsory Reading:

- 1. Microbial Ecoology, Atlas and Bartha, Pearson Publication
- 2. Comprehensive Biotechnology—2 nd Edition,Murray Moo Young ISBN-9780444533524,Pergman
- Industrial Microbiology, Samuel Cate Prescot and Cecil Gordan Dunn, Third edition Mac Graw-Hill
- 4. Waste water microbiology, Gabriel Bitton, Third edition, Wiley, ISBN-9780471717966

- 1. Environmental Biotechnology -Theory and application , Gareth m Evans and Judith C Furlong , Wiley 2003
- 2. Envoronmental Chemistry-Anilkumae DE,

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School Name	School of Biosciences							
Programme	Msc Biotechnology/ I	Msc Biotechnology/ Biochemistry/ Biophysics/ Microbiology						
Course Name	IPR AND PATENTI	IPR AND PATENTING						
Type of Course	Elective	Elective						
Course Code	BSM 21E 63	BSM 21E 63						
Course Summary & Justification	To introduce students	To introduce students the concept of intellectual property and IPR						
Semester			Fourth					
Total StudentLearningT ime (SLT)	Learning Approach	Learning ApproachLectureTutorialPracticalOthersTotal Learning Hours						
	Authentic learning6020040120Collaborative learningIndependent learningIndependent learningIndependent learningIndependent learningIndependent learningIndependent learning							
Pre-requisites	None							

СО	Expected Course Outcome	Learning	PSO No.
No.			

		Domains	
1	On completing this course, the student will be able to	u	1
	Define different international agreement on IPR		
2	Analyse the patentability of an invention and laws on plant variety protection	An	1, 2
3	Compare the patentability of biological entities	U	2
4	File a patent	S	2, 4
5	Communicate effectively about a patent related topic	An/ C	1
	both verbally and in writing		
*Remem	ber (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Cred	te (C), Skill (S),	Interest (I)

*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

Module	Module Content	СО	Hrs
1	Introducti Introduction. Definitions General Agreement on Trade and Tariff (GATT) and World Trade Organizations Establishment and functions of GATT, WTO, and WIPO. WTO Guidelines and Summits. Physical and Intellectual Property	1, 5	10
2	TRIPS Different types of intellectual property rights (IPR) - Patents, Trade mark, Trade secret, copyright and Geographical indications Requirement of patentability, Biotechnological examples of patents, trademark, trade secret and copy right	1, 5	10
3.	Patenting research tools and the law: Patents as a Strategy for Protection of Intellectual Property, Benefits and Costs of Patents, Requirements for Patent Protection, patentable subjects and protection in biotechnology, international convention for the protection of new varieties – Strasbourg convention, UPOV convention. Experimental Use Exemption	2,5	10
4	Patent filing and Infringement Patent application- forms and guidelines, fee structure, time frames; Types of patent applications: provisional and complete specifications; PCT and convention patent applications; International patenting-requirement, procedures, and costs; financial assistance for patenting-introduction to existing schemes; Indian Patent Act, 1970 and recent amendments Publication of patents in India Status of patenting in Europe and US. Patenting by research students, lecturers, and scientists University/organizational rules in India and abroad, credit sharing by workers, financial incentives, Patent infringement- meaning, scope, litigation, case studies and examples	4, 5	20

5	The patentability of microorganisms, legal protection for plants and other higher organisms, new plant varieties by rights, tissue culture protocols, transfer of technology. Patentability of vectors. Licensing - Flavr Savr TM tomato as a model case, Biopiracy and case studies on patents (Basmati rice, Turmeric, and Neem)	3, 5	10
	Total Credits of the Course	3	

TeachingandL earningAppro ach	Classroom Procedure (Mode of transaction) Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning, Interactive Instruction:, Active co-operative learning, Seminar, Group Assignments Authentic learning, , Library work and Group discussion, Presentation by individual student/ Group representative					
Assessment Types	Mode of AssessmentKK.Continuous Internal Assessment (CIA)1. Internal Tests of maximum 20 marks2. Seminar Presentation – a theme is to be discussed and identified to prepare a paper and present in the seminar Maximum marks 103. Write a detailed report on a given topic based on research findings and literature search – 10 marks LL.Semester End examination – 60 marks					

Compulsory Reading:

- 1. Patents (2003), N.Subbaram, Pharma Book Syndicate, Hyderabad.
- 2. WIPO Hand book on Intellectual Property
- 3. IPR , Biosafety, and Bioethics Deepa Goel and Shomoni Parashar

Further Reading:

1. Revised guidelines for research in Transgenic plants (August 1998), Department of Biotechnology, Ministry of Science & Technology, Government of India, New Delhi.

2. Intellectual Property, W.R. Cornish, Sweet and Maxwell publishers, London

Web resources

- 3. https:// worldwide. espacenet.com
- 4. https:// patentscope. wipo. int
- 5. https://ipindiaservices.gov.in

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Папчи зараните	MAHATMA GANDHI UNIVERSITY BSM 21E 64: OMICS IN BIOTECHNOLGY					
School Name	School of Biosciences	School of Biosciences				
Programme	MSc Biotechnology					
Course Name	Omics in Biotechnolo	ogy				
Type of Course	Elective					
Course Code	BSM 21E 64					
Course Summary & Justification	 1.The course describes new approach, the concept of "OMICS" in various levels.It is a multi-disciplinary emerging field that encompasses genomics, epigenomics, transcriptomics, proteomics, and metabolomics. 2.The course content explain the high-quality techniques, methods & analysis from genome level will help in the complete understanding of a biological process.These approaches are targeted towards understanding complex systems more thoroughly at the molecular level 					
Semester	Fourth					
Total StudentLearningT ime (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Authentic learning Collaborative learning Independent learning	60	20	0	40	120

Pre-requisites	Basics of Molecular Biology

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1	On completing this course, the student will be able to Explain genome and types of genomics, tool and methods in genomic study, as well as Genome structure of selected organisms.	U/E	1
2.	Explain the Proteomics, Transcriptomics & Metabolomics & Describe the tool and methods employed to study. Students have able to explain the various application of Proteomics, Transcriptomics & Metabolomics study	An/A	1, 4
3.	Students have able to illustrate the techniques employed for metagenomic analysis and application of metagenomic study	S/I	2, 4
4.	Describe the classification and types of databases & applications of data bases	U/R	1
5.	Communicate effectively about a chosen topic in Omics in Biotechnology both practically and theoratically.	C/S	1

*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE	COURSE CONTENT			
Module	Module Content	CO	Hrs	
No				
1	Genome & Genomics: Definition of Genome &	1, 5	20	
	Genomics.Types of genomics,, Functional Genomics.Structural			
	genomics&Comparative genomics, Tools in			
	Genomics, Structural genomics: - Classical ways of genome			
	analysis, large fragment genomic libraries; Physical &			
	Genetic mapping of genomes; Genome sequencing,			
	sequence assembly, annotation& bioinformatics.Functional			
	genomics:-DNA chips and their use in transcriptome			
	analysis; Mutants and RNAi in functional genomicsNext			
	generation sequencing methods; Structure of genomes:			
	bacteria, yeast, nematode, Arabidopsis, rice, zebra fish, mouse			
	and man.Applications of genomics			
2.	Proteomics, Transcriptomics & Metabolomics: Basic	2, 5	10	
	concepts, Introduction to transcriptomics, proteomics and			

	Total Credits of the Course	3	
	modification databases		
	databases - PDB- Metabolic databases – post translational		
	PROSITE and BLOCKS - 2D PAGE databases – Structure		
	sequence databases - SWISS-PROT and TrEMBL —		
	resources, GRAIL, GENSCANProteome databases Protein		
	Resources: DNA sequence databases-specialized genomic		
	databases, Pattern and profile databases Genome Information		
	databases- Secondary databases-composite protein pattern		
	databases-primary sequence databases- Composite sequence	., .	
4	Biological data bases: Classification databases Biological	4.5	20
	data Application of metagenomics		
	library Screen or sequence Analysis of metagenomic		
	sampleClone DNA Insert into plasmid Develop sample		
э.	metagenomics. Definition of metagenomics, rechniques in metagenomics-Isolating DNA from an environmental	3, 3	10
2	Metagenemics: Definition of metagenemics Techniques in	2 5	10
	techniques. Applications of proteomics in agriculture, numan		
	electrophoresis and Mass spectrometric and computational		
	through emerging metabolomic techniques like 2D gel		
	analysis of protein-protein interactions, and metabolic profiling		
	of proteins and metabolites:. Proteomics approaches to the		
	composition, Motifs and patterns, Analysis and characterization		
	,Applications of proteomics Protein identity based on		
	,Protein identification by peptide mass fingerprinting		
	Liquid chromatography, Mass Spectrometry (ESI and MALDI)		
	metabolomicsTools of proteomics- SDS PAGE, 2D PAGE,		

TeachingandL	Classroom Procedure (Mode of transaction)
ach	Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning, interactive Instruction:, Active co-operative learning, Seminar, Group Assignments Authentic learning, Library work and Group discussion, Presentation by individual student/ Group representative
Assessment Types	Mode of Assessment
Types	MM. Continuous Internal Assessment (CIA)
	1. Internal Tests of maximum 20 marks
	2. Seminar Presentation – a theme is to be discussed and identified to
	prepare a paper and present in the seminar Maximum marks 10
	3. Write a detailed report on a given topic based on research findings and
	literature search – 10 marks
	NN. Semester End examination – 60 marks

Compulsory Reading:

- 1. Introduction to proteomics, Daniel. C. Libeler, Humana Press 2002
- 2. Thompson, J.D., Schaeffer-Reiss, C., and Ueffing, M. 2008. *Functional Proteomics*. *Methods andProtocols*. Humana Press, New York.
- 3. Metabolomics- Methods and Protocols by Wolfram Weckwerth, Humana Press.
- 4. Aurthur M Lesk Introduction to Bioinformatics .Oxford University press.

- 1. Bostjan Koba., Mitchell Guss & Thomas Habs Structural Proteomics. Humana Press.
- 2. Twyman, R.M. 2004. Principles of Proteomics. Taylor & Francis
- 3. Mass Spectrometry for Biotechnology by Gary Siuzdak, Academic Press.
- 4. Proteomics for Biological Discovery by Timothy Veenstra and John Yates, Wiley.
- 5. Lipidomics- Technologies and Applications by Kim Ekroos, Wiley-VCH.
- 6. Web/Journal Resources.
- 7. Transcriptomics: Expression Pattern Analysis, Virendra Gomase, Somnath Tagore; VDM Publishing, 2009 Science
- 8. Brown TA. 2007. Genome III. Garland Science Publ.
- 9. Campbell AM & Heyer L. 2004. Discovery Genomics, Proteomics and Bioinformatics. Pearson Education.
- 10. Jollès P & Jörnvall H. 2000. Proteomics in Functional Genomics: Protein Structure Analysis.
- 11. Kamp RM. 2004. Methods in Proteome and Protein Analysis. Springer.
- 12. Primrose SB & Twyman RM. 2007. Principles of Genome Analysis and Genomics
- 13. Blackwell. Sensen CW. 2005. Handbook of Genome Research. Vols. I, II. Wiley CVH.

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MAHATMA GANDHI UNIVERSITY

BSM 21E 65: MOLECULAR PHYLOGENY

School Name	School of Biosciences					
Programme	Msc Biotechnology/ Biochemistry/ Biophysics/ Microbiology					
Course Name	MOLECULAR PHY	LOGEN	Y			
Type of Course	Elective					
Course Code	Irse Code BSM 21E 65					
Course Summary & Justification	 This elective course deals with the tools and techniques of Molecular phylogeny. The course has a theoretical and a practical dimension The learner will develop an understanding about models of nucleic acid substitution, tree building algorithms, data mining tools and submission tools for nucleic acid data and applications of Molecular phylogeny 					
Semester	Fourth					
Total StudentLearningT ime (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Authentic learning Collaborative learning Independent learning	60	20	0	40	120
Pre-requisites	Basics of genome organisation and organic evolution, concepts of					

biological classification

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1	On completing this course, the students will be able to	An	2, 3, 4
	Compare and narrate the models of nucleic acid substitution, tree building algorithms, data mining tools, and submission tools for nucleic acid data		
2	Deposit nucleic acid sequences in databases and able to perform data mining	S	2, 4
3	Perform sequence alignment and editing	S	2,4
4	Analyse sequence alignments by suitable software and perform phylogenetic analysis	S	2, 4
5	Carry out a phylogenetic analysis from raw sequence data up to final conclusions	S	2,4
6	Communicate effectively about a phylogenetic problem both verbally and in writing.	An/ C	1
*Remem and App	*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)		

COURSE CONTENT

Module	Module Content	CO	Hrs
No			
1	Basic concepts of molecular evolution: Genetic information, population dynamics, evolution and speciation, data used for molecular phylogenetics, phylogenetic tree, methods for inferring phylogenetic trees, networking, RNA world	1, 6	15
2	Sequence databases and data base searches: Sequence databases, composite databases, database mirroring, and search tools, data base searching by sequence similarity – BLAST and FASTA, multiple sequence alignments CLUSTAL, MUSCLE, T-COFFEE	2, 3, 6	10

3.	Phylogenetic inference: Genetic distances and nuclear substitution models, phylogenetic inference based on distance methods- UPGMA, Neighbour Joining, Minimum Evolution, Least square	4, 5, 6	10
4	Phylogenetic inference: Maximum Likelihood and Bayesian phylogenetic analysis, phylogenetic analysis based on parsimony, phylogenetic analysis using protein sequences, testing tree reliability – Bootstrapping and jackknifing	4, 5, 6	10
5	Testing models and trees: Models of evolution and phylogeny reconstruction, model fit, likelihood ratio tests, Practising MEGA, Paup*, RaxML, Mr Bayes, J Model Test, Sequence submission tools- SEQUIN and BankIt	4, 5, 6	15
	Total Credits of the Course	3	

TeachingandL earningAppro ach	Classroom Procedure (Mode of transaction) Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning, interactive Instruction:, Active co-operative learning, Seminar, Group Assignments Authentic learning, , Library work and Group discussion, Presentation by individual student/ Group representative	
Assessment Types	 Mode of Assessment OO. Continuous Internal Assessment (CIA) 1. Internal Tests of maximum 20 marks 2. Seminar Presentation – a theme is to be discussed and identified to prepare a paper and present in the seminar Maximum marks 10 3. Write a detailed report on a given topic based on research findings and literature search – 10 marks 	
	PP. Semester End examination – 60 marks	

Compulsory Reading:

- 1. Molecular evolution And Phylogenetics, Masatoshi Nei and Sudhir Kumar, Oxford University Press, ISBN 0195135857
- 2. Baldauf, SL (2003) "Phylogeny for the faint of heart: a tutorial." Trends in Genetics; 19(6):345-351.

- The phylogenetic Hand book, 2nd Edition, Philippe Lemey, Marco Salemi, Anne Mieke Vandamme, Cambridge University Press, ISBN-13 978-0-511-71963-9
- 4. Hall, BG. (2004) Phylogenetic Trees Made Easy: A How-To Manual, 2nded. Sinauer Associates, Inc.: Sunderland, M A. ISBN: 978-0-87893-606-9

 Hartwell, LH, L Hood, ML Goldberg, AE Reynolds, LM Silver, RC Veres (2008) Genetics: From Genes to Genomes, 3rd Ed. McGraw-Hill: New York ISBN-13: 978-0073525266ISBN-10: 007352526X

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	MAHATMA GANDHI UNIVERSITY
विद्यवा अमृतमग्रनुते	BSM 21E 66: HUMAN VIROLOGY

SchoolName	School of Biosciences							
Programme	M.Sc Microbiology/B	M.Sc Microbiology/Biochemistry/Biotechnology/Biophysics						
Course Name	HUMAN VIROLOG	HUMAN VIROLOGY						
Type of Course	Core							
Course Code	BSM 21E 66							
Course Summary & Justification Semester	This course on Human Virology deals with an important area of Medical Microbiology The objective of the course content is to create a sound awareness in human viruses and viral diseases. their The course will augment the student's knowledge in pathogenesis of viral diseases and their laboratory diagnosis and prophylaxis.							
Total								
StudentLearningT ime (SLT)	Learning Approach	Learning Approach Lecture Tutorial Practical Others Total LearningH ours						
	Authentic learning Collaborative learning Independent learning	60	20	0	40	120		
Pre-requisite	Basic understanding of	on Humai	n Anatom	y, Physiolo	ogy and			

Biochemistry
Knowledge in Basic Virology, Molecular Biology and Immunology

COURSE OUTCOMES (CO)

СО	Expected Course Outcome	Learning	PSO No.
No.		Domains	
1.	On completing this course student will be able to analyse comparatively the structure and properties of important human viruses	U/An	1
2.	Students will be able to understand and evaluate the mechanism of pathogenesis of viral diseases	U/E	1, 2
3.	Students will become aware of the methods applicable in viral diagnostics	U/A	2, 4
4.	Students will be able to analyse the various mechanisms of viral oncogenesis	An	1, 2
5,	Students will be able to understand and compare the mechanisms of action of various antiviral agents	U/An	1, 2
6	Students will be able to understand and evaluate the methods of prophylaxis of viral diseases in humans	U/E	1, 4
*Remem and App	ber (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Crec reciation (Ap)	ute (C), Skill (S),	Interest (I)

Modu	Module Content	CO	Hrs
le No			

1	Study of properties of human DNA viruses viz. Pox, Herpes,	1, 2, 3	10
	Adeno, Papova, and Parvo viruses. Pathogenesis and laboratory		
	diagnosis of diseases caused by these viruses		
2	Study of properties of human RNA viruses viz. Picorna,	1, 2, 3	20
	Orthomyxo, Paramyxo, Rhabdo, and Rubella viruses		
3.	Arboviruses and Hepatitis viruses - Properties. Pathogenesis	1, 2, 3	20
	and laboratory diagnosis of diseases caused by these viruses.		
	Viral haemorrhagic fevers, SARS CoV-2, HIV, Properties,		
	pathogenesis and laboratory diagnosis of Slow virus infections,		
	Prion diseases		
4	Viruses and cancer, Viral oncogenesis, Viruses implicated in the cancers of humans. Prophylavis of viral diseases. Types of	2, 4,	10
	viral vaccines, antiviral agents and their mechanisms of action,	5,0	
	Interferons		
	Total Credits of the Course	3	

TeachingandL earningAppro	Classroom Procedure (Mode of transaction)				
ach	Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning, interactive Instruction:, Active co-operative learning, Seminar, Group				
	Assignments Authentic learning, Library work and Group discussion,				
	Presentation by individual student/ Group representative				
Assessment	Mode of Assessment				
Types					
	QQ. Continuous Internal Assessment (CIA)				
	1. Internal Tests of maximum 20 marks				
	2. Seminar Presentation – a theme is to be discussed and identified				
	to prepare a paper and present in the seminar Maximum marks 10				
	3. Write a detailed report on a given topic based on research				
	findings and literature search – 10 marks				
	RR. Semester End examination – 60 marks				

Compulsory Reading: 1.Jawetz,Melnick& Adelberg's Medical Microbiology27 th Edition Carrol, Butel, Morse, Mietzner Mc Graw Hill 2.Ananthanarayan & Panicker's Text book of Microbiology.9th Edition Arti Kapil (Ed) University Press (India) Pvt.Ltd. Further Reading:

- 1. Human Virology Fourth Edition Leslie Collier, John Oxford & Paul Kellam Oxford University Press.
- 2. Fundamental Virology 5th Edition David M.Knipe& Lippincott Williams & Wilkins
- 3. Viruses Biology, Applications & Control

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COND HI CONTRACTOR	MAHATMA GANDHI UNIVERSITY
मिलपण अमृतमहन्त	BSM 21E 67: ADVANCED TECHNIQUES IN DIAGNOSTIC MICROBIOLOGY

SchoolName	School of Biosciences						
Programme	M.Sc. Microbiology/Biotechnology/Biochemistry/Biophysics						
Course Name	ADVANCED TECH	ADVANCED TECHNIQUES IN DIAGNOSTIC MICROBIOLOGY					
Type of Course	Elective						
Course Code	BSM 21E 67						
Course Summary & Justification	Different methods microorganisms. The with an objective to various methods used students to learn th microbiology which opportunities based o	Different methods are used to detect the diseases caused by microorganisms. The syllabus content in this course has been designed with an objective to provide the basic principle and applications of various methods used in diagnostic microbiology. This will enable the students to learn the basic and advanced methods in diagnostic microbiology which will enable them to identify the research and job opportunities based on the latest developments in this subject					
Semester		Fourth					
Total Student Learning Time (SLT)	Learning ApproachLectureTutorialPracticalOthersTotalHours						
	Authentic learning Collaborative learning Independent learning	60	20	0	40	120	

Pre-requisite	Basic understanding on diseases caused by microorganisms, different
	methods used to detect the diseases

CO No.	Expected Course Outcome	Learning Domains	PSO No.			
1.	Students will able to understand the process and methods	R/U	1, 4			
	in medical microbiology lab					
2.	Students will able to understand various clinical samples	R/U	1, 2, 4			
	used for diagnostic applications					
3.	Students will able to explain the principles of methods	U/ An/E	1,4			
	used in medical microbiology					
4.	Students will get exposed to both the conventional and	U/An/A	2, 4			
	rapid methods used for the microbial identification					
5.	Students will able to identify research and job	C/S	2			
	opportunities in diagnostic microbiology					
6.	Students will able to analyze scope of technological	S/I	4			
	advancement for rapid microbial identification					
*Remer Interest	*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)					

Module No	Module Content	СО	Hrs
1	Introduction to diagnostic microbiology, laboratory safety, hospital epidemiology. Lab methods in Medical Microbiology, basic virology, basic mycology, Clinical material - collection and transport. Etiological agents recovered from different clinical materials	1, 2, 3	20
2	Biochemical profile based microbial identification systems, Urea breath test, Rapid antigen tests, Enzyme-Linked Immunoassay, Western blot, Advanced antibody detection, Bacterial antimicrobial susceptibility tests	1, 4	20
3.	Polymerase chain reaction, Principle, applications and types of PCR	4, 5	10

	in medical diagnostic field, Microbial Identification Based on PCR		
	amplification of 16S rDNA, Sequence analysis, Application of Real		
	Time PCR in Diagnostic Microbiology, Microbial Strain Typing		
	Using Repetitive Sequences Advances in the Diagnosis of		
	Mycobacterium tuberculosis and methicillin resistant		
	Staphylococcus aureus.		
4	Probe-Based Microbial Detection and Identification, Southern Blot	5, 6	10
	Hybridization, Microarray- Based Microbial Identification and		
	Characterization, Recent advances in medical microbiology		
	Total Credits of the Course	3	

Teaching And Learning Approach	Classroom Procedure (Mode of transaction) Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning, interactive Instruction, Active co-operative learning, Seminar, Group Assignments Authentic learning, Library work and Group discussion, Presentation by individual student/ Group representative
Assessment Types	 Mode of Assessment SS. Continuous Internal Assessment (CIA) Internal Tests of maximum 20 marks Seminar Presentation – a theme is to be discussed and identified to prepare a paper and present in the seminar - Maximum marks 10 Write a detailed report on a given topic based on research findings and literature search – 10 marks TT.Semester End examination – 60 marks

Compulsory Reading:

1. Bailey and Scott's Diagnostic Microbiology Publisher: Elsevier Health, 28 Jun 2013

2. Advanced Techniques in Diagnostic Microbiology Editors: Wu, Shangwei, Stratton, Charles, 2012

Further Reading:

3.Textbook of Diagnostic Microbiology Hardcover, by Mahon (Author), Publisher:

Elsevier Health - US; 5 edition (18 February 2014)

4.Koneman's Color Atlas and Textbook of Diagnostic Microbiology 7th Edition by Gary

W. Procop MD MS, Elmer W. Koneman, Publisher: LWW; 7 edition (June 15, 2016)

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SchoolName	School of Biosciences					
Programme	Msc Biochemistry/ N	Msc Biochemistry/ Microbiology/ Biotechnology/ Biophysics				
Course Name	RADIATION BIOF	PHYSICS				
Type of Course	Elective					
Course Code	BSM 21E 68	BSM 21E 68				
Course Summary & Justification	To introduce the student to an important division of Biophysics- Radiation Biophysics To familiarize the topics of Radiation and Radioactivity, its interactions, biological effects, dosimetry, hazards, protection and application in medicine, industry and agriculture The course is designed to provide an overview of different imaging techniques used in medical field					
Semester	Fourth					
Total StudentLearning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours

	Authentic learning	60	20	0	40	120
	Collaborative					
	learning					
	Independent					
	learning					
Pre-requisite	Basics of Radiation	biophysic	es			

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1	To describe various kinds of radiation and radiation	Е	1
	units		
2	To explain the various biological effects of radiation	U/ An	1
3	To narrate how to detect and measure radiation	R	1, 2
4	To explain how to protect from radiation exposure	S	1
5	To describe the use of radioisotopes in medicine, industry and agriculture	Е	1
6	To discuss about the biomedical imaging techniques	An/ C	1
*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

Module No	Module Content	CO	Hrs
110			
1	Radioactivity: Laws of radioactivity, α , β , γ rays. Properties of	1	10
	electromagnetic radiation. Radiation units; Exposure and Dose,		
	Dose equivalent unit, KERMA, Absorbed dose and Derived Units-		
	Equivalent Dose and Effective dose, Dose rate. Interaction of		
	radiation with matter- Bremsstrahlung, Photoelectric effect,		
	Compton effect, Ion pair production. Interaction, absorption and		
	scattering of electron. Heavy charged particles and Neutrons.		
	Attenuation coefficient and absorption coefficient. HVL, Mean free		
	path, Absorption edges, LET, Relative biological effectiveness		
	(RBE)		
2	Biological effects of radiation: Radiolysis of water, Production of	1, 2	10
	free radicals & their interactions, Competition kinetics, Diffusion		
	kinetics & Physicochemical effects, Role of scavengers, G-value,		
	Genetic Effect of radiolysis, Chromosomal breakage and		

	Aberrations Direct and Indirect action, Oxygen and temperature effect, OER. Target theory, Single hit & Multi hit theory, Multi target theory, Calculation of target, Mass, Volume & Molecular weight, Effect of radiation on Nucleic acids, Proteins, Enzymes & Carbohydrates, Somatic and genetic effects of radiation, Stochastic and deterministic effects, early and late effects, Radiation sickness, Radiation syndrome, Haemopoietic syndrome, G.I syndrome, CNS syndrome, Acute radiation damage, Early and late effects of radiation, Effect of chronic exposure to radiation. Acute radiation damage, LD-50, Dose effect relationship. Cell recovery and modification of Radiation damage		
3.	Radiation dosimetry : Principles of radiation detection and measurement- Dosimetry- General requirements of Dosimeters, Radiation sources, Telegamma Unit (Cobalt unit), Gamma chamber, Nuclear reactors, Thermal & fast neutron sources. Dosimeters- Basic principles, Design & Working of physical dosimeters- Ionization chamber, Proportional counters, GM- Counter, Concepts of Gas amplification, Resolving time & Dead time, Scintillation Detectors, Thermolumeniscent Dosimeter, Semiconductor, Surface barrier & Lithium detectors, Area survey meter & Pocket dosimeter, Film badge, General principle of chemical dosimetry, Salient Features of Chemical dosimeter, Dose evaluation formula for chemical dosimetry, Principles of radiolytic reaction, Experimental methods- Influencing factors of Fricke dosimeter methyl orange, FBX dosimeter, Free radical dosimeter, Ceric sulphate dosimeter, PMMA, PVC, chlorobenzene dosimeter, High & low dose indicators	3	20
4	Radiation Hazards and Protection : Natural and man-made radiation exposures, maximum possible dose, Radiation hazards-external and internal radiation hazards. Radiation protection measurement in industrial establishment, Radioisotope labs, diagnostic and therapeutic installation and during the transportation of radioactive substances, Disposal of radioactive wastes.	4	10
5	Applications of radiation- Radioisotopes in Biology, Agriculture, Plant breeding, Plant Physiology, Medicine. Internally administered isotopes. Radioiodine in thyroid function analysis. Renal, liver and lung function analysis. Radio Immuno Assay, Radiotracer techniques. Auto radiography. Specialized radio isotopic applications in industries Biomedical imaging techniques- Principle of analogue and digital imaging, Ultra sound imaging, Nuclear resonance imaging, X-ray imaging and CT scan, Principle of tomographic techniques,	5, 6	10

Computerised	tomography,	positron	emission	tomography,		
application and	interpretation o	f image				
		То	tal Credits	of the Course	3	

Teachingand LearningApp roach	Classroom Procedure (Mode of transaction) Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning, interactive Instruction:, Active co-operative learning, Seminar, Group Assignments Authentic learning, , Library work and Group discussion, Presentation by individual student/ Group representative			
Assessment Types	Mode of Assessment			
- 5 P - 5	UU. Continuous Internal Assessment (CIA)			
	1. Internal Tests of maximum 20 marks			
	2. Seminar Presentation – a theme is to be discussed and identified			
	to prepare a paper and present in the seminar Maximum marks 10			
	3. Write a detailed report on a given topic based on research			
	findings and literature search -10 marks			
	VV. Semester End examination – 60 marks			

Compulsory Reading:

- Glenn.F.knoll., Radiation detection and Measurement; III Edition, John Wiley & Sons, Inc.
- 2. Edward L. Alphen., Radiation Biophysics©, Prentice Hall

- 1. Frank.H. Attix., Introduction to Radiological Physics & Radiation dosimetry
- 2. Wagner, Szabo, Buchanan., Principles of Nuclear medicine.
- 3. Orton, C.G., Radiation Dosimetry: Physical and Biological aspects.
- 4. Girish Lahari- Nuclear Physics, Mohit Books International.
- 5. S.P.Yarmonenko; Radiobiology, Mir Publishers.
- 6. JozsefKonya.Noemi M. Nagy; Nuclear and Radiochemistry,Elsevier insight

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Maral suburba	MAHATMA GANDHI UNIVERSITY
	BSM 21E 69: GOOD LABORATORY PRACTICES

SchoolName	School of Biosciences					
Programme	MSc Biochemistry/ Microbiology/ Biotechnology/ Biophysics					
Course Name	GOOD LABORATO	RY PRA	CTICES	•		
Type of Course	Elective					
Course Code	BSM 21E 69					
Course Summary & Justification	To equip the students with appropriate knowledge, skills to undertake general and quality management of laboratory practices and procedures. To adequately address quality issues and improve the overall delivery of clinical and public health laboratory services in their facilities/organizations. To sensitize the students with medical and public health ethics issues and to ensure its application in teaching and practice.					
Semester	Fourth					
Total StudentLearning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Authentic learning Collaborative learning Independent learning	60	20	0	40	120
Pre-requisite	Basics Knowledge in	Bioscier	nces			

CO No.	Expected Course Outcome	Learning Domains	PSO No.	
1	derstand basic good laboratory practice	U	1	
2	Appreciate how to conduct research safely and iciently	Ар	2	
3	Understand the requirements for safe working practices and risk assessment	U	2, 3	
4	Apply experimental design and the need for controls	А	2	
5	Consider ways in which student can maximise research effort	С	2	
*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)				

Module No	Module Content	CO	Hrs
1	Introduction to good laboratory practices (GLP) and its application, history of GLP, fundamental points of GLP	1	10
2	Resources-personnel, Facilities - buildings and equipment, Characterization- test item, test system, rules for performing studies-the study plan or protocol, standard operating procedures (SOPs) raw data and data collection- records and recording, study report, archives and archiving, quality assurance, audit and inspections, implementation of GLP	2	20
3.	Applications of the GLP principles to field studies, applications of the GLP principles to short term studies, applications of the GLP principles to in vitro studies	3	10
4	Ethics in research- locating ethics in research, justice in research, science and society, ethical issues in biotechnology, ethical guidelines related to human experimentation, guidelines regarding animal use in research, institutional biosafety monitoring mechanisms.	4, 5	20
	Total Credits of the Course	3	60

Teachingand LearningApp roach	Classroom Procedure (Mode of transaction) Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning, interactive Instruction:, Active co-operative learning, Seminar, Group Assignments Authentic learning, , Library work and Group discussion, Presentation by individual student/ Group representative			
Assessment Types	Mode of Assessment			
J	WW. C	Continuous Internal Assessment (CIA)		
		1. Internal Tests of maximum 20 marks		
	2. Seminar Presentation – a theme is to be			
		discussed and identified to prepare a paper and present in the seminar Maximum marks 10		
	3. Write a detailed report on a given topic based			
		on research findings and literature search -10		
		marks		
	XX. S	Semester End examination – 60 marks		

Compulsory Reading

1. Handbook on Good Laboratory Practice- World Health Organization

2. Ethical Guidelines for Biomedical Research on Human Participants- Indian Council of

Medical Research

3. Guidelines on the regulation of scientific experiments on animals- Ministry of Environment and Forests, India

4. Textbook on Ethics in Research- European Commission, Publications Office of the European Union

- 1. Good Laboratory Practice Regulations, 4th edition edited By Sandy Weinberg- CRC Press, 2007
- 2. The Indispensable Guide to Good Laboratory Practice (GLP): Second Edition 2nd Edition- Mark Gregory Slomiany- Springer, 2009

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MAHATMA GANDHI UNIVERSITY

BSM 21E 70: HEALTH AND NUTRITION

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SchoolName	School of Biosciences					
Programme	M.Sc. Biochemistry/Microbiology/Biotechnology/Biophysics					
Course Name	HEALTH AND NUTRITION					
Type of Course	Elective	Elective				
Course Code	BSM 21E 70	BSM 21E 70				
Course Summary & Justification	The course is designed to provide basic information on nutrition and its importance in providing health.					
Semester	Four					
Total Student Learning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Eg. Authentic learning Collaborative learning Independent learning	60	30	0	40	130
Pre-requisite	Basic understanding of food and food ingredients					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.		
1	To describe the basic principles of nutritional biochemistry and different methods of nutritional analysis.	R/U	1		
2	To identify and compare the different ingredients and nutritional value of food components	A	1, 2		
3	identify different diseases associated with nutritional deficiency and overnutrition	U	1		
*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)					
COURSE CONTENT					

Module	Module Content	CO	Hours	
No				
1	Introduction to nutrition - Food as source of nutrients, functions of food, definition of nutrition, nutrients & energy, adequate, optimum & good nutrition, malnutrition. Basics of energy metabolism, nutrition & dietetics - Unit of measuring energy, calorific value of food, BMR & factors affecting it, SDA of food, calculation of energy requirement, balanced diet, nutrition in health & disease. Nutritional disorders- Epidemiology, clinical features, prevention and dietary treatment for Protein Energy malnutrition, nutritional anaemias.	1, 3	20	
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2	Food sources: Carbohydrates : Functions, classification, food sources, storage in body. Fats & oils : composition, saturated and unsaturated fatty acids, classification, food sources, function of fats. Proteins - composition, sources, essential & non-essential amino acids, functions, Protein deficiency	2	10	
3.	Water, Vitamins and minerals- Water - as a nutrient, function, sources, requirement, water balance & effect. Minerals - macro & micronutrients functions, sources. Bioavailability and deficiency of Calcium, Iron, Iodine, Sodium & Potassium (very briefly). Vitamins (water & fat soluble) - definition, classification & functions. Effect of cooking & heat processing on the nutritive value of foods. Processed supplementary foods.	2	10	
4	Nutritional problems affecting the community- Etiology, prevalence, clinical features and preventive strategies of- Undernutrition - Protein energy malnutrition: Nutritional Anaemias, Vitamin A Deficiency, Iodine Deficiency Disorders. Overnutrition – obesity, coronary heart disease, diabetes. Fluorosis	3	20	
	Total Credits of the Course	3		
	Books for Reference			
 Compulsory Reading: 1. Mudambi, SR and Rajagopal, MV. Fundame ntals of Foods, Nutrition and Diet Therapy; Fifth Ed; 2012; New Age International Publishers 2. Mudambi, SR, Rao SM and Rajagopal, MV . Food Science; Second Ed; 2006; New Age 				
Publ.				
Further 1. Srilaks 2. Swami 3. Bamji	Reading: hmi B. Nutrition Science; 2012; New Age International (P) Ltd. nathan M. Handbook of Foods and Nu trition; Fifth Ed; 1986; BAPPCC MS, Krishnaswamy K and Brahmam GNV (Eds) (2009). Textbook of H). Juman N	utrition,	

3rd edition. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.

Teachingand LearningApp roach	Classroom P Direct Instruct Active co-op learning, Lib student/ Grou	assroom Procedure (Mode of transaction) rect Instruction, Explicit Teaching, E-learning, interactive Instruction:, ctive co-operative learning, Seminar, Group Assignments, Authentic arning, Library work and Group discussion, Presentation by individual udent/ Group representative		
Assessment Types	Mode of Assessment			
- J F	YY.	Continuous Internal Assessment (CIA)		
		Internal Test -20 marks		
		Assignment – Every student needs to write an		
		assignment on a given topic based on the		
		available published literature – 10 marks		
		Seminar Presentation – A topic needs to be		
		presented and discussed with the class- 10		
		marks		
	ZZ.	Semester End examination – 60 marks		

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A CONTRACTOR OF THE STATE	MAHATMA GANDHI UNIVERSITY
विद्यया अमृतमयन्ते	BSM 21E 71: NEUTROPHIL BIOLOGY

SchoolName	School of Biosciences
Programme	M.Sc. Biochemistry/Microbiology/Biotechnology/Biophysics
Course Name	NEUTROPHIL BIOLOGY
Type of Course	Elective
Course Code	BSM 21E 71
Course Summary &	The course is designed to get a detailed idea about the functioning of neutrophils in providing immune response and the mechanisms behind

Justification	it. This would be helpful for the students, in case they take up research in immunology, cell biology or cellular biochemistry.					
Semester	Four					
Total Student Learning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Eg. Authentic learning Collaborative learning Independent learning	60	20	10	40	130
Pre-requisite	Basic understanding of immunology and blood cells					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1	describe the role of neutrophils in imparting and fine- tuning immune response	R/U	1
2	identify and compare different functions of neutrophils	U/A	1, 2
3	identify different techniques to perform neutrophil functional analysis	S	1, 4
*Remem and App	ber (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Crea reciation (Ap)	ute (C), Skill (S),	Interest (I)

COURSE CONTENT

Module	Module Content	CO	Hours
1	Introduction to immune system- innate and adaptive immune system, cells involved in immune system, humoral immunity, cytokines, antibodies, complement system. cell- mediated and humoral immune response	1	10
2	Neutrophil Physiology -Neutrophil structure, Granule types- azurophilic, specific, gelatinase, secretory vesicles, Antimicrobial peptides. Neutrophil Subpopulations. Neutrophil activation, apoptosis and clearance. Neutrophils in the resolution of inflammation. Neutrophil in immune cross-talk	2	10
3.	Neutrophil defense mechanisms- Chemotaxis, Phagocytosis, degranulation, ROS generation,NADPH oxidase, Neutrophil extracellular trap formation, NETosis vs. apoptosis and necrosis, Cytokine secretion. Diseases associated with altered neutrophil defence- Autoimmunity, cancers, thrombosis.	2	20

4	Techniques to study neutrophils: Neutrophil isolation and maintenance, Cell counting, Phagocytic assays, chemotactic assays, NBT assay, MTT assay, other assays of ROS production, Granule isolation, Neutrophil protein analysis, microscopic analysis of neutrophils and granules – Light and fluorescent microscopy, SEM and TEM	3	20
	Total Credits of the Course	3	
	Books for Reference		
 Compulsory Reading: 1. Neutrophil Methods and Protocols, Quinn, Mark T., DeLeo, Frank R., Bokoch, Gary M. (Eds.). ISBN 978-1-59745-467-4. 2. Biochemistry and physiology of the neutrophil, Steven W Edwards, Cambridge university press Online ISBN-9780511608421 3. The Neutrophil Murphy Patrick Springer ISBN- ISBN 978-1-4684-7418-3 			
 Further Reading: 1. Neutrophil function: Mechanisms to diseases. Borko Amulic, Christel Cazalet, Garret L. Hayes, Kathleen D. Metzlerand Arturo Zychlinsky; Annu. Rev. Immunol. 2012. 30:459–89. 2. Neutrophil biology: an update. Yoshiro Kobayashi, EXCLI J. 2015; 14: 220–227. doi: 10.17179/excli2015-102. 3. Advances in neutrophil biology: clinical implications. Cowburn AS, Condliffe AM, Farahi N, Summers C, Chilvers ER. Chest. 2008 Sep;134(3):606-12. doi: 10.1378/chest.08-0422. 4. The Neutrophils: New Outlook for Old Cells. 3rd Edition.Edited by: Dmitry Gabrilovich (H Lee Moffitt Cancer Center, USA & University of South Florida, USA). ISBN: 978-1-84816-836-7 			

Teachingand LearningApp	Classroom Procedure (Mode of transaction)			
roach	Direct Instruction, Explicit Teaching, E-learning, interactive Instruction:, Active co-operative learning, Seminar, Group Assignments, Authentic learning, Library work and Group discussion, demonstrations, Presentation by individual student/ Group representative			
Assessment Types	Mode of Assessment			
~ 1	A. Continuous Internal Assessment (CIA)			
	Internal Test -20 marks			
	Assignment – Every student needs to write an			
	assignment on a given topic based on the			
	available published literature – 10 marks			
	Seminar Presentation – A topic needs to be			
	presented and discussed with the class- 10			
	marks			
	B. Semester End examination – 60 marks			

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	MAHATMA GANDHI UNIVERSITY
विद्यापा अपूरतमञ्जूत	BSM 21E 72: PLANT-MICROBE INTERACTIONS

SchoolName	School of Biosciences
Programme	M.Sc. Microbiology
Course Name	PLANT-MICROBE INTERACTIONS
Type of Course	Elective
Course Code	BSM 21E 72
Course Summary & Justification	This course develops concepts in plant- microbe interaction The major objective of this paper is to give an insight into the consequences, on population and ecosystem level, of compatible and incompatible interactions, to understand infection process and control measures and to familiarize with the microbial production of plant metabolites.
Semester	First

Total StudentLearningT ime (SLT)	Learning Approach	Lecture	Tutoria 1	Practic al	Others	Total LearningHou rs
	Authentic learning Collaborative learning Independent learning	60	20	0	40	120
Pre-requisite	Basics of agricultura	l microb	oiology			

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1	Comprehensively discuss interactions between plants and microbes as well as the defense reactions of the host plant	U/R/ An	1
2	Gain insight into genetics of host-pathogen interactions and resistance mechanism in plants.	C/ I/An	1
3	Comprehend various methods to analyse plant diseases and biological methods of disease control	S/An/A	1, 4
4	Analyse why plants and microbes react in certain ways in pathogenic and symbiotic interactions	U/R/An	1, 2
5	Understands the role of microbes in developing plant immunity	U/R	1
6	Have an in-depth knowledge on biopesticides and their role in pest control	An/ C	1
*Remem and App	bber (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Crea reciation (Ap)	ute (C), Skill (S),	Interest (I)

COURSE CONTENT

Modu le No	Module Content	СО	Hrs
1	Different interfaces of interactions -soil-plant-microbe interactions leading to symbiotic (rhizobial and mycorrhizal), associative, endophytic and pathogenic interactions	1, 2	10

2	General concepts of plant immunity. PAMP-triggered immunity (PTI) and Effector triggered immunity (ETI). Outer membrane vesicles (OMVs) and their involvement in plant immunity. The type III secretion system. Hypersensitive response. Genetic basis of plant defences. Quorum-sensing in bacteria and their role in plant defence mechanisms. Phytohormones and antibiotics as plant therapeutics.	2, 3, 4	20
3.	Plant pathogens and molecular basis of pathogenesis .Genetics of host-pathogen interactions, resistance genes, resistance mechanisms in plants. basal and induced defence mechanisms. Systemic Acquired Resistance (SAR) and Induced Systemic Resistance (ISR), Recognition mechanism and signal transduction during plant - pathogen interaction. Virulence determinants of plant pathogenic bacteria-Enzymes, Toxins, pili, siderophores, secretion systems	4, 5	20
4	Microbial pest control: Bacillus thuringiensis-mode of action, Biocontrol agents– uses and practical constraints Biofungicide and bioherbicides. Plant growth promoting rhizobacteria. Use of plant–microbe symbiosis for remediation of pollutants and carbon (C) sequestration Total Credits of the Course	6	10

TeachingandL	Classroom Procedure (Mode of transaction)			
earningAppro	Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning,			
ach	interactive Instruction: Active co-operative learning, Seminar, Gro			
	Assignments Authentic learning: Library work and Group discussion,			
	Presentation by individual student/ Group representative			

Assessment	Mode of Assessment				
Types	AAA. Continuous Internal Assessment (CIA)				
	1. Internal Tests of maximum 20 marks				
	2. Seminar Presentation – a theme is to be discussed and identified				
	to prepare a paper and present in the seminar Maximum marks 10				
	3. Write a detailed report on a given topic based on research				
	findings and literature search -10 marks				
	BBB. Semester End examination – 60 marks				

REFERENCES

Compulsory Reading:

- 1. Subba Rao, N.S. 2005. Soil Microorganisms and Plant Growth, Oxford and IBH Publishing Co.
- 2. B. Lugtenberg (ed). 2015.Principles of plant microbe interactions, Springer

Further Reading:

- 1. Microbial control and pest Management S.Jayaraj.
- 2. Paul, E.A. 2007. Soil Microbiology, Ecology and Biochemistry, Academic Press.
- 3. M.Gillings and Holmes .2004.Plant microbiology-Bios Scientific publishers.
- Kosuge T & Nester EW. 1989. Plant-Microbe Interactions: Molecular and Genetic Perspectives .Vols I-IV. McGraw Hill.
- Verma DPS & Kohn TH. 1984. Genes Involved in Microbe-Plant Interactions. Springer Verlag.
- Gary Stacey, Noel T. Keen, 1995. Plant-Microbe Interactions. Vols I-VI Springer Science & Business Media.
- Jeng-Sheng Huang 2001.Plant Pathogenesis and ResistanceBiochemistry and Physiologyof Plant-Microbe Interactions .Springer Verlag

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THE REAL PROPERTY OF THE REAL	MAHATMA GANDHI UNIVERSITY			
जिन्नाया अमृतमञ्चले	BSM 21E 73: SUSTAINABLE AGRICULTURE			

School Name	School of Biosciences
Programme	M.Sc. Biochemistry/Microbiology/Biotechnology/Biophysics
Course Name	SUSTAINABLE AGRICULTURE
Type of Course	Elective
Course Code	BSM 21E 73
Names of Academic	Dr J G RAY
Staff & Qualifications	
Course Summary &	The course is to introduce the concept of sustainable agriculture,
Justification	especially its principles of ecological sustainability. The course will
	equip students to understand the concept of organic farming. It will
	enable an understanding of plant nutrient management as well as pest

Seme	management in sustainable agriculture. Organic farming is becoming ar internationally significant agricultural practice, and the knowledge has global significance. Interdisciplinary biology students with a good understanding of organic farming will enable our students to find suitable job opportunities in such farming industries.emesterFirst						is becoming an knowledge has s with a good tudents to find
Total Time	Student Learning (SLT)	Learning Approach	Lecture	Tutorial Practical Oth		l Others	Total Learning Hours
		E.g., Authentic learning Collaborative learning Independent learning	60	18	0	28	106
Pre-re	equisite	Knowledge in Bota	any at th	e Gradua	te level		
No.	E	Expected Course Ou	tcome		PS	50	Learning Domains
1	Students will develop a critical knowledge of the basic principles of sustainable agriculture					2	R/U/A
2	They will be able to analyze environmental issues related to chemicalized agriculture				to	1, 2	U/A
3	They will acquire agriculture	the basic skills of su	stainable	organic		2,4	U/An/Ap
4	They will develo farming	p the skills to evalu	ate diffe	rent kinds	of	2, 4	An/Ap
*Reme Interes	mber (R), Understand (\ t (I) and Appreciation (A	U), Apply (A), Analyse (A Ap)	n), Evalua	ite (E), Crea	te (C), Sk	ill (S),	
Mod ule No		Module content				СО	
1	Introduction to Sustainable agriculture: Concept of ecological sustainability and sustainable agriculture-Natural, Ecological and organic farming – definition, concepts, and practices – management, principles, methods, merits and demerits.				cal 1, 1 cal s –	2	10
2	Challenges to Sustainable agriculture – Productivity vs sustainability; Soil organic matterdecomposition, C: N ratios, mineralization and immobilization processes, hummus, the role of organic matter in soil quality – natural way to prevent soil degradation and erosion, types and control measures. Soil related water pollution- sources, different pollutants in soils and their managements Plant nutrient management in sustainable agriculture: Bio- availability of nutrients in soils, deficiency symptoms on				vs 1, os, the ent soil pils io- on	2	20

	plants, nutrient interactions and chelated micronutrients.Bio- fertilizers – benefits - classifications, production - maintenance and application		
3	Organic Manures – bulky and concentrated – FYM – Biocomposting, Compost – rural, urban, vermicompost and coirpith; Panchagavya preparation and other organic nutrients application - Enrichment of organic manures; Sewage and sludge; Green manures – potentials and limitations; Quality parameters of organic manures and specifications – Biofertilizers -	3, 4	10
4	 Biopesticides and biological control agents: Types of biocontrol agentsbiological agents and pheromones, control of weeds, diseases and insect pests and field sanitation - competition, predation, antibiosis and fungistatic Efficacy of traditional biopesticides - Botanical insecticides-beneficial insects like the honeybee, lac insect, silkworm and pollinators Biological control - concepts and potentialities for managing soil-borne pathogens. Types of biological interactions, competition, 1.078 mycoparasitism; Mycorrhizal associations, Biodynamic products, Biodynamic composting, Liquid manure, Influence of Bio-dynamic products on crop production. Visit Organic Farms 	3, 4	20
	Total Credits of the course	3	
	Books for References		
1. I	pulsory Reading: Dahama AK (2007). Organic Farming for Sustainable Agricultu Published by AGROBIOS (India) Jodhpur	re. 2nd Edn.	
2. N (c	National Standards Programme for Organic Production and Orga 2000) Department of Commerce, Ministry of Commerce and In of India	anic Products dustry, Govt.	
 Further Reading: 3. Gehlot D (2005). Organic Farming: Standards, Accreditation, Certification and Inspection, AGROBIOS (India) Jodhpur 			
4. C	Gupta PK (2007). Soil, Plant, Water and Fertilizer Analysis AGROBIOS (India), Jodhpur	Published by	
5. S S O	Sadasivam S and Manickam A (1992). Biochemical Methods for Sciences Wiley Eastern Limited and Tamil Nadu Agricultura Coimbatore	Agricultural University,	

Rubrics selected for OBE implementation

1.Overall performance in each course of the semester on a continuous basis

2. Response to critical theoretical questions in each course

3. Procedural approach adopted towards **lab oriented critical questions** in each practical course

4. Response to socially relevant issues and recent trends in each course

5.Aptitude to research and specific research problem in each course

PART 1<u>Task Description</u>

- 8. Written Examination
- 9. Assignment
- 10. Seminar
- 11. Practical Exam
- 12. Viva voce

PART II Scale-Continuous mode

Excellent, Satisfactory, Needs improvement (remedial practices recommended)

PART III Dimensions

Written Examination-Content, Communicating

Assignment -Content, level of Comprehension

Seminar-Content, Performance

Practical exam- Conduct of practical, Observation and recording

Viva voce -Response to questions, Attitude

PART IV Description of the dimensions

Content-Brief and meaningful

Comprehension- Precise and effective

Communicating-Direct and orderly

Procedure adopted- Scientific Suitability and easiness

Conduct of practical-Accuracy and reproducibility

Observation and recording- Sharp and systematic

Response to questions- Analyitical approach and level of accuracy

Attitude- Positive and self-inspiring

MODEL QUESTION PAPERS

School of biosciences

Mahatma Gandhi University

SBS MIC1703: CELL BIOLOGY, GENETICS & EVOLUTION

Model Questions: (5 marks each for all the three)

TIME 3 HRS

MAX MARKS 60

A. Easy

- 1. What are the common characteristics of phenotypic expressions in Quantitative Inheritance with the example of skin colour in human beings. Explain the basic differences between multiple allelic and Multigenic inheritance.
- 2. Comment on the role of p21 in the DNA replication checkpoint. Explain with appropriate diagram.
- 3. What are the factors affecting recombination frequencies?
- 4. Compare apoptosis and necrosis?

B. Medium

- 5. Explain why monohybrid and dihybrid ratios are different? Solve the following problem: A tall Red flowered plant when crossed with a dwarf white flowered plant there four different offspring such as Tall Red, Tall white, Dwarf Red and Dwarf white. But when the same Tall Red flowered plant was crossed with another Tall Red flowered plant, all the 2229 offspring produced were Tall Red. Using a checker-board analysis find out the genotype of all the parents and offspring in both cases.
- 6. Specify the role of Cdc 14 phosphatase in the regulation of cell cycle. Explain how it prompts the exit of mitosis. What is the significance of sequestration of Cdc 14 phosphatase?
- 7. The father supplies a mutated UBEA3 and the mother supplies a mutated SNRPN to a child. What will be the phenotype of the child? Explain the reason for the said phenotype?
- 8. What is the application of transduction by blue white screening?

C. Difficult

9. (a) Explain the evidences provided by Charles Darwin to prove his theory of origin of new species through natural selection? (b) How do the Lamarckian and Darwinian theories become identical as per genetic principles followed by them? (c) Explain how modern findings in population genetics defeats Lamarckian concepts while it is supportive of Darwinian theory of origin of species by natural selection?

- 10. Intensive research in Cell Biology has provided significant contributions in the treatment of various types of cancer. Justify the statement
- 11. Hardy Weinberg equilibrium is shown only by cross pollinated plants and not by self-pollinated plants? Justify the statement based on HW theorem?
- 12. Describe any two recent research using yeast as a genetic system.

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School of Biosciences Mahatma Gandhi University I Semester MSc Biochemistry/Biotechnology/Microbiology/Biophysics Examination SBS MIC 1701 Biochemistry

*Draw structures wherever needed.

Time 3 hours

Max marks 60

Answer all of the following briefly. Each question carries *five* marks

- 1. Draw the predominant conformation of glucose and explain why it is predominant in nature.
- 2. Explain the characteristics of amphipathic lipid aggregates that form in water?
- 3. Describe the differences in the mechanism of action of progesterone and prolactin.
- 4. Does sucrose exhibit mutarotation? Give the reason for your answer.
- 5. Draw the structures of tryptophan and arginine at pH 7.Explain the importance of charge-based separation techniques during the isolation of proteins.
- 6. Suppose that the Sanger dideoxy method shows that the template strand sequence is 5'-TGCAATGGC-3'. Sketch the gel pattern that would lead to this conclusion. What is the purpose of the dideoxynucleoside triphosphate in this reaction?
- 7. Give a list of three vitamins that act as coenzymes and explain their importance.
- 8. Distinguish between Watson-crick base pairing and Hoogsteen base pairing.
- 9. Discuss the chemistry and physiological functions of prostaglandins and thromboxanes?
- 10. Explain the following terms (with examples) related to protein structure
 - a. Supersecondary structures
 - b. Motifs
 - c. Domains
 - d. oligomer
- 11. Which is more common alpha helix or beta pleats? Substantiate your answer.
- 12. Mention the importance of lipid molecules containing sphingomyelin.

(12 x 5= 60 marks)

School of Biosciences Mahatma Gandhi University I Semester MSc Biochemistry/Biotechnology/Microbiology/Biophysics Examination

SBS MIC 1701 Biochemistry

TIME: 3 HRS

MARKS: (12 X 5 = 60)

Answer all questions. Each question carries 5 marks.

- 1. Glucose and fructose form same osazone. Why?
- 2. Distinguish between secondary structures and supersecondary structures.
- 3. Detail the importance of different proteins in DNA compaction.
- 4. Design a set of experiments for the isolation and purification of a membrane protein.
- 5. What is the role of Ramachandran plot in the structure determination of proteins?
- 6. If starch, glycogen and cellulose are made up of glucose molecules, what is the basis for the difference in their structure and function?
- 7. The densities of lipoproteins increase as their particle diameters decrease. Why?
- 8. Eicosanoids can act as hormones. Explain.
- 9. How does vitamin and hormones differ in their action?
- 10. Describe in your own words the structural features of
 - a. a ceramide and how it differs from a cerebroside.
 - b. a phosphatidylethanolamine and how it differs from a phosphatidylcholine.
 - c. a ganglioside and how it differs from a cerebroside

11. A polypeptide when treated with 2-mercaptoethanol yielded two polypeptides with the following amino acid sequences:

- a. Leu-Phe-Cys-Met-Tyr-Cys-Leu-Trp-Cys-Asn
- b. Val-Cys-Trp-Val-Ile-Phe-Ala-Cys-Lys

These two polypeptides on chymotrypsin treatment yielded small peptides with the following amino acid compositions:

- a. (Leu, Phe)
- b. (Asn, Cys2, Met, Tyr)
- c. (Cys, Ala, Lys)
- d. (Cys2, Leu, Trp2, Val)
- e. (Ile, Phe, Val)
- 12. Find out the positions of the disulfide bonds in the parent polypeptide.

The following DNA fragment was sequenced by the Sanger method. The fragments were produced by this reaction was separated by gel electrophoresis. Sketch the gel pattern.

School of Biosciences

Mahatma Gandhi University

I Semester MSc Biochemistry/Biotechnology/Microbiology/Biophysics Examination, July 2021

SBS MI C 1704: BIOPHYSICS & BIOSTATISTICS

TIME: 3 HRS

MARKS: (12 X 5 = 60)

- 1. Explain multimolecular and macromolecular colloids? Give one example of each. How are associated colloids different from these two types of colloids?
- 2. Describe the following processes
- a) Redox potential
- b) Surface tension
- c) Osmosis
- d) Adsorption
- e) Carnot cycle
- 3. A simple sample of the height of 6,400 Englishmen has a mean of 67.85 inches and a standard deviation of 2.56 inches while a simple sample of heights of 1,600 Austrians has a mean of 68.55 inches and standard deviation of 2.52 inches. Do the data indicate that the Austrians are on the average taller than the Englishmen?
- 4. Mention the physical interactions of proteins with nucleic acids. Comment on the Shape, flexibility and packing of proteins and nucleic acids in complexes
- 5. Discuss about different types of electromagnetic radiation. Compare the properties of ionizing and non-ionizing radiations.
- 6. In a simple random sample of 600 men taken from a big city 400 are found to be smokers. In another simple random sample of 900 men taken from another city 450 are smokers. Do the data indicate that there is significant difference in the habit of smoking in the two cities?
- 7. How can we propose a protein secondary structure prediction method based on Ramachandran map? Diagrammatically represent the allowed and disallowed regions of Ramachandran plot.
- 8. Describe the biophysical method to purify bovine serum albumin from a mixture of salts and diagrammatically represents the instrumentation setup for that.

9. Explain the applications of electromagnetic radiation in the field of Agriculture, Medicine and Industry?

10. Two types of drugs were used on 5 and 7 patients for reducing their weight. Drug A was imported and drug B indigenous. The decrease in the weight after using the drugs for six months was as follows:

Drug A: 10 12 13 11 14 Drug B: 8 9 12 14 15 10 9 Is there a significant difference in the efficacy of the two drugs?

11. From the following data estimate y when x = 92

X Girth	Y Wood volume
90	0.5
95	0.6
100	0.7
85	0.5
88	0.53
70	0.40
72	0.41
74	0.42
70	0.39
69	0.38

12. From the following data, examine whether there is significant difference between three groups

Self (T1)	Govt (T2)	Aided (T3)
65	60	74
75	62	78
76	70	80
78	74	82
80	76	88

School of Biosciences Mahatma Gandhi University

I Semester MSc Biochemistry/Biotechnology/Microbiology/Biophysics Examination

SBS MIC 1703 Cell Biology, Genetics and Evolution

Max marks 60

Answer all of the following briefly. Each question carries *five* marks

1. Find out the Caucasian admixture of Afro Americans in two different cities of the United States of America by analysing the data given in the table. The data is about the presence of Duffy blood group allele in different populations.

Locality	Afro Americans population	African population	Caucasian population
Oakland	0.094	0.0	0.429
Charleston	0.016	0.0	0.429

2. A hypothetical mutant phenotype, wrinkled chloroplast shows a maternal pattern of inheritance in the dandelion plant. What would be the outcome of

- a) mating male wrinkled to female smooth (wild)
- b) mating male smooth to female wrinkled

Time 3 hours

3. What are the factors affecting recombination frequencies?

4 .(a) Explain the phenotypic expressions of Comb pattern in fowls using a checker board? (b) How does the mode of inheritance of 'Comb pattern in fowls' differ from that of 'Fruit colour in summer squashes'?

5.(a) Compare and contrast a typical Mendelian dihybrid appearance of four phenotypic classes of offspring with the four phenotypic classes of offspring of a cross between heterozygous 'A-blood group' and heterozygous 'B-blood group' persons? (b) If a 'B-blood group' woman who is married to an 'O-blood group' man have three children, and one among them is an 'O-blood group' boy, explain the genotypes of the parents and that of all the possible children to them.

 $6.(\mathbf{a})$ Compare and contrast Lamarkism and Darwinism (**b**) Explain the advantages of Darwinism over that of Lamarkism in the explanation of evolution of species, especially in relation to the modern theory of genetics? (**c**) How do natural selection work as per the concept of population genetics?

7.Illustrate the Biotechnological application of bacterial genetic transformation.

8. Describe suitably features and valuable research conducted in *Neurospora* to establish a model organism

9.Specify the differences between cancerous cells and normal cells.

10. Comment on the significance of DNA damage check points in the regulation of cell cycle.

11.What are polarity and segmentation genes? Discuss their role in the genetic control of embryonic development in drosophila

12. Discuss the regulatory role of cell survival pathway in apoptosis.

(12 x 5= 60 marks)