

MAHATMA GANDHI UNIVERSITY

School of Biosciences

Priyadarsini Hills P. O., Kottayam – 686560



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

OPEN COURSES OFFERED

**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 (IUIIC).

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 students can 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 on and 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 a programme 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.

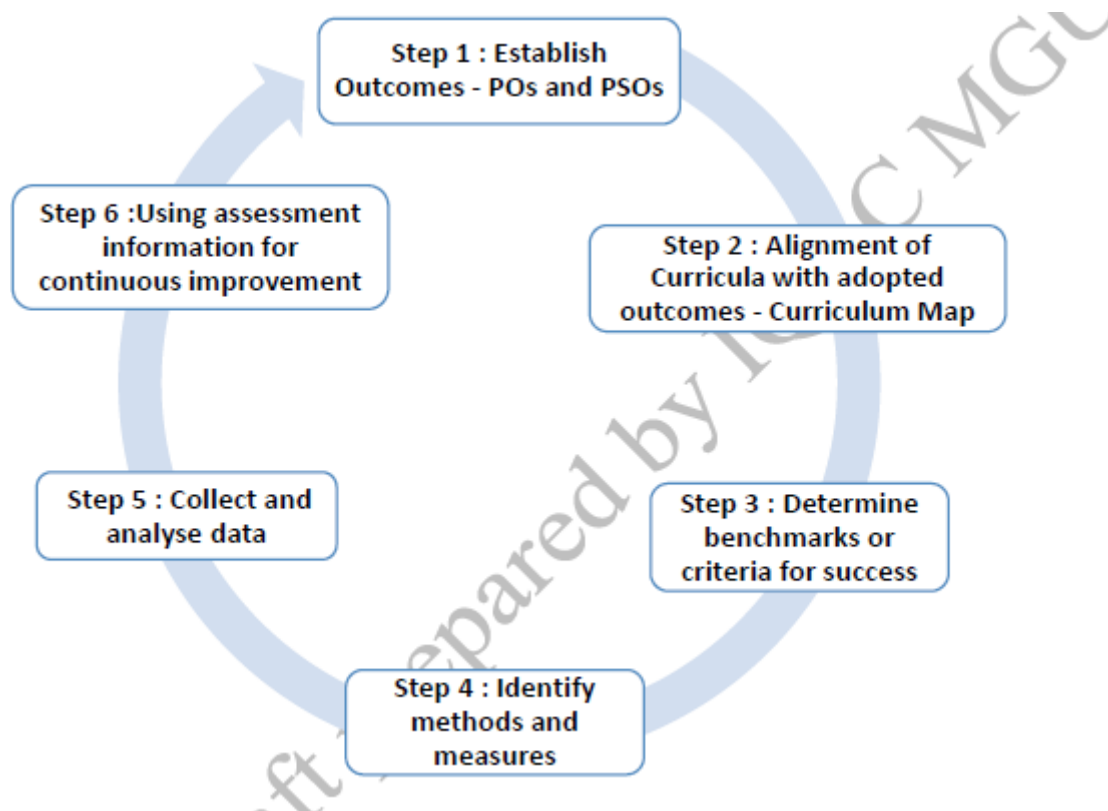
An OBE system has been proposed and to be implemented at various Departments of Mahatma Gandhi University, as a quality-assurance approach to improve teaching and learning

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 all the 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 of Biological sciences.
- * To utilise the expertise of faculty in diverse areas of biology for benefitting the students in achieving 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.

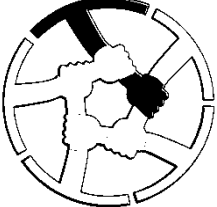

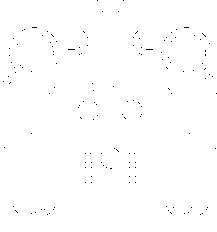

Key points

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.



**Mahatma Gandhi University
Graduate attributes**

	<p>Critical thinking and analytical reasoning</p>	<p>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.</p>
	<p>Scientific reasoning and Problem solving</p>	<p>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 research and apply one's learning to real life situations.</p>
	<p>Multidisciplinary/ Interdisciplinary/ Transdisciplinary approach</p>	<p>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.</p>
	<p>Intra and Interpersonal skills</p>	<p>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.</p>
	<p>Digital literacy</p>	<p>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.</p>

	Global Citizenship	<p>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.</p>
	Social competency	<p>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.</p>
	Equity, Inclusiveness and Sustainability	<p>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</p>
	Lifelong learning	<p>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.</p>



**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 research and 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 at personal 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.

Rubrics selected for OBE implementation

- 1.Overall performance** in each course of the semester on a continuous basis
- Response to **critical theoretical questions** in each course
- Procedural approach adopted towards **lab oriented critical questions** in each practical course
- Response to **socially relevant issues and recent trends** in each course
- Aptitude to research and specific research problem** in each course

PART I Task Description

- Written Examination
- Assignment
- Seminar
- Practical Exam
- 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- Analytical approach and level of accuracy

Attitude- Positive and self-inspiring

OPEN Courses

OFFERED BY SCHOOL OF BIOSCIENCES

FOR STUDENTS OF OTHER SCHOOLS

SCHEME OF THIRD SEMESTER OPEN ELECTIVE COURSES			
Students need to select one open elective course offered by other departments			
Sl. No.	Course No.	Subject of the Course	Credits
	Course No.	Subject of the Course	Credits
	BSM 21O 40	Biotechnology and Society	4
	BSM 21O 41	Microbiology in Everyday Life	4
	BSM 21O 42	Environment Lead Auditor Course	4
	BSM 21O 43	System Biology	4
	BSM 21O 44	Ecology of Soil Fertility	4
	BSM 21O 45	Infectious Disease Management	4
	BSM 21O 46	Probiotics and Nutraceuticals	4
	BSM 21O 47	History and Philosophy of Science	4
	BSM 21O 48	Organic Farming For sustainability	4



MAHATMA GANDHI UNIVERSITY

BSM 210 40: BIOTECHNOLOGY AND SOCIETY

SchoolName	School of Biosciences					
Programme	MSc/ MA/ MBA (offered for schools other than School of Biosciences)					
Course Name	Biotechnology and Society					
Type of Course	Open					
Course Code	BSM 210 40					
Names of Academic Staff & Qualifications	Dr Jayachandran K and Dr.Linu Mathew					
Course Summary & Justification	<ol style="list-style-type: none"> 1. This course is meant for PG students of MG University other than the students of School of Biosciences. 2. The course deals with the applications of Biotechnology in a societal perspective; the learner has a previous knowledge about biotechnology through mass media and their secondary school education 3. In this course they will develop a scientific understanding about biotechnology and how it benefits the society 					
Semester	Third					
Total Student Learning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours

	Authentic learning Collaborative learning Independent learning	80	20	0	40	140
Pre-requisite	None					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1	Describe the applications of Biotechnology in a societal perspective	E	
2	Critically evaluate the benefits of biotechnology to society	U/ An	
3	Analyse the ethical and social issues related to biotechnology and intellectual property	An	
4	Communicate effectively about a given topic in biotechnology and society both verbally and in writing	An/ C	
*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Module No	Module Content	CO	Hrs
1	Introduction to biotechnology: Biotechnology – a boon or a bane, Biotechnology-an interdisciplinary pursuit, public perception of biotechnology, biotechnology and the developing world, biotechnology – Indian scenario	1,2,4	10
2	Industrial and environmental biotechnology: Bioprocess and fermentation technology, enzyme technology; food and beverage biotechnology; biological fuel generation and single cell protein, GM food and controversies associated, Biosensors and biochips, Biotechnology for profit making	1,2,4	20
3.	Genetics and biotechnology: Protoplast and cell fusion techniques, genetic engineering, whole genome sequencing, Animal cloning - ethics and applications, genetic engineering - social, moral and ethical considerations, mitochondrial evolution – tracing your routes, DNA Fingerprinting - concept and applications	1,2,4	20
4	Biotechnology in agriculture and medicine: Creation and applications of transgenic animals and plants, applications of plant and animal cell culture; gene therapy-techniques and applications	1,2,4	15

5	Protection and safety of biotechnological inventions: Patents trade secrets and plant breeders' rights, biological and physical containment, and problems of organism pathogenesis and biologically active biotechnology products, Bioterrorism, Biopiracy	3,4	15
Total Credits of the Course		4	


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) 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: <ol style="list-style-type: none"> 1. Biotechnology, John E Smith, Cambridge low price editions; Cambridge University press ISBN 0-521-58694 2. An introduction to genetic engineering, Desmond. T. Nicholl. Cambridge University press ISBN 81-7596-101-5
Further Reading: <ol style="list-style-type: none"> 1. Gene cloning and DNA analysis an introduction, T A Brown, Blackwell science publishers ISBN 0-632-05901-X 2. Molecular biotechnology, Principles and Applications of Recombinant DNA, Glick Pasternak and Patten, 4th edition ISBN 978-1-55581-498-4 Wiley International Publishers

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	MAHATMA GANDHI UNIVERSITY
	BSM 210 41: MICROBIOLOGY IN EVERYDAY LIFE

SBS M III O 1744 MICROBIOLOGY IN EVERYDAY LIFE

SchoolName	School of Biosciences					
Programme	M.Sc./M.A. in any subject					
Course Name	MICROBIOLOGY IN EVERYDAY LIFE					
Type of Course	Open Course					
Course Code	BSM 210 41					
Names of Academic Staff & Qualifications	Dr.Radhakrishnan E.K. M.Sc.,Ph.D					
Course Summary & Justification	Microorganisms have important role to support the human life. The syllabus content in this course has been designed with an objective to provide overall understanding on importance of beneficial microorganisms and the challenges with microbial pathogens to humans. This will enable the students to identify the importance of microorganisms. With the emerging health challenges a better understanding on microorganisms will be highly beneficial for the students.					
Semester	Third					
Total Student Learning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total LearningHours
	Authentic learning Collaborative learning Independent learning	80	20	0	40	140
Pre-requisite	Basic interest in microbiology, understanding on importance of microorganisms and its relation with humans					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1.	Students will able to understand the importance of microbiology in various processes of daily life	R/U/I	
2.	Students will able to understand the methods to study microorganisms	R/U	
3.	Students will get exposed to the techniques used in microbiology	U/ E	
4.	Students will able to explain the role of microorganisms in relation to health and disease	U/An/A	
5.	Students will able to understand disease progression and mechanisms involved	C/S	
6.	Students will able to apply the knowledge to for better management of microorganisms for healthy life	A/S	
*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Module No	Module Content	CO	Hrs
1	History and Developments in Microbiology: Prokaryotic and eukaryotic cell, Contributions from Leuwenhoek, Louis Pasteur, and Robert Koch. Microbiome, An overview of microorganisms, the bacteria and the archea. General characteristics, morphology, Structure of bacteria. Virion, viroids and prions, Eukaryotic Microorganisms., A brief introduction to microscopy, Staining of bacteria and fungi, Cultivation of bacteria and fungi, culture media and methods	1,2	20
2	Methods to control Microorganisms: Disinfection, Sterilization, Sterilizing Agents, Antibiotics, Antibiotic Sensitivity tests, Antibiotic Resistance	2,3	20

3.	Microbes in relation to health and disease: Human microbiome, Infection, source of infection, method, of transmission, Immunity, Innate and adaptive immunity, Microorganisms involved in respiratory tract infection, Meningitis, Urinary tract infection, STD, Skin infection, Nosocomial infection, Tuberculosis, Typhoid fever, Dengue, AIDS, Hepatitis, Ebola and COVID-19	4,5	20
4	Microbes in relation to food: Microorganisms in preparation of food materials, lactic acid bacteria, role of microorganisms in preparation of curd, cheese and cultured dairy products, probiotics, and their importance, single cell protein, Microorganisms responsible for food borne infection and intoxication. Water borne diseases- prevention and control Fermented food, milk and milk products, role of food preservative Industrially important microbial products: Role of Microorganisms in 74 production of bread and beer. Microbial enzymes and their uses- detergent, enzymes, therapeutic enzyme Streptokinase	5,6	20
Total Credits		4	

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) 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. Microbiology. Prescott, Harley and Klein with C Brown publishers, 2014
2. Brock Biology of Microorganisms, Michael T. Madigan, John M. Martinko, David A. Stahl, David P. Clark, 14th edition, 2015

Further Reading:

3. Principles and practice of disinfection, preservation and sterilization – Russel AD et al., Blackwell Scientific Publications, 2013
4. Microbiology Concepts and Applications. Pelczar Jr Chan. Creig. McGraw Hill Inc, 5 th edition, 2001 5.
5. Topley and Wilson's Principles of Bacteriology, Virology and Immunology – Arnold – Heinemann, 1990

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MAHATMA GANDHI UNIVERSITY

BSM 210 42: ENVIRONMENT LEAD AUDITOR COURSE

School Name	School of Biosciences					
Programme	III SEM Open Course					
Course Name	ENVIRONMENT LEAD AUDITOR COURSE					
Type of Course	Core					
Course Code	BSM 210 42					
Names of Academic Staff & Qualifications	Dr J G RAY					
Course Summary & Justification	<p>This course provides postgraduates with a thorough understanding of the basic principles of ecology and environment and introduces the basic concept of ecological objects – population, community, and ecosystem- and then explain the details of the environmental auditing process. The course will equip them as environment auditors - ‘Lead Auditor’ as per ISO 14001 Standards. Environmental auditing is an essential process of all institutions and industrial processes to achieve sustainability in their activities, process, production and practice. It is an emerging career as well.</p>					
Semester	Third					
Total Student Learning 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	Students of arts/science/management/commerce at Graduate level
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o.	Expected Course Outcome	Learning Domain s	PSO No.
1	Upon completing this course, students will develop a critical knowledge of the basic principles of ecology and the environment.	R/U/A	
2	They will be able to analyse environmental issues from a social perspective.	U/A	
3	They will acquire the basic skills of environmental auditing. They will develop the skills of a lead auditor	U/An/A p	
4	They will develop the skills of an Environment lead auditor of ISO-14000 standard as per the British Standard Institution requirements	An/Ap	

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

modul e No	Module content	CO	hrs
1	Introduction to Ecology and Environment science: the concept of the environment; Life as a system phenomenon- hierarchy in the system of life; Ecological objects- population, community and ecosystem; Ecology of humans, Concept of sustainable environmental quality. Environment Pollution – definition and classification; Water pollution – water quality parameters and standards, control of water pollution, wastewater treatments; Air pollution – primary and secondary pollutions, air pollution monitoring and control; Land pollution – solid waste management, recycling, reuse and recovery, problems of plastic waste	1	20
2	Natural Resources and Biodiversity Conservation: classification of resources, resource depletion, preservation, conservation and restoration of	1	10

	resources; Concept of biodiversity – genetic, species and ecosystem diversities, principles of biodiversity conservation, ex-situ and in-situ conservations; IUCN accounting of biodiversity – hot spots, red data book; Global environmental crisis - UNEP, UNFCC, One earth programme, globally crucial agricultural heritage (GIAH)			
3	Legal methods to sustain environment quality: environment laws – national and international environmental laws; Montreal protocol and its amendments, Kyoto protocol, constitutional provisions of environment quality in India, major environmental laws of India, environment protection act of 1986, National environment policy; Environment Impact Assessment	2	10	
4	Environment Audit: definition, types of audit, objectives of environmental audit, benefits of ecological audit, basic environment management philosophy, critical steps to environment audit – pre-audit, onsite audit and post-audit, step by step approach of auditing, action plan, auditor requirements; Environment Management Systems: ISO-14000-2004, model for this international standard, different clauses in ISO 14000 standard – scope, normative references, terms and definitions, EMS requirements – clauses 4.1 to 4.6	3,4	40	
Total Credits of the course		4		
Books for References				
Compulsory Reading:				
<ol style="list-style-type: none"> 1. Ray J G (2010) Basic Principles of Ecology and Environment, Prathibha Publications, Kerala, India 2. Mehrotra A et al. (2001) A to Z of Environmental Audit, SOFEM Publ. New Delhi 3. Dash M C (1993) Fundamentals of Ecology, Tata McGraw Hills Publ. Co. New Delhi 				
Further Reading:				
<ol style="list-style-type: none"> 4. Singer FD (2016) Ecology in Action, Cambridge University Press 5. Chapman JL and Reiss MJ (1998) Ecological Principles and Applications, Cambridge University Press, London 				

<p>6. Trivedi RK (Ed) International Encyclopaedia of Ecology and Environment (Volumes 1-30), IIE, New Delhi</p> <p>7. Ramade F (1981) Ecology of Natural Resources, John Wiley and Sons, New York</p>	
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MAHATMA GANDHI UNIVERSITY

BSM 210 43: ECOLOGY AND SOIL FERTILITY

School Name	School of Biosciences					
Programme	III Sem Open Course					
Course Name	Ecology of Soil Fertility					
Type of Course	Elective					
Course Code	BSM 210 43					
Names of Academic Staff & Qualifications	Dr J G RAY, Ph D in Soil Ecology					
Course Summary & Justification	<p>The course is designed to help postgraduates of both arts and science know what soils are and how they form and sustain them. The course will help them understand the nature and importance of soil fertility and its natural biological maintenance. They will also know the role and importance of soil biodiversity in soil fertility and its sustenance.</p> <p>Since farming has become an important activity to ensure ecosystem sustainability, it has become imperative for every educated person to understand the scientific principles of soil fertility and its natural maintenance. Organic farming is also becoming an essential career for educated youth.</p>					
Semester	Third					
Total Student Learning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	E.g., Authentic learning Collaborative learning Independent learning	80	20	0	40	140
Pre-requisite	Knowledge in Botany at the Graduate level					
No.	Expected Course Outcome					
1	Students will develop a critical knowledge of the concept of soil fertility					
2	They will be able to understand the vital natural components of soil fertility					

3	They will learn to account for various soil biodiversity components and their significance		
4	They will know sustainable management of soil fertility		
*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			
Module No	Module content	Credits offered	
1	Concept of soils – soil and parent materials– soil formation – role of climate and vegetation in soil formation – soil profile, soil taxonomy; water relations of soils – hygroscopic, capillary and field water content – run-off water – factors affecting percolation	1	20
2	Soil Physics and Chemistry; soil physical properties - colour and texture, soil structure - aggregate formation, aggregate stability, capillarity, porosity; Soil chemistry, pH, carbon in soils –humus – its chemistry and role in soil, exchangeable and soluble cations and anions in soils soil as a buffer system; soil amendments – problems of tillage – problems of irrigation – problems of chemical fertilizers and liming	2	20
3	Soil biology – the role of soil biota – soil fauna and flora - soil ecological processes and microbial function - decomposition - introduction, overview, fragmentation, factors controlling decomposition, carbon, nitrogen and phosphorus cycles in soils, transformations of nitrogen nitrification-immobilization-volatilization, denitrification, soil ecosystem management and soil biota	3	20
4	Agriculture – traditional versus modern – problems of chemicalized agriculturecontrol of soil degradation - desertification of soils – soil reclamation – soil conservation –prevention of soil erosion - mulching, contour bunds – sustainable soil fertility - ecology of soil fertility – principles of ecological and organic farming - climate change, global warming and soil ecology	4	20
Total Credits of the course		4	
Books for References			
Compulsory Reading:			
8. Nyle C Brady (1984) Nature and properties of Soil, Mc Milan Publishers			
9. Ray J G (2010) Basic Principles of Ecology and Environment, PrathibhaPubli., Kerala, India			
Further Reading:			
10. Colemn DC et al. (2003) Fundamentals of soil ecology, Elsevier			

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| 11. Christian Ditchfield (2003) Soils, Children's Press, Dublin | |
| 12. James BN (2003) The world beneath our feet: A guide to life in the soil, Oxford University Press | |



MAHATMA GANDHI UNIVERSITY

BSM 210 44: INFECTIOUS DISEASE MANAGEMENT

SBS M III O 1749: INFECTIOUS DISEASE MANAGEMENT

SchoolName	School of Biosciences					
Programme	M.Sc./M.A. in any subject					
Course Name	INFECTIOUS DISEASE MANAGEMENT					
Type of Course	Open Course					
Course Code	BSM 210 44					
Names of Academic Staff & Qualifications	Dr.Radhakrishnan E.K. M.Sc.,Ph.D					
Course Summary & Justification	<p>Infectious diseases cause significant threat to the existence of humans. The syllabus of this course has been designed to introduce the importance and relevance of infectious diseases. This also include the mode of transmission of various infectious diseases and the diagnostic methods used for various infectious diseases This will enable the students to identify the importance of infectious diseases and the microbial basis of the same. With the emerging health challenges a better understanding on infectious diseases will be highly beneficial for the students.</p>					
Semester	Third					
Total Student Learning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total LearningHours
	Authentic learning Collaborative learning Independent learning	80	20	0	40	140
Pre-requisite	Basic interest in infectious diseases and microbiology					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
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1.	Students will able to understand the importance of infectious diseases	R/U	
2.	Students will able to understand the types of organisms causing infectious diseases	R/I/ U	
3.	Students will learn the mode of transmission of infectious diseases	U/ E	
4.	Students will able to explain the infectious diseases and its basis	U/I/A	
5.	Students will able to understand diagnosis of infectious diseases	C/S	
6.	Students will able to apply the knowledge on infectious diseases for better its management	S/C	
*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Module No	Module Content	CO	Hrs
1	Infectious disease, etiological agents-bacteria, fungi, viruses, prions, protozoan. Special focus on COVID-19, Reservoir- human, environment. Carriers- incubatory, inapparent infection, convalescent and chronic carriers. Mode of transmission- direct and indirect. Portal of entry- respiratory, genitourinary, alimentary, skin and transplacental	1,2,3	20
2	Infectious disease- acute respiratory infections, diarrheal diseases, hepatitis, HIV, tuberculosis, sexually transmitted diseases, malaria, and other vector-borne diseases	2,3,4	20
3.	Lab diagnosis of infectious disease, sample collection, sample processing microscopy, culture, immunological methods, nucleic acid based identification methods and non-nucleic acid based identification methods	1,3,4	20
4	Infectious disease management, treatment, antibiotics- types of antibiotics, mode of action, antibiotic resistance, antiviral, antifungal, and antibacterial	1,3,6	20

	agents, immunization and infectious diseases, vaccination against major infectious diseases, types of vaccines		
Total Credits		4	

Teaching And Learning Approach	<p style="text-align: center;">Classroom Procedure (Mode of transaction)</p> <p>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</p>
Assessment Types	<p>Mode of Assessment</p> <p>A. Continuous Internal Assessment (CIA)</p> <ol style="list-style-type: none"> 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 <p>B. Semester End examination – 60 marks</p>

REFERENCES

<ol style="list-style-type: none"> 1. Bailey and Scott's Diagnostic Microbiology Publisher: Elsevier Health, 28 Jun 2013 2. CURRENT Diagnosis & Treatment in Infectious Diseases, Walter R. Wilson and Merle A. Sande 3. Fundamentals of Molecular Diagnostics (1st Edition) By David Bruns Edward Ashwood Carl Burtis : Elsevier. 2007
<p>Further Reading:</p> <ol style="list-style-type: none"> 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).

5. Advanced techniques in Diagnostic microbiology. Yi-wei Ting, Charles W. Stratton: Springer

7. Sherris Medical Microbiology (5th edition) by Kenneth J. Ryan, C. George Ray

5. Infectious Disease: Pathogenesis, Prevention and Case Studies By Nandini Shetty, Julian W Tang, Julie. Wiley- Blackwell (April, 2009).

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MAHATMA GANDHI UNIVERSITY

BSM 210 45: PROBIOTICS AND NUTRACEUTICALS

School Name	School of Biosciences					
Programme	MSc/ MA/ MBA (offered for schools other than School of Biosciences)					
Course Name	Probiotics& Nutraceuticals					
Type of Course	Open Course					
Course Code	BSM 210 45					
Names of Academic Staff & Qualifications	Dr.Keerthi TR					
Course Summary & Justification	<p>1.The cover concept of nutraceuticals/functional food - extra health benefits in addition to the basic nutritional value of food.</p> <p>2.Enable students to recognize the link between nutrition, health and diseases</p> <p>3.Identify major types of health foods and nutraceutical products in the market. Role of Probiotics & Prebiotics to maintain health.</p> <p>4.Students get exposure towards the market opportunity of nutraceuticals and the nutraceutical industry</p>					
Semester	Third					
Total Student Learning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Authentic learning Collaborative learning Independent learning	80	20	0	40	140
Pre-requisites	Basics of Health and Nutrition.					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1	On completing this course, the student will be able to Explain the classification and types of nutraceuticals/functional foods. Describe the role of nutraceuticals in lifestyle diseases.	U/E	
2.	Describe the nutraceuticals from plant origin including algal nutraceuticals & their health benefits.	U/R	

3.	Explain various nutraceuticals of animal origin & their therapeutic applications.	An/U	
4.	Illustrate the health benefits & mechanism of probiotics & prebiotics. Describe the various probiotics & prebiotics available in the market & their production & specific applications	U/A	
5.	Communicate effectively about a chosen topic in Probiotics & Nutraceuticals both verbally and orally	An/A	
*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Module No	Module Content	CO	Hrs
1	Concept of Functional Foods/Nutraceuticals: Definition and classification of nutraceuticals, dietary supplements, fortified foods, functional foods and Phyto- nutraceuticals. Scope involved in the industry, Indian and global scenario. Relation of functional foods/ Nutraceutical (FFN) to foods & drugs. Applications of herbs to functional foods. Concept of free radicals and antioxidants; Nutritive and Non-nutritive food components with potential health effects. Role of nutraceuticals in the prevention and treatment with special reference to diabetes mellitus, hypertension, hypercholesterolemia. Concept of antioxidants - use of antioxidants as dietary supplements in prevention and treatment of cancer, obesity and stress	1,5	20
2.	Nutraceuticals of plant origin: Nutraceuticals in Fruits and Vegetables and their Health Benefits; Sources and role of Isoprenoids, Isoflavones, Flavonoids, carotenoids, Tocotrienols, polyunsaturated fatty acids, sphingolipids, lecithin, choline. terpenoids. Vegetables, Cereals, milk and dairy products as Functional foods. Health effects of common beans, <i>Capsicum annum</i> , mustards, , garlic, grape, citrus fruits. Algal nutraceuticals: Micro & macro algae as nutraceuticals. Algae as source of omega - 3 fatty acids, antioxidants and minerals - extraction and enrichment	2,5	20
3.	Nutraceuticals of animal origin: Animal metabolites - Sources and extraction of nutraceuticals of animal origin. Examples: chitin, chitosan, glucosamine, chondroitin sulphate	3,5	20

	and other polysaccharides of animal origin, uses and applications in preventive medicine and treatment. fish oils, and sea foods		
4	Probiotic & Prebiotic: Concept of prebiotics and probiotics - principle, mechanism, production and technology involved different forms available in the market. Benefits & applications - examples of bacteria used as probiotics, Types & use of prebiotics in maintaining the useful microflora & other health benefits .Other biotic approaches for maintaining good health. Market opportunities of nutraceuticals	4,5	20
Total Credits of the Course		4	

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 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

Compulsory Reading: 1. Shi, J. Asian Functional Foods CRC Press 2005 2. Webb, G.P. Dietary Supplement and Functional Foods Blackwell 2006 . 3. Shibamoto T. Functional food and health, Oxford University Press, 2008
Further Reading: 1. Shi, J. Functional Food Ingredients and Nutraceuticals: Processing Technologies CRC Press 2007 2. Bagchi D. Nutraceutical and functional food regulations in the United States 3. and around the world, Elsevier/Academic Press, 2008. 4. Guo M. Functional foods: principles and technology, CRC Press, 2009. 5. J.Paulo Sousa e Silva.,Ana.C.Freiles.Probiotic Bacteria .Pan slanford publishing Pte.Ltd 6. FaizelBux. Biotechnological Application of Microalgae.CRC Press. 7. Wayne.RBidlack.,Roymond L Rodringuez.NutritionalGenomics.CRC Press. 8. Frances Sizer., Elecener Whitney Nutrition concept and contraversesisWordswerth Publishers.

9. Thomas J Mont Ville.,Kart R Matthews 7 Kalmia E Kniel Food Microbiology, ASM Press.

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BSM 210 46: SYSTEM BIOLOGY

SchoolName	School of Biosciences					
Programme	MSc Biochemistry/ Microbiology/ Biotechnology/ Biophysics					
Course Name	SYSTEM BIOLOGY					
Type of Course	Open course					
Course Code	BSM 210 46					
Names of Academic Staff & Qualifications	Dr. R. Harikumar Nair MSc, PhD					
Course Summary & Justification	This 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	Third					
Total Student Learning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Authentic learning Collaborative learning Independent learning	80	20	0	40	140
Pre-requisite	Basics Knowledge in Biology					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1	Students should be capable of effectively communicating how the human body works	U	
2	Students should describe the interdependency and interactions of the systems	A	

3	students should be able to explain contributions of organs and systems to the maintenance of homeostasis	E	
4	The content of the course will elicit curiosity in functioning of human body	I	
<i>*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)</i>			

COURSE CONTENT

Mod ule No	Module Content	CO	Hrs
1	Body organization, cells, tissues, organ and organ systems, body fluid compartments, reflex, biological rhythms	1,4	5
2	Cell membrane, cell organelles, movement of molecules across cell membranes, diffusion, osmosis, endocytosis, exocytosis	2,3,4	5
3.	Neuron, basic principles of electricity, neuronal potentials, neuronal communications, brain, spinal cord, different nervous systems, somatic sensation, vision, hearing, chemical sense, motivation, emotion, learning, memory	2,3,4	10
4	Muscles, muscle contraction, body movement, hormones, hormone disorders, heart, cardiac functions, blood, hypertension, respiration, gas transport between lungs and tissues, respiratory problems	2,3,4	30
5	Kidney, dialysis, digestion and absorption of food, diabetes mellitus, increased plasma cholesterol, body temperature, gametogenesis, male and female reproductive functions	2,3,4	30
Total Credits of the Course		4	80

Teaching and Learning Approach	<p>Classroom Procedure (Mode of transaction)</p> <p>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</p>
Assessment Types	<p>Mode of Assessment</p> <p>E. Continuous Internal Assessment (CIA)</p> <ol style="list-style-type: none"> 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 <p>F. Semester End examination – 60 marks</p>

REFERENCES

<p>Compulsory Reading</p> <ol style="list-style-type: none"> 1. Systems Biology: Definitions and Perspectives. Alberghina, L. and Westerhoff, H, 2. Essentials of Medical Physiology. K Sembulingam & Prema Sembulingam 3. Biochemistry and Physiology of the cell. An introductory text second edition- Edwards, N. A Hassall, K.A
<p>Further Reading:</p> <ol style="list-style-type: none"> 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. Human Physiology: an integrated approach- Silverthorn, Dee Unglaub 5. Principles of anatomy and physiology- Tortora, Gerald J Derrickson, Bryan

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MAHATMA GANDHI UNIVERSITY

BSM 210 47: HISTORY AND PHILOSOPHY OF SCIENCE

SchoolName	School of Biosciences					
Programme	M.Sc.					
Course Name	History and Philosophy of Science					
Type of Course	Open					
Academic staff	Dr.Jayachandran.K					
Course Code	BSM 210 47					
Course Summary & Justification	The course on history and philosophy of science is offered with an objective to provide a general understanding of the growth of science since its origin and the role it has been playing in bringing transformation in human thoughts, approaches and life					
Semester	Third					
Total Student Learning Time (SLT)	Learning Approach	LecturA ademic staffe	Tutorial	Practical	Others	Total Learning Hours
	Authentic learning Collaborative learning Independent learning	80	20	0	40	140
Pre-requisite	Fundamental Knowledge in Science					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1.	The students will be able to get an idea about the historical aspects of the developments taken place in Science	R/U	

2.	The students will be able to analyse the contributing factors and milestones in the progressive growth of Science	R/U	
3.	The students will be able to identify the reputed scientists and their school of thoughts that have contributed to the transformation in scientific approaches	U/ An	
4.	The epistemological aspects and its significance in scientific growth will bring an insight into role of science in bringing benefits to the society	U/An	
5.	Knowledge in philosophy of science and an exposure into its historical aspects can give inspiration to young generations	C/S	
6.	The students will also be able to trace the growth in science, its contributions to society and its ability to bring transformation in human life	A/S	
*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Module No	Module Content	CO	Hrs
1	History of science Origin of science in Ancient Mesopotamia, Egypt, Greece.Civilization in India, China, Aristotelian views, Archimedes, The Copernican revolution, Contributions of Galileo, Lois Pasteur, Newton, Einstein, Bohr, Schrodinger, Heisenberg, Linus Pauling, Development of science ,Newtonian physics, Revolution in Science	1,3	20
2	Philosophy of Science Ancient Philosophy, Kuhn's paradigm shifts, Contributions of Immanuel Kant, Argumentation, Analysis-Rhetorical Dialogue, Positivism, Relativism ,Realism,Shift from classical physics to quantum mechanics	2	20

3.	Teaching and Critical thinking Improving reasoning, Critical thinking, affective strategies, Cognitive strategies Media role, Science and knowledge, Beliefs, Justification	5	15
4	Factors affecting scientific interaction Positivist perspective, Social perspective, Ethical dilemmas, Proximate vs ultimate causation, Pseudoscience. How science transforms the world? challenges and prospects	4,5,6	15
5	Scientific ethics Verifiability and reproducibility, Plagiarism, IPR, Cyber laws, Internet security. , Need of environmental education	5,6	10
Total Credits		4	

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	<p>Mode of Assessment</p> <p>A. Continuous Internal Assessment (CIA)</p> <ol style="list-style-type: none"> 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 <p>B. Semester End examination – 60 marks</p>

REFERENCES

Compulsory Reading:

1. Thomas S Kuhn .1996.The structure of scientific revolutions,3 rd Edition, Chicago, University of Chicago Press
- 2.Henri Poincare ;Science and method, Dover,ISBN0486432696
- 3.Karl Popper, The logic of scientific discovery, Hutchinson, London 1959
- 4.Imre Lakatos, Proofs and refutations. The logic of mathematical discovery, Cambridge University, Press 1976
- 5.Glennan, Stuart ,2002.Rethinking mechanistic explanation. Philosophy of Science , 69, S 342-S353

Further Reading:

1. Takacs, Peyter and Ruse, Michael,2013. The current status of the philosophy of biology ,Science and Education, 22, 5-48

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MAHATMA GANDHI UNIVERSITY

BSM 210 48: ORGANIC FARMING FOR SUSTAINABILITY

School Name	School of Biosciences					
Programme	MSc/ MA/ MBA (offered for schools other than School of Biosciences)					
Course Name	Organic Farming for Sustainability					
Type of Course	Open					
Course Code	BSM 210 48					
Names of Academic Staff & Qualifications	Dr Jisha MS and Dr.Linu Mathew					
Course Summary & Justification	<ol style="list-style-type: none"> 1. This course is meant for PG students of MG University other than the students of School of Biosciences. 2. The course deals with the sustainable farming practises benefitting the earth and the environment 3. In this course they will develop a scientific understanding about organic farming as a sustainable alternative for future well being 					
Semester	Third					
Total Student Learning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Authentic learning Collaborative learning Independent learning	80	20	0	40	140
Pre-requisite	None					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1	Describe the detrimental effects of chemical based farming practices	U	
2	Compare different types of farming practices	U/ An	
3	Understand about the plant nutrient and their sources and evaluate the pros and cons of chemical fertilizers and organic fertilizers and develop knowledge about composting and organic cultivation of crops	U/An	
4	Communicate effectively about a given topic in organic farming verbally and in writing	An/ C	

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

COURSE CONTENT

Mod ule No	Module Content	CO	Hrs
1	Detrimental effects of chemical dependant farming. (Reduction of crop production due to depletion of soil Health Pesticide contamination and human health hazard). Contamination of food products by pesticides & chemicals. Reduction of natural enemies of crop pests. Threat to Bio diversity.	1,4	10
2	Types of Farming (Advantage & disadvantage of each system)-Pure Organic Farming – Definition, Concept & Benefits Integrated Farming system (Combination of Organic and Inorganic) Mixed Farming, Concept of different cropping systems in relation to Organic Farming (Inter cropping etc)	2,4	10
3.	Plant Nutrients: Name of plant Nutrients with gradation • Functions of Nutrients in plant growth and Development of crops, Nutrient uptake and Utilization by plant-From Organics, From Inorganic, Chemical Fertilizer-Advantage & Disadvantage of their use. Balanced Nutrients supply: a) For Organic Farming system using nutrients from Organic sources. b) Integrated plant nutrient Management. Green Manure – Green Manure with Leguminous crops in crop rotation. In-situ incorporation of crop residues -Benefits of Other Nitrogen contributing plants. Liquid Manures, Importance of Bio fertilizers in soil productivity, Nitrogenous, Phosphatic, Potassic biofertilizers	3,4	30
4	Preparation of Compost: (Video) Different Methods, Enrichment of compost, Nutrient composition, Preparation of vermi-compost: (Video) Pit construction, Raw materials, Availability of specific species of earth worm, Method of preparation, Quality improvement of finished vermin compost	3,4	15
5	Cultivation of crops with organic inputs: Field crops, Leguminous crops, Cultivation of Horticultural crops with organic inputs: Vegetable, Fruits, Flowering plants, Plant Protection Measures:, Integrated pest & disease managements and Botanical pesticides, Organic pesticides, bio-pesticides, Inorganic pesticides, disadvantages of their use. Importance of Neem in organic Agriculture, Mushroom cultivation Quality Control and certification procedures of Organic products	3,4	15
Total Credits of the Course		4	

Teaching and Learning Approach	<p>Classroom Procedure (Mode of transaction)</p> <p>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</p>
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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
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REFERENCES

<p>Compulsory Reading:</p> <p>1.Principles of Organic Farming: (With Theory and Practicals) 2019 edn by E Somasundaram, D UdhayaNandhini, M Meyyappan, New India Publishing Agency- Nipa</p> <p>2. Basics of Organic Farming. 2020 edn. Bansal M. CBS publishing</p> <p>3.Biotechnology in Sustainable and Organic Farming: Scope and Potential, 2010 by Vinod Kumar Jain published by Oxford Book Company</p>
<p>Further Reading:</p> <p>1. Moong over Microchips: Adventures of a Techie-Turned-Farmer. 2018 Venkat Iyer Penguin Viking</p> <p>2. Natural Way of Farming. 1985 by Masanobu Fukuoka published by Book venture</p> <p>3. The Road Back to Nature: Regaining the Paradise Lost. 2011 by Masanobu Fukuoka (Author), Fredric Metraud (Translator) Published by Book venture: Madras. 1996. 2001.</p> <p>4. The One-Straw Revolution: An Introduction to Natural Farming (New York Review Books Classics). 2009. by Masanobu Fukuoka , Larry Korn , Wendell Berry , NYRB Classics</p> <p>5. Secrets of the Soil. 2004. by Peter Tompkins. Rupa publishers</p> <p>6. Secrets of Fertile Soils: Humus as the Guardian of the Fundamentals of Natural Life. 2015. By Erhard Hennig Acres U.S.A., Inc</p>

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