

SANKALCHAND PATEL UNIVERSITY, VISNAGAR

Faculty of Science and Humanities



Structure, Teaching Scheme and Syllabus of B.Sc. (Honours) Microbiology as per NEP 2020

Program Code: SC102

With effect from:2023-24

Graduate attributes (Generic learning outcomes)

Program Out Comes:

PO1: *Complex problem-solving*: The graduates should be able to demonstrate the capability to solve different kinds of problems in familiar and non-familiar contexts and apply the learning to real-life situations.

PO2: *Critical thinking*: The graduates should be able to demonstrate the capability to:

- apply analytic thought to a body of knowledge, including the analysis and evaluation of policies, and practices, as well as evidence, arguments, claims, beliefs, and the reliability and relevance of evidence,
- identify relevant assumptions or implications; and formulate coherent arguments,
- identify logical flaws and holes in the arguments of others,
- analyze and synthesize data from a variety of sources and draw valid conclusions and support them with evidence and examples.

PO3: *Creativity*: The graduates should be able to demonstrate the ability to:

- create, perform, or think in different and diverse ways about the same objects or scenarios,
- deal with problems and situations that do not have simple solutions,
- innovate and perform tasks in a better manner,
- view a problem or a situation from multiple perspectives,
- think 'out of the box' and generate solutions to complex problems in unfamiliar contexts,
- adopt innovative, imaginative, lateral thinking, interpersonal skills and emotional intelligence.

PO4: *Communication Skills*: The graduates should be able to demonstrate the skills that enable them to:

- listen carefully, read texts and research papers analytically and present complex information in a clear and concise manner to different groups/audiences,
- express thoughts and ideas effectively in writing and orally and communicate with others using appropriate media,
- confidently share views and express herself/himself,
- construct logical arguments using correct technical language related to a field of learning, work/vocation, or an area of professional practice, and convey ideas, thoughts, and arguments using language that is respectful and sensitive to gender and other minority groups.

PO5: *Analytical reasoning/thinking*: The graduates should be able to demonstrate the capability to:

- evaluate the reliability and relevance of evidence;
- identify logical flaws in the arguments of others;
- analyze and synthesize data from a variety of sources; draw valid conclusions and support them with evidence and examples, and address opposing viewpoints.

PO6: *Research-related skills*: The graduates should be able to demonstrate:

- a keen sense of observation, inquiry, and capability for asking relevant/ appropriate questions,
- the ability to problematize, synthesize, and articulate issues and design research proposals,
- the ability to define problems, formulate appropriate and relevant research questions, formulate hypotheses, test hypotheses using quantitative and qualitative data, establish hypotheses, make inferences based on the analysis and interpretation of data, and predict cause-and-effect relationships,
- the capacity to develop appropriate methodology and tools for data collection,
- the appropriate use of statistical and other analytical tools and techniques,
- the ability to plan, execute and report the results of an experiment or investigation.

PO7: Coordinating/collaborating with others: The graduates should be able to demonstrate the ability to:

- work effectively and respectfully with diverse teams,
- facilitate cooperative or coordinated effort on the part of a group,
- act together as a group or a team in the interests of a common cause and work efficiently as a member of a team.

PO8: Leadership readiness/qualities: The graduates should be able to demonstrate the capability for:

- mapping out the tasks of a team or an organization and setting direction.
- formulating an inspiring vision and building a team that can help achieve the vision, motivating and inspiring team members to engage with that vision.
- using management skills to guide people to the right destination.

PO9: Learning how to learn skills: The graduates should be able to demonstrate the ability to:

- acquire new knowledge and skills, including ‘learning how to learn skills, that are necessary for pursuing 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 the workplace, including adapting to the changes in work processes in the context of the fourth industrial revolution, through knowledge/ skill development/reskilling,
- work independently, identify appropriate resources required for further learning,
- acquire organizational skills and time management to set self-defined goals and targets with timelines.
- inculcate a healthy attitude to be a lifelong learner

PO10: Digital and technological skills: The graduates should be able to demonstrate the capability to:

- use ICT in a variety of learning and work situations,
- access, evaluate, and use a variety of relevant information sources, and use appropriate software for analysis of data

PO11: Multicultural competence and inclusive spirit: The graduates should be able to demonstrate:

- the acquisition of knowledge of the values and beliefs of multiple cultures and a global perspective to honour diversity,
- capability to effectively engage in a multicultural group/society and interact respectfully with diverse groups,
- capability to lead a diverse team to accomplish common group tasks and goals.
- gender sensitivity and adopting a gender-neutral approach, as also empathy for the less advantaged and the differently-abled including those with learning disabilities.

PO12: Value inculcation: The graduates should be able to demonstrate the acquisition of knowledge and attitude that are required to:

- embrace and practice constitutional, humanistic, ethical, and moral values in life, including universal human values of truth, righteous conduct, peace, love, nonviolence, scientific temper, citizenship values,
- practice responsible global citizenship required for responding to contemporary global challenges, enabling learners to become aware of and understand global issues and to become active promoters of more peaceful, tolerant, inclusive, secure, and sustainable societies,
- formulate a position/argument about an ethical issue from multiple perspectives
- identify ethical issues related to work, and follow ethical practices, including avoiding unethical behavior such as fabrication, falsification or misrepresentation of data, or committing plagiarism, and adhering to intellectual property rights,
- recognize environmental and sustainability issues, and participate in actions to promote sustainable development.
- adopt an objective, unbiased, and truthful actions in all aspects of work,
- instill integrity and identify ethical issues related to work, and follow ethical practices.

PO13: *Autonomy, responsibility, and accountability:* The graduates should be able to demonstrate the ability to:

- apply knowledge, understanding, and/or skills with an appropriate degree of independence relevant to the level of the qualification,
- work independently, identify appropriate resources required for a project, and manage a project through to completion,
- exercise responsibility and demonstrate accountability in applying knowledge and/or skills in work and/or learning contexts appropriate for the level of the qualification, including ensuring safety and security at workplaces.

PO14: *Environmental awareness and action:* The graduates should be able to demonstrate and required to take appropriate actions for:

- mitigating the effects of environmental degradation, climate change, and pollution
- effective waste management, conservation of biological diversity, management of biological resources and biodiversity, forest and wildlife conservation, and sustainable development and living.

PO15: *Community engagement and service:* The graduates should be able to demonstrate the capability to participate in community-engaged services/ activities for promoting the well-being of society.

PO16: *Empathy:* The graduates should be able to demonstrate the ability to identify with or understand the perspective, experiences, or points of view of another individual or group, and to identify and understand other people's emotions.

Program Specification Outcomes (PSOs):

PSO1: Students will develop basic as well as advance skill to observe, isolate, identify and cultivate microorganisms.

PSO2: Students will develop theoretical and practical skills of tools and techniques used to study microbiology and applications in applied as well as interdisciplinary areas of science its applied areas.

Semester- IV

Branch Name:	B.Sc. Microbiology
Program Code:	SC102
Course Name:	Microbial Diversity
Course Code:	14-MIM208-2C
Pre-requisite Course:	Fundamental of Microbiology

Course Objectives:

- To understand basic information to origin and diversity of microbes
- To understand characteristics of various microorganisms other than bacteria
- To understand the concepts of taxonomy and phylogenetic relationships between various domains
- To understand the diversity amongst the different domains and diversity in-between the same domain
- To enable the students useful and harmful effects of microorganisms on other organisms of various domains

Teaching and Examination Scheme:

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
Lecture (L)	Tutorial (T)	Practical (P)	Credit	Theory (Marks)		Practical (Marks)		Total (Marks)
				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
3	-	2	4	50	25	--	25	100

Subject Contents:

Unit	Content	Total Hour	Weightage
1	INTRODUCTION TO MICROBIAL DIVERSITY • Introduction to Biodiversity- Microbial evolution and diversity; Major domains of life; Overview of the functional and metabolic diversity between- the similar domains and the different domains • Microbial Taxonomy: Major characteristics used in taxonomy classical and molecular; Classification systems-phenetic, numerical and phylogenetic; Taxonomic ranks of microorganisms • ARCHAEA: General Characteristics- Difference between Archaea and Bacteria, Major divisions of Archaea: <i>Euryarchaeota</i>, <i>Thaumarchaeota</i>, <i>Nanoarchaeota</i>, and <i>Korarchaeota</i>, <i>Crenarchaeota</i> Evolution and Life at High Temperatures: Molecular adaptations and Hyperthermophilic <i>Archaea</i>	15	34%
2	EUKARYOTIC DIVERSITY • FUNGI: General characteristics – Definition, occurrence, Structure, reproduction, Classification and introduction to major divisions of Fungi; Economic importance of fungi • ALGAE: General Characteristics – Definition, reproduction Occurrence, Ultra Structure, Economic importance of Algae • PROTOZOA: General Characteristics – Definition, Occurrence, Ultra Structure, reproduction, Economic importance of Protozoa	15	33%
3	AKARYOTIC DIVERSITY-(VIRUSES) • Introduction and General Characteristics: Definition, Structure, Classification • Cultivation and Enumeration of Viruses. Viroids and Prions • Bacterial Viruses: Classification, Lytic life cycle (T4 phage), lysogenic life cycle • Plant Virus: TMV, CMV • Animal Virus: Poliovirus, HIV	15	33%

List of Experiments:

1. Isolation and culture of photosynthetic bacteria
2. Isolation and culture of halophilic bacteria
3. Isolation and enumeration of fungi from different samples

4. Isolation of yeast from sugary/starchy material
5. Isolation and identification of algae from soil
6. Isolation and enumeration of phage from sewage sample
7. Isolation of protozoa from soil

Textbooks:

- Michael Pelczar, text book of microbiology, 5th ed.
- Microbiology by R.M. Atlas (1996).
- Practical Microbiology by Dr.R.C.Dubey and Dr. D.K.Maheshwari (2008).

Reference Books:

- Madigan MT, and Martinko J M (2014). Brock Biology of Microorganisms. 14th edition. Prentice Hall International Inc.
- Willey JM, Sherwood LM, and Woolverton CJ. (2013). Prescott's Microbiology. 9th edition. McGraw Hill Higher Education

List of Open-Source Software/learning website:

- <https://archive.nptel.ac.in/courses/102/103/102103015/>
- https://onlinecourses.nptel.ac.in/noc21_ce07/preview
- <https://www.studocu.com/in/document/amity-university/microbiology/diversity-of-microbial-orld/4680392>
- <https://academic.oup.com/book/504/chapter-abstract/135265982?redirectedFrom=fulltext>

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	Categorize and classify various domains on the basis of their characteristics, and illustrate their classical and molecular characters for the classification of different living organisms	1 Remembering 2 Understanding 3 Applying 4 Analyzing
CLO2	Compare physiology of the organisms of same and/or different domains, illustrate the classification of organisms on the basis of taxonomic rank	1 Remembering 2 Understanding
CLO3	Categorize and classify Eukaryotic organisms, Classify the fungi on the basis of phenotypic characters, and illustrate the economic importance of fungi, and clinically important fungi	1 Remembering 2 Understanding
CLO4	Classify the fungi on the basis of phenotypic characters, and illustrate the economic importance of fungi, and clinically important fungi	1 Remembering 2 Understanding
CLO5	Categorize and classify akaryotic organisms, Classify the virus on the basis of the nucleic acid material, and illustrate the clinical importance of viruses	1 Remembering 2 Understanding 3 Applying 4 Analyzing 5 Evaluating
CLO6	Illustrate the viruses that can cause infections to bacteria, plants, and animals	3 Applying 2 Understanding 4 Analyzing 5 Evaluating 6 Creating

Mapping of CLO s with POs & PSOs

Course Learning Outcomes	Program Outcomes (POs)																Program Specific Outcome (PSOs)	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	PSO1	PSO2
CLO1						2								1			1	3
CLO2						2								1			3	2
CLO3						3								2			3	1
CLO4						2								2			3	2
CLO5						3								2			3	3
CLO6						3								1			3	3

3: High, 2: Medium, 1: Low

Branch Name:	B.Sc. Microbiology
Program Code:	SC102
Course Name:	Gene Transfer Techniques
Course Code:	14-MIM209-2C
Pre-requisite Course:	Molecular Biology

Course Objectives:

- The course is designed to acquire basic knowledge of gene transfer and simple outline of how the gene can be transferred from one to the other organism.
- It will also help in acquiring knowledge on artificial gene transfer tools and methods.
- This course will enable to students to understand transposition mechanism.

Teaching and Examination Scheme:

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
Lecture (L)	Tutorial (T)	Practical (P)	Credit	Theory (Marks)		Practical (Marks)		Total (Marks)
				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
3	-	2	4	50	25	--	25	100

Subject Contents:

Unit	Content	Lectures	Weightage
1	• Bacterial recombination: Principles, its biological significance, types of recombination and their molecular mechanisms (generalized-Homologous DNA recombination-Holiday Model, Non homologous site specific and illegitimate recombination), recombination frequency and its significance. • Transposable genetic elements: Structure: Insertion, Types of bacterial transposons: Composite Transposons and Non composite transposons; • Mechanisms of Transposition – replicative and non-replicative • Plasmid DNA – Introduction of Bacterial Plasmid, f –plasmids, R plasmids, colicinogenic, Other types of Plasmid	15	34%
2	Gene transfer in bacteria. • Transformation: transformation principle, competence factor, mechanism of DNA uptake, transfection. • Transduction: Introduction, types-restricted, generalized and abortive transduction • Conjugation: Introduction, types of crosses involved: F⁺, Hfr and F', interrupted mating Experiment	15	33%
3	Methods of gene transfer • Physical (Electroporation, Gene gun- particle bombardment, Microinjection- divert transformation, transformation by ultrasonication -liposome mediated- gene transfer, Silicon carbide based) • Chemical Method (Competent cell preparation, CaCl₂ mediated gene transfer, PEG mediated gene transfer) • Biological method (Agrobacterium mediated gene transfer, Ti plasmid)	15	33%

List of Experiments:

1. Isolation and quantification of DNA from Bacteria.
2. Extraction of plasmid DNA from bacterial cell.

3. Study & Visualization of DNA using Agarose Gel Electrophoresis.
4. Preparation of Competent cell for Transformation.
5. Transformation and selection of recombinants.
6. To study and schematically demonstrate phenomena of Conjugation.
7. To study and schematically demonstrate phenomena of Transduction.

Textbooks:

- Prescott, Harley and Klein's Microbiology. 9th Edition. McGraw Hill Higher education
- Principles of Microbiology by R. M. Atlas

Reference Books:

- Brown TA. (2010). Gene Cloning and DNA Analysis. 6th edition. Blackwell Publishing, Oxford, U.K.
- Molecular Cell Biology 5th edition by Lodish, Berk, Matsudalia
- Clark DP and Pasternik NJ. (2009). Biotechnology: Applying the Genetic Revolution. Elsevier Academic Press, USA
- Primrose SB and Twyman RM. (2008). Genomics: Applications in human biology. Blackwell Publishing, Oxford, U.K.

List of Open-Source Software/learning website:

- <https://archive.nptel.ac.in/courses/102/103/102103013/#>
- <https://www.google.com/search?q=nptel+on+gene+transfer&oq=nptel+on+gene+transfer+&aqs=chrome..69i57j0i22i30j0i390i650l3.15670j0j15&sourceid=chrome&ie=UTF-8#fpstate=ive&vld=cid:48eeb28e,vid:Pg-HzNgna7w>
- <https://nptel.ac.in/courses/102103041>

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	Discuss the mechanism of transformation, conjugation transduction.	2 Understanding
CLO2	List the types of gene transfer and use of biomolecules.	1 Remembering
CLO3	Enabling students to understand types, advantages and disadvantages transgenesis.	2 Understanding,
CLO4	Development of capacity to understand recombination and apply its knowledge.	3 Applying, 2 Understanding
CLO5	Learn about transposable element, evaluate mechanisms associated with it, identify and compare the different types of it.	3 Applying 4 Analyzing 5 Evaluating,
CLO6	Understand the mechanism of artificial gene transfer and apply its knowledge for creating recombinant DNA	6 Creating

Mapping of CLOs with POs & PSOs

Course Learning Outcomes	Program Outcomes (POs)																Program Specific Outcome (PSOs)	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	PSO1	PSO2
CLO1	3	3	2	2	3	3	3	2	3		1	3	1		1			
CLO2	2	2			1	3	3	3	1		2			2	2	1	1	
CLO3	2	3	2				2	2	3	1		3	3				1	
CLO4	3	3	1	2				1	2	2	3	1		2	3	2		3
CLO5	2	1	2	2	2	2	1	2		2	3	3	1	1	2			2
CLO6	2	2	2		2	1	1	2	1	1	3	2	2	3		2		3

3: High, 2: Medium, 1: Low

Branch Name:	B.Sc. Microbiology
Program Code:	SC102
Course Name:	Recombinant DNA Technology
Course Code:	14-MIM210-2C
Pre-requisite Course:	Basics of cell

Course Objectives:

- This course is designed to acquire basic knowledge Recombinant DNA technology.
- The course will also provide the knowledge of various vectors of gene transfer and their importance.
- It will also provide the knowledge of steps and methods of transferring DNA in prokaryotes and Eukaryotes.
- The advance techniques like genome mapping, Polymerase chain reaction etc.

Teaching and Examination Scheme:

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
Lecture (L)	Tutorial (T)	Practical (P)	Credit	Theory (Marks)		Practical (Marks)		Total (Marks)
				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
3	-	2	4	50	25	--	25	100

Subject Contents:

Unit	Content	Total Hour	Weightage
1	• Historical perspectives of genetic engineering. • Methods of nucleic acid Isolation (DNA & RNA), Quality and Quantity determination of isolated nucleic acid • Basics of methods of DNA manipulation – Digestion, Ligation, labelling, etc. • Blotting: Southern blotting, Western blotting, Northern blotting, Colony blotting, Dot blotting. • Hybridization and detection of probe using autoradiography (FISH). • Colony hybridization technique • Sequencing of DNA: Sanger's method for DNA sequencing, automated DNA sequencings, pyro-sequencing and microarray based sequencing. • Chemical and automated DNA Synthesis, Next Generation Sequencing. • Gene library construction (Genomic & c-DNA library)	15	33%
2	• Enzymes: restriction endonucleases, RNA polymerase, DNA ligase, alkaline phosphatase, reverse transcriptase. • Cloning and expression vectors: Plasmid based vectors, bacteriophage lamdabased vectors, cosmids, P1 based vector, PAC, BAC , Phagemids ,High capacity yeast cloning vector:-YAC, specialized yeast vectors: pYES and pPPICZ • Gene cloning in prokaryotes – isolation of DNA to be cloned – insertion of DNA fragments in to vector – use of linkers and adaptors- use of homo polymer tails , transfer of recombinant DNA into bacterial cells. • Cloning in eukaryotes in plant cell, yeast, filamentous fungi	15	33%
3	• Genome mapping: • Molecular markers (RFLP, RAPD, AFLP, SNP, SCAR, SSR, VNTR). • Chromosome walking. • Polymerase chain reaction techniques: Basic PCR technique, • Variation of PCR techniques and Applications of PCR. • Applications of r-DNA technology: Gene therapy, Expression of therapeutic proteins, Forensic science, Food, Agriculture.	15	34%

List of Experiments:

1. To isolate the DNA from a plant source.
2. To isolate the DNA from a animal source.
3. To perform restriction digestion.(RFLP)
4. Ligation of digested DNA.
5. Transformation and selection of recombinants.
6. Amplification of DNA by PCR

Textbooks:

- Brown TA. (2010). Gene Cloning and DNA Analysis. 6th edition. Blackwell Publishing, Oxford,U.K.
- Textbook of Biotechnology by R. C. Dubey, Publisher : S. Chand, and Co
- Biotechnology by S.S.Purohit.
- Genetic Engineering by Sandhya Mitra
- Fundamentals of Molecular Biology 2009, Tar ganti K. Pal, Saroj S.
- Cell biology & Genetics: Verma and Agrawal

Reference Books:

- Biotechnology by S.S.Purohit.
- Genetic Engineering by Sandhya Mitra
- Fundamentals of Molecular Biology 2009, Tar ganti K. Pal, Saroj S.
- Molecular Cell Biology 5 th edition by Lodish, Berk, Matsudalia
- Clark DP and Pasternik NJ. (2009). Biotechnology: Applying the Genetic Revolution. ElsevierAcademic Press, USA
- Primrose SB and Twyman RM. (2006). Principles of Gene Manipulation and Genomics, 7th edition. Blackwell Publishing, Oxford, U.K.
- Sambrook J and Russell D. (2001). Molecular Cloning-A Laboratory Manual. 3rd edition. Cold
- Genetics: principles and analysis. 4 th edition 1998, Denial L. Hartl, Elizabeth tones. Principles of genetics: E.J. Gardner. Genes 9: Benjamin Levi
- Lehninger Principles of Biochemistry, 5th Edition, Nelson DL and Cox MM (2008)., W.H. Freeman and Company,
- Microbiology by Powar and Dagainawala, Himalaya Publisher

List of Open-Source Software/learning website:

- <https://archive.nptel.ac.in/courses/102/103/102103013/>
- <https://archive.nptel.ac.in/courses/102/103/102103074/>
- https://www.youtube.com/watch?v=6ztkp2dqp_I

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	Discuss the mechanism of DNA isolation, manipulation, hybridization experiments.	2 Understanding
CLO2	List the types of PCR. Various types of gene transfer methods	1 Remembering
CLO3	Enabling students to understand types, advantages and disadvantages various molecular markers.	2 Understanding,
CLO4	Development of capacity to understand DNA sequencing, Chromosome walking..	3 Applying, 2 Understanding
CLO5	Learn about PCR, Prokaryotic and Eukaryotic Gene cloning	3 Applying 4Analyzing 5 Evaluating,
CLO6	Discuss the mechanisms involved in pyrosequencing, gene transfer techniques, NGS.	6 Creating

Mapping of CLO s with POs & PSOs

Course Learning Outcomes	Program Outcomes (POs)																Program Specific Outcome (PSOs)	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	PSO1	PSO2
CLO1	3	3	2	2	3	3	3	2	3		1	3				1		
CLO2	2	2			1	3	3	3	1		2		1	2	1		1	
CLO3	2	3	2				2	2	3	1		3				2		
CLO4	3	3	1	2	2			1	2	2	3	1	3	1	2	1		
CLO5	2	1	2	2	2	2	1	2		2	3	3	2				2	
CLO6	2	2	2			2	1	2	1	1	3	2	1		1	2		3

3: High, 2: Medium, 1: Low

Branch Name:	B.Sc. Microbiology
Program Code:	SC102
Course Name:	Bryophytes, Pteridophytes and Gymnosperms
Course Code:	14-BIE206-2C
Pre-requisite Course:	Basics Biology

Course Objectives:

- Demonstrate an understanding of archegoniate, Bryophytes, Pteridophytes and Gymnosperms.
- Develop critical understanding on morphology, anatomy and reproduction of Bryophytes, Pteridophytes and Gymnosperms.
- Understanding of plant evolution and their transition to land habitat.
- Demonstrate proficiency in the experimental techniques and methods of appropriate analysis of Bryophytes, Pteridophytes, Gymnosperms

Teaching and Examination Scheme:

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
Lecture (L)	Tutorial (T)	Practical (P)	Credit	Theory (Marks)		Practical (Marks)		Total (Marks)
				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
3	-	2	4	50	25	--	25	100

Subject Contents:

Unit	Content	Lectures	Weightage
1	Diversity of Bryophytes General Characters and group characteristics with suitable examples • Occurrence, thallus structure, Morphology, anatomy, and reproduction in: Marchantia, Peltia, Anthoceros and Polytrichum	15	34%
2	Diversity of Pteridophytes General characters and group characteristics with suitable examples Morphology, anatomy and reproduction in: Lycopodium, Isoetes, Marsilea, Osmunda and Adiantum, Ultra Structure, reproduction, Economic importance of Protozoa	15	33%
3	Diversity of Gymnosperms General characteristics and group characteristics with suitable examples Morphology, anatomy and reproduction in: Zamia, Pinus, Biota and Ephedra	15	33%

Textbooks:

1. Smith, G.M. 1972 Cryptogamic Botany Vol I and II
2. Vasishtha, B.R. 1974 Botany for Degree students Vol I Algae
3. Vasishtha, B.R. 1974 Botany for Degree students Vol III Bryophyta
4. Vasishtha, P.C. 1974 Botany for Degree students Vol IV Pteridophyta
5. Vasishtha, P.C. 1976 Botany for Degree students Vol V Gymnosperms
6. Bhatnagar, S.P. and Alok Moitra 1996. Gymnosperms New Age International Publishers
7. Inderdeep Kaur and Prem Lal Uniyal 2019. Text book of Gymnosperms Daya Publishing house

List of Open-Source Software/learning website:

- <https://www.youtube.com/watch?v=eN5ROvpx8Q>
- <https://archive.nptel.ac.in/noc/courses/noc22/SEM1/noc22-bt17/>
- <https://archive.nptel.ac.in/noc/courses/noc22/SEM1/noc22-bt18/>
- <https://archive.nptel.ac.in/courses/102/103/102103091/>
- <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=2rAs1Puvga4LW93zMe83aA=>

List of Experiments:

- Morphology and anatomy of vegetative and reproductive parts in:
- *Oedogonium*, *Chara*, *Dictyota*, *Batrachospermum*
- *Marchantia*, *Anthoceros*, *Polytrichum*
- *Lycopodium*, *Isoetes*, *Marsilea*, *Adiantum*
- *Zamia*, *Pinus*, *Biota*

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	Discuss the diversity of bryophytes.	2 Understanding
CLO2	List the diverse group of pteridophytes.	1 Remembering
CLO3	Acquire fundamentals knowledge that will enable them to identify and study Gymnosperms.	2 Understanding
CLO4	Learn basic techniques to identify and interpret Protein synthesis and transporting in the cell.	2 Understanding 3 Applying,
CLO5	Learn about membrane transport, evaluate diseases associated with them, identify and compare the exocytosis and endocytosis in the cell.	3 Applying 4 Analyzing 5 Evaluating
CLO6	Discuss the mechanisms involved in mitosis and meiosis.	6 Creating

Mapping of CLO s with POs & PSOs

Course Learning Outcomes	Program Outcomes (POs)																Program Specific Outcome (PSOs)	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	PSO1	PSO2
CLO1	1	1	1		1	1												
CLO2	1	3	1		1	1									2			
CLO3	1	3	1		2	2			2						1			
CLO4	2	3	1		3	3			3									
CLO5	2	3	3		3	3			3						3			
CLO6																		

3: High, 2: Medium, 1: Low

Branch Name:	B.Sc. Microbiology
Program Code:	SC102
Course Name:	Biotechnology applied to Plants
Course Code:	14-BIE207-2C
Pre-requisite Course:	

Course Objectives:

- The course is designed to acquire basic knowledge of plant tissue culture and simple outline of how the micropropagation done.
- This will enable the student to understand basics of plant gene transfer. It will also help in acquiring knowledge on artificial gene transfer tools and methods for transgenesis.
- This course is designed to enable students in understanding the basics and applications of plant tissue culture.
- Understanding the Applications and Scope of Plant Genetic Engineering.

Teaching and Examination Scheme:

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
Lecture (L)	Tutorial (T)	Practical (P)	Credit	Theory (Marks)		Practical (Marks)		Total (Marks)
				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
3	-	2	4	50	25	--	25	100

Subject Contents:

Unit	Content	Lectures	Weightage
1	Overview of Tissue Culture Plant Tissue culture : History The laboratory facilities: Equipment and apparatus, Design Concepts of totipotency of cells, Concept of cytodifferentiation/ morphogenesis. Plant tissue culture media: Media composition, Types of media Selection, isolation and preparation of explant Micropropagation and its stages	12	28 %
2	Techniques of tissue culture Culture of organized tissues: Root culture, shoot culture, meristem culture, embryo culture, Pollen and anther culture (production and uses of haploids.) Callus culture Protoplast culture: Somatic hybridization and its application. Somatic embryogenesis & Synthetic seeds Cell suspension culture and production of secondary metabolite • Cryopreservation of germplasm	16	35%
3	Physical and chemical methods used for gene transfer in plants. Agrobacterium mediated gene transfer in plants, Other biological gene transfer methods Structure of plant gene, Use of different promoters, selectable markers, reporter genes, Plant cloning vectors: Seed terminator technology Chloroplast transformation – a potential alternative to nuclear transformation Transgenic plants: Insect resistance-BT Cotton, herbicide resistance, Disease resistance, Stress tolerance, improvement of crop quality molecular pharming Post-harvest technology: RNAi and antisense RNA technology for extending shelf life of fruits (delay of softening and ripening of fleshy fruits eg. tomato)	17	37%

List of Experiments:

1. Sterilization techniques: Theory and Practical: Glass ware sterilization, Media sterilization, Laboratory sterilization
2. Preparation of complex nutrient medium (Murashige & Skoog's medium)
3. To selection, Prune, sterilize and prepare an explant for culture.
4. To study various steps of Micropropagation & to study the significance of growth hormones in culture medium
5. Callus culture development.

Textbooks:

- Biotechnology in crop improvement – H S Chawla.

Reference Books:

- Plant biotechnology – J Hammond, et. al., Springer Verlag.
- Practical application of plant molecular biology – R J Henry, Chapman & Hall.
- Elements of biotechnology – P K Gupta.
- An introduction to plant tissue culture – M K Razdan.
- Plant propagation by tissue culture: The technology (Vols. 1 & 2) – Edwin George.
- Handbook of plant cell culture (Vols. 1 to 4) – Evans et. al., Macmillan.
- Plant tissue and cell culture – H E Street, Blackwell Scientific.
- Cell culture and somatic cell genetics of plants (Vols. 1 to 3) – A K Vasil, A. Press.
- Plant cell culture technology – M M Yeoman.
- Plant tissue culture and its biotechnological applications – W Bary, et. al., Springer Verlag.
- Principles of plant biotechnology: An introduction to genetic engineering in plants – S H Mantel, et. al.
- Applied and fundamental aspects of plant cell tissue and organ culture edited by Reinert & Bajaj Y P S, Springer Verlag.
- Plant cell and tissue culture – S Narayanswamy, Tata McGraw Hill Co
- Das and Mookerjee. Outline of biology.
- Plant tissue culture K.K. De.
- Plant and tissue culture Radint and Bhojwani

List of Open-Source Software/learning website:

- <https://www.youtube.com/watch?v=EDReGW95EGk>
- <https://www.youtube.com/watch?v=HHYDmfj4ojk>
- <https://www.youtube.com/watch?v=vPkI34wXAHl>

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	Discuss the developing an understanding towards fundamentals of plant biotechnology.	2 Understanding
CLO2	List the applications of Plant Biotechnology.	1 Remembering
CLO3	Enabling students to understand types, advantages and disadvantages molecular markers.	2 Understanding
CLO4	Development of capacity to formulate application of plant biotechnology for production of commercial transgenic plants.	2 Understanding 3 Applying,
CLO5	Learn about biocatalysts, evaluate diseases resistant associated with plant, identify and compare the conventional propagation and micropropagation.	3 Applying 4 Analyzing 5 Evaluate
CLO6	Discuss the mechanisms involved in gene transfer in plant.	6 Creating

Mapping of CLO s with POs & PSOs

Course Learning Outcomes	Program Outcomes (POs)																Program Specific Outcome (PSOs)	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	PSO1	PSO2
CLO1	2	2	3	3		2	3	1		1	1	3	1					
CLO2	2	3		2	2	2	2	3	2		2	1		1	1	1		
CLO3		2	3			2	2		1	3		3	3					
CLO4	3	3					3	2	3		2	1	1	2	1	2		
CLO5	3	2	2	2	3	2	2			2	1	2						
CLO6	2	1	2	1	2	1		2			2		1	3	2			

3: High, 2: Medium, 1: Low

Branch Name:	B.Sc. Microbiology
Program Code:	SC102
Course Name:	Grammar and Communication Skill-II
Course Code:	14-AEC204-2C
Pre-requisite Course:	Basics English Grammar Basics English up to S.Y.B.Sc.

Course Objectives:

- To inculcate human values among the students through poems and prose.
- To create an interest in literature and to develop language skills.
- The students will become familiar with formal vocabulary that is common in academic texts.

Teaching and Examination Scheme:

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
Lecture (L)	Tutorial (T)	Practical (P)	Credit	Theory (Marks)		Practical (Marks)		Total (Marks)
				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
2	-	-	2	25	25	--	-	50

Subject Contents:

Unit	Content	Lectures	Weightage
1	VOCABULARY&GRAMMARLINK • Prefix-Suffix, Gerund and Participle, Concord, Apply capitalization and comma use rules. Sentences: Simple Sentences, Compound Sentences, Complex Sentences	9	30%
2	SPEAKING Conversations: - College/School related conversations:- Parent – teacher, Advice from a teacher, Admission to a college , Getting ready for a school trek. Family conversations:- A family get together , Cleaning the house , Sharing the day’s experiences Job related Enquiries:- • Job seekers’ course , Job seekers - a discussion , Job opportunities , Short courses during a vacation	6	20%
3	READING&WRITING Paragraph Writing. List of Topics for Paragraph Writing: Personal: (a) My Ambition in Life (b) India - My Country (c) College Life (d) My Favorite Movie State/ nation/ media: (a) My City/ Village (b) My Favorite Sports person (c) Gandhi Ashram (d) Importance of English in India Environment/ social life: (a) Pollution (b) Traffic Awareness (c) Trees – Our Best Friends (d) Gender Discrimination Translation: - • Translate the Accident/Incident Paragraphs given by your teacher from the English News Papers (Teacher has to give small paragraphs at least 5 to 6 paragraphs or more than that for the entire semester based on especially from the pages no. 3 & 4 of The Times of India).	6	20%
4	TEXT Glimpses of Life-An Anthology of Short Stories Orient Black Swan) Lesson (8 to 12	9	30%

Textbooks:

1. Glimpses of Life-An Anthology of Short Stories (Orient Black Swan)
2. Easy to learn English grammar by Dr. Jayesh Patel

Reference Books:

1. Very Useful Verbs book (Enka Publication)
2. Contemporary English Grammar Structure & Composition
3. Murphy R. Intermediate English Grammar (New Delhi: Cambridge University)
4. The Art of Public Speaking by Vijay Kumar.
5. The Times of India/The Indian Express
6. Business Correspondence and Report Writing by R.C Sharma & Krishna Mohan.

List of Open-Source Software/learning website:

1. englishpage.com
2. epaper.timesofindia.com
3. epaperindianexpress.com
4. <https://www.youtube.com/watch?v=QdAgyD4xhY>

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	Describe how public speaking can be used to advocate or create change	1 Remembering
CLO2	Explain the goals and benefits of public speaking	2 Understanding
CLO3	Use parallel structures correctly and effectively.	3 Applying
CLO4	Identify strategies for researching and supporting a speech	4 Analysing
CLO5	Recognize when to use visual aids	3 Applying
CLO6	Describe how public speaking can be used to advocate or create change	6 Creating

Mapping of CLO s with POs & PSOs

Course Learning Outcomes	Program Outcomes (POs)																Program Specific Outcome (PSOs)	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	PSO1	PSO2
CLO1				3			1											
CLO2				3			1											
CLO3				3			1											
CLO4				3			1											
CLO5				3			1											
CLO6				3			1											

3: High, 2: Medium, 1: Low

Branch Name:	B.Sc. Microbiology
Program Code:	SC102
Course Name:	Biofertilizers and Biopesticide
Course Code:	14-SEC218-2C
Pre-requisite Course:	Basic knowledge of Microbiology

Course Objectives:

- To understand Biofertilizers
- To understand nitrogen fixing bacteria
- To understand Mycorrhizal Biofertilizers
- To understand Biopesticides

Teaching and Examination Scheme:

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
Lecture (L)	Tutorial (T)	Practical (P)	Credit	Theory (Marks)		Practical (Marks)		Total (Marks)
				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
2	-	-	2	25	25	-	-	50

Subject Contents:

Unit	Content	Total Hours	Weightage
1	Importance of Biofertilizers its advantage over chemical fertilizers and their limitations General account of the microbes used as biofertilizers for various crop plants. Symbiotic N₂ fixers: Rhizobium - Isolation, characteristics, types, inoculum production and field application, legume/pulses plants Frankia - Isolation, characteristics, Alder, Casurina plants, non-leguminous crop symbiosis. (A) Cyanobacteria, Azolla - Isolation, characterization, mass multiplication, Role in rice cultivation, Crop response, field application. (B) Non - Symbiotic Nitrogen Fixers Free living Azospirillum, Azotobacter - free isolation, characteristics, mass inoculums, production and field application. (C) Phosphate Solubilizers Phosphate solubilizing microbes - Isolation, characterization, mass inoculum production, field application (D) Mycorrhizal Biofertilizers Importance of mycorrhizal inoculum, types of <i>Mycorrhizae</i> and associated plants, Mass inoculum production of VAM, field applications of Ectomycorrhiza and VAM.	24	80%
2	Biopesticide General account of microbes used as biopesticide and their advantages over synthetic pesticides. Biopesticide, <i>Bacillus thuringiensis</i>- production and Field applications Viruses – cultivation and field applications.	6	20%

Textbooks:

- Dubey R.C.. and Maheshwari D.K., Textbook of microbiology, S Chand Publications.
- Dubey R.C.. and Maheshwari D.K., Textbook of Biotechnology, S Chand Publications.
- Michael Pelczar, text book of microbiology, 5th ed.

Reference Books:

- Kannaiyan, S. (2003). Bioethnology of Biofertilizers, CHIPS, Texas.
- Mahendra K. Rai (2005). Hand book of Microbial biofertilizers, The Haworth Press, Inc. New York.
- Reddy, S.M. et. al. (2002). Bioinoculants for sustainable agriculture and forestry, Scientific Publishers.
- Subba Rao N.S (1995) Soil microorganisms and plant growth Oxford and IBH publishing co. Pvt. Ltd. NewDelhi.
- Saleem F and Shakoori AR (2012) Development of Bioinsecticide, Lap Lambert Academic Publishing GmbH KG
- Aggarwal SK (2005) Advanced Environmental Biotechnology, APH publication.

List of Open-Source Software/learning website:

- <https://onlinecourses.swayam2.ac.in>
- <https://archive.nptel.ac.in/courses>
- <https://onlinecourses.nptel.ac.in>
- <https://www.coursera.org>

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	List and understand the concept of Biofertilizers	1 Remember 2 Understanding
CLO2	General account of the microbes used as biofertilizers	1 Remembering 2 Understanding 3 Applying
CLO3	Discuss Nitrogen fixing bacteria and its importance.	2 Understanding 3 Applying 4 Analyzing
CLO4	Mycorrhizal Biofertilizers its mechanism and uses.	1 Remembering 2 Understanding 3 Applying 4 Analyzing
CLO5	General account of microbes used as biopesticide with an example of <i>Bacillus thurengensis</i> .	3 Applying, 5 Evaluating
CLO6	Learn about the microbes used in agricultural area which helps to design a biofertilizer or biopesticide for the field	3 Applying, 6 Creating

Mapping of CLO s with POs & PSOs

Course Learning Outcomes	Program Outcomes (POs)																Program Specific Outcome (PSOs)	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	PSO1	PSO2
CLO1	1	2			1	1								3			1	3
CLO2														3			3	3
CLO3						1								3			3	3
CLO4						1								3			2	3
CLO5						1								3				3
CLO6		2	2			2								3				3

3: High, 2: Medium, 1: Low

Branch Name:	B.Sc. Microbiology
Program Code:	SC102
Course Name:	Nanobiotechnology
Course Code:	14-SEC219-2C
Pre-requisite Course:	Basic Science

Course Objectives:

- To identify and classify Microbes
- Understanding various classification scheme with details of five kingdom concept
- Knowing application and scope of microbiology in various fields

Teaching and Examination Scheme:

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
Lecture (L)	Tutorial (T)	Practical (P)	Credit	Theory (Marks)		Practical (Marks)		Total (Marks)
				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
2	-	-	2	25	25	-	-	50

Subject Contents:

Unit	Content	Lectures	Weightage
1	Basics of biology - cell, organelles and nucleic acids as genetic material. Biomacromolecules - Carbohydrates, lipids, proteins and Nucleic acids. Nanomaterial in biotechnology - nanoparticles, quantum dots, nanotubes and nanowires etc. Development of nanobiotechnology – timelines and progress, overview. Biosensors: different classes molecular recognition elements, transducing elements. Applications of molecular recognition elements in nano sensing of different analytes. Application of various transducing elements as part of nano-biosensors.	15	50 %
2	Miniaturized devices in nanobiotechnology - types and applications, lab on a chip concept. Biological nanoparticles production - plants and microbial. Nanobiotechnological applications in health and disease - infectious and chronic. Nanobiotechnological applications in Environment and food - detection and mitigation.	15	50 %

Textbooks:

- Nanotechnology in Biology and Medicine: Methods, Devices, and Applications.

Reference Books:

- .Nanobiotechnology: Concepts, Applications and Perspectives (2004), Christof M. Niemeyer (Editor), Chad A. Mirkin (Editor), Wiley VCH.
- Nanobiotechnology - II more concepts and applications. (2007) - Chad A Mirkin and Christof M. Niemeyer (Eds), Wiley VCH.

List of Open-Source Software/learning website:

<https://www.youtube.com/watch?v=dQhhcgn8YZo>

<https://www.youtube.com/watch?v=0jb3FdYeht4>

<https://www.youtube.com/watch?v=Y7tRAv-wcy4>

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	List and understand the concept of Biosensors.	1 Remembering 2 Understanding
CLO2	General account of the cell organelles as cell functioning units	1 Remembering 2 Understanding 3 Applying
CLO3	Discuss biomolecules and its importance.	2 Understanding 3 Applying 4 Analyzing
CLO4	Molecular recognition elements and various transducing elements its mechanism and uses.	1 Remembering 2 Understanding 3 Applying 4 Analyzing
CLO5	General account of s lab chip concept used as miniaturized devices.	3 Applying, 5 Evaluating
CLO6	Learn about the bionanoparticals and nanotechnology used in agricultural,environmental, food and health area which helps to disease recognition.	3 Applying, 6 Creating

Mapping of CLO s with POs & PSOs

Course Learning Outcomes	Program Outcomes (POs)																Program Specific Outcome (PSOs)	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	PSO1	PSO2
CLO1	3	3								3				2	1			
CLO2	3	3																
CLO3	3	3		3														
CLO4	3	3	3	3						3				1	1			
CLO5	3	3	3	2						3				2	2			
CLO6	3	3	3	2						3				3	3			3

3: High, 2: Medium, 1: Low

Branch Name:	B.Sc. Microbiology
Program Code:	SC102
Course Name:	Environmental Science
Course Code:	14-VAC202-2C
Pre-requisite Course:	Basic knowledge of 11-12 th Science

Course Objectives:

- To provide students with a broad interdisciplinary liberal arts framework for understanding the relationship between humans and their environment.
- To prepare students for careers, citizenship and environmental stewardship through experiential curricular and co-curricular opportunities.
- To equip students with the knowledge and skills necessary to pursue professional careers and advanced study related to the multi-faceted nature of environmental studies.
- Students by offering this course will get proper understanding of important aspects that affects environment and ecology

Teaching and Examination Scheme:

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
Lecture (L)	Tutorial (T)	Practical (P)	Credit	Theory (Marks)		Practical (Marks)		Total (Marks)
				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
2	-	-	2	25	25	-	-	50

Subject Contents:

Unit	Content	Lectures	Weightage
1	Introduction to Environment and Environmental Studies: Definition and Components of Environment, Relationship between the different components of Environment, Man and Environment relationship, Impact of technology on Environment, Environmental Degradation, Multidisciplinary nature of the Environment studies, its scope and importance in the present day Education System Ecology and Ecosystems: Introduction: Ecology- Objectives and Classification, Concept of an ecosystem- structure and functions of ecosystem Components of ecosystem- Producers, Consumers, Decomposers Bio-Geo- Chemical Cycles- Hydrologic Cycle, Carbon cycle, Energy Flow in Ecosystem, Food Chains, Food webs ,Ecological Pyramids Major Ecosystems: Forest Ecosystem, Grassland Ecosystem, Desert Ecosystem, Aquatic Ecosystem, Estuarine Ecosystem.	15	50%
2	Human Population and Environment: Population Growth, World and Indian scenario, Population and Environmental Degradation, Malthusian theory, Optimum theory, Population explosion – Causes, Effects and Control. Urbanization: Urban population growth and Environmental problems Environmental pollution: Types of Environmental Pollution: 1) Water Pollution: Introduction – Water Quality Standards, Sources of Water Pollution: Industrial, Agricultural, Municipal; Classification of water pollutants, Effects of water pollutants, Eutrophication 2)Air Pollution: Composition of air, Structure of atmosphere, Ambient Air Quality Standards, Classification of air pollutants, Sources of	15	50%

	common air pollutants like PM, SO ₂ , NO _x , Natural & Anthropogenic Sources, Effects of common air pollutants 3) Land Pollution: Land uses, Land degradation: causes, effects and control, soil erosion 4) Noise Pollution: Introduction, Sound and Noise, Noise measurements, Causes and Effects 5) Thermal Pollution: Causes and effects Role of individual in the prevention of pollution		
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List of Experiments:

Textbooks:

Textbook of Environmental Studies for Undergraduate Courses by Erach Bharucha Second edition, 2013 Publisher: Universities Press (India) Private Ltd, Hyderabad.

Reference Books:

1. Basics of Environmental Studies by Prof Dr N S Varandani, 2013 Publisher: LAP -Lambert Academic Publishing, Germany
2. Environmental Studies by Anindita Basak, 2009 Publisher: Drling Kindersley (India) Pvt. Ltd Pearson
3. Textbook of Environmental Studies by Deeksha Dave & S SKateva, Cengage Publishers.
4. Environmental Sciences by Daniel B Botkin & Edward A Keller Publisher: John Wiley & Sons.
5. Environmental Studies by R. Rajagopalan, Oxford University Press
6. Environmental Studies by Benny Joseph, TMH publishers
7. Environmental Studies by Dr. Suresh K Dhameja, 2007 Published by: S K Kataria & Sons New Delhi
8. Basics of Environmental Studies by U K Khare, 2011 Published by Tata McGraw Hill

List of Open-Source Software/learning website:

<https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=0Xvq9yUM2ILDrJ07Fv1ArQ==>

<https://nptel.ac.in/courses/120108004>

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	Use critical thinking, problem-solving, and the methodological approaches of the social sciences, natural sciences, and humanities in environmental problem solving.	3 Applying
CLO2	Demonstrate an integrative approach to environmental issues with a focus on sustainability.	2 Understanding
CLO3	Communicate complex environmental information to both technical and non-technical audiences.	2 Understanding 3 Applying
CLO4	Understand and evaluate the global scale of environmental problems.	1 Remembering 2 Understanding
CLO5	Predicting the consequences of human actions on the web of life, global economy and quality of human life.	1 Remembering 2 Understanding
CLO6	Adopting sustainability as a practice in life, society and industry.	2 Understanding

Mapping of CLO s with POs & PSOs

Course Learning Outcomes	Program Outcomes (POs)																Program Specific Outcome (PSOs)	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	PSO1	PSO2
CLO1	3	3	2											3	2			
CLO2	2	2	3											3	2			
CLO3			2							2				3	2			
CLO4	1	1	1											3	2			
CLO5														3	2			
CLO6														3	2			

3: High, 2: Medium, 1: Low

Branch Name:	B.Sc. Microbiology
Program Code:	SC102
Course Name:	Integrated Personality Development Course
Course Code:	14-VAC203-2C
Pre-requisite Course:	Zeal to Learn the Subject

Course Objectives:

- To provide students with a holistic education – focused on increasing their intelligence quotient, spiritual quotient, emotional quotient and physical quotient.
- To provide students with hard and soft skills, making them more marketable when entering the workforce.
- To educate students on their social responsibilities as citizens of India and have a greater sense of social responsibility.
- To provide students with a value-based education this will enable them to be successful in their family, professional, and social relationships by improving their moral and ethical values.
- To teach self-analysis and self-improvement exercises to enhance the potential of the participants.
- To have a broader sense of self-confidence and a defined identity

Teaching and Examination Scheme:

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
Lecture (L)	Tutorial (T)	Practical (P)	Credit	Theory (Marks)		Practical (Marks)		Total (Marks)
				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
	-	4	2	-	-	25	25	50

Subject Contents:

Unit	Content	Lectures	Weightage
1	Introduction: The Need for Values Remaking Yourself: Restructuring Yourself, Power of Habit Learning from Legends: Tendulkar & Tata From House to Home: Listening & Understanding	20	34 %
2	Facing Failures: Welcoming Challenges, Significance of Failures My India My Pride: Glorious Past - Part 1, Glorious Past - Part 2 Learning from Legends: A.P.J. Abdul Kalam Soft Skills: Networking & Leadership, Project Management	20	33 %
3	Remaking Yourself: Handling Social Media Facing Failures: Power of Faith From House to Home: Bonding the Family Selfless Service: Seva	20	33 %

Textbooks:

- IPDC Workbook-1 (Presented by B.A.P.S. Swaminarayan Sanstha)

Reference Books:

- Thomas Edison's factory burns down, New York Times Archives, Page 1, 10/12/1914
- Playing It My Way: My Autobiography, Sachin Tendulkar, Hodder & Stoughton, 2014
- The Rise of Civilization in India and Pakistan, Raymond Allchin, Bridget Allchin, Cambridge University Press, 1982
- Seven Habits of Highly Effective Teens, Sean Covey, Simon & Schuster, 2012

List of Open-Source Software/learning website:

- <https://www.youtube.com/watch?v=r6LtC1prqLs>
- <https://www.youtube.com/watch?v=oxoZW6RMspI>
- <https://www.youtube.com/watch?v=FWCTTsaR4Zg>

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	To provide students with a holistic value-based education that will enable them to be successful in their academic, professional, and social lives.	1 Remembering 2 Understanding 3 Applying
CLO2	To give the students the tools to develop effective habits, promote personal growth, and improve their wellbeing, stability, and productivity.	1 Remembering 2 Understanding 3 Applying
CLO3	To allow students to establish a stronger connection with their family through critical thinking and devolvement of qualities such as unity, forgiveness, empathy, and effective communication.	1 Remembering 2 Understanding 3 Applying
CLO4	To provide students with soft skills that complement their hard skills, making them more marketable when entering the workforce.	1 Remembering 2 Understanding 3 Applying
CLO5	To enhance awareness of India's glory and global values, and to create considerate citizens who strive for the betterment of their family, college, workforce, and nation.	1 Remembering 2 Understanding 3 Applying
CLO6	To inspire students to strive for a higher sense of character by learning from role models who have lived principled, disciplined, and value-based lives.	1 Remembering 2 Understanding 3 Applying

Mapping of CLO s with POs & PSOs

Course Learning Outcomes	Program Outcomes (POs)																Program Specific Outcome (PSOs)	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	PSO1	PSO2
CLO1							3	2	2			3	2	1		1		
CLO2							3	3				3		2	2	1		
CLO3		3		1			3	3			2	3				3		
CLO4							3	3				3			2	2		
CLO5							3					3			2	1		
CLO6	1	1					3	3	2			3	1		2			

3: High, 2: Medium, 1: Low