SOPHIA COLLEGE FOR WOMEN (EMPOWERED AUTONOMOUS)

Affiliated to

UNIVERSITY OF MUMBAI

Syllabi for the Common Courses

Based on National Education Policy 2020

Value Education Course

Course Code: VEC

F.Y.B.A. & FYBSc

2024-25 (NEP)

Programme Outline : Value Education Course
FYBA & FYBSc (SEMESTER I)

Course Code	Name of the Unit	Credits
VEC101	Indian Fables	2
VEC102	Climate Studies and Indian Literature	2
VEC103	Hindi Sahitya Mein Manviya Mulya	2
VEC104	Elements of Ecology	2
VEC105	UN Sustainable Development Goals	2
VEC106	Digital Empowerment	2
VEC107	Introduction to Energy Sources	2
VEC108	Microorganisms and Environmental Sustainability	2

Programme Outline : Skill Enhancement Course
FYBA & FYBSc (SEMESTER II)

Course Code	Name of the Unit	Credits
VEC201	Indian Fables	2
VEC202	Climate Studies and Indian Literature	2
VEC203	Hindi Sahitya Mein Manviya Mulya	2
VEC204	Elements of Ecology	2
VEC205	UN Sustainable Development Goals	2
VEC206	Digital Empowerment	2
VEC207	Environmental Science	2
VEC208	Microorganisms and Environmental Sustainability	2

ASSESSMENT DETAILS:

Continuous Assessment (50 marks)

1. A minimum of two activities will be given in each semester.
2. Each will be for 20 marks.
3. The nature of the activities will be decided by the Examiner and may include Assignment/ MCQs/ Short notes and/or any other type of /combination of objective or descriptive type activity.
4. 10 marks will be given for Class participation.

NAME OF THE COURSE	**INDIAN FABLES**
CLASS	FYBA & FYBSc
COURSE CODE	**VEC101 & VEC201**
NUMBER OF CREDITS	2
NUMBER OF LECTURES PER WEEK	2
TOTAL NUMBER OF LECTURES PER SEMESTER	30
EVALUATION METHOD	CONTINUOUS ASSESSMENT
TOTAL MARKS	50
PASSING MARKS	20

COURSE OBJECTIVES:

CO 1.	The course aims to enable students to engage critically with the notion of values as represented in the fables from the *Panchatantra* and *Hitopadesa*.
CO 2.	The course aims to help students understand the link between the prescribed texts and the cultural contexts in which they are produced and consumed.

COURSE LEARNING OUTCOMES:

CLO 1.	The learner will be able to engage critically with the notion of values as represented in the fables from the *Panchatantra* and *Hitopadesa.*
CLO 2.	The learner will be able to understand the link between the prescribed texts and the cultural contexts in which they are produced and consumed.

UNIT 1	
1.1	Introduction to *The Pańcatantra* by Viṣṇu Śarma, translated from the Sanskrit with an introduction by Chandra Rajan
1.2	stories from Book I of *The Pańcatantra* by Viṣṇu Śarma, translated from the Sanskrit with an introduction by Chandra Rajan
UNIT 2	
2.1	Introduction to *The Hitopadeśa* by Nārāyaṇa, translated from the Sanskrit with an introduction by A. N. D. Haksar
2.2	stories from Book I of *The Hitopadeśa* by Nārāyaṇa, translated from the Sanskrit with an introduction by A. N. D. Haksar

REFERENCES:

1. Alphonso-Karakala, John. B., and JOHN B. ALPHONSO-KARKALA. “Facets Of Panchatantra.” *Indian Literature*, vol. 18, no. 2, 1975, pp. 73–91. *JSTOR*, http://www.jstor.org/stable/23329777. Accessed 20 Feb. 2024.

2. Banerjee, Utpal Kumar. “The Subtle Art of Story Telling.” *Indian Literature*, vol. 52, no. 4 (246), 2008, pp. 147–52. *JSTOR*, http://www.jstor.org/stable/23347960. Accessed 20 Feb. 2024.

3. Brown, W. Norman. “The Pañcatantra in Modern Indian Folklore.” *Journal of the American Oriental Society*, vol. 39, 1919, pp. 1–54. *JSTOR*, https://doi.org/10.2307/592712. Accessed 20 Feb. 2024.

4. Buchthal, Hugo. “Indian Fables in Islamic Art.” *The Journal of the Royal Asiatic Society of Great Britain and Ireland*, no. 4, 1941, pp. 317–24. *JSTOR*, http://www.jstor.org/stable/25221796. Accessed 20 Feb. 2024.

5. Ivanovic, Christine. “Talking Animals and Politics of World Literature.” *Comparative Literature Studies*, vol. 54, no. 4, 2017, pp. 702–30. *JSTOR*, https://doi.org/10.5325/complitstudies.54.4.0702. Accessed 20 Feb. 2024.

6. Naithani, Sadhana. “The Teacher and the Taught: Structures and Meaning in the ‘Arabian Nights’ and the ‘Panchatantra.’” *Marvels & Tales*, vol. 18, no. 2, 2004, pp. 272–85. *JSTOR*, http://www.jstor.org/stable/41388713. Accessed 20 Feb. 2024.

7. Nārāyaṉa. *Hitopadeśa*. Gurgaon: Penguin Books India, 1998.

8. Sarma, Vishnu. *The Pañćatantra.* Gurgaon: Penguin Books India, 1993.

9. Singh, Dhananjay. *Fables in the Indian Narrative Tradition: An Analytical Study*. New Delhi: D. K. Printworld, 2011.

10. Upadhyaya, K. D. “A General Survey of Indian Folk Tales.” Midwest Folklore, vol. 10, no. 4, 1960, pp. 181–96. JSTOR, http://www.jstor.org/stable/4317882. Accessed 20 Feb. 2024.

NAME OF THE COURSE	**CLIMATE STUDIES AND INDIAN LITERATURE**
CLASS	FYBA & FYBSc
COURSE CODE	**VEC102 & VEC202**
NUMBER OF CREDITS	2
NUMBER OF LECTURES PER WEEK	2
TOTAL NUMBER OF LECTURES PER SEMESTER	30
EVALUATION METHOD	CONTINUOUS ASSESSMENT
TOTAL MARKS	50
PASSING MARKS	20

COURSE OBJECTIVES:

CO 1.	The course aims to enable students to interrogate the links between discussions of values and the multiple areas of concern that the field of climate studies deals with, through an analysis of Indian literary texts.
CO 2.	The course aims to enable students to understand the connections between socio-historical contexts and literary texts.
CO 3.	The course aims to train students to apply contemporary theoretical approaches to the study of cultural texts.

COURSE LEARNING OUTCOMES:

CLO 1.	The learner will be able to interrogate the links between discussions of values and the multiple areas of concern that the field of climate studies deals with, through an analysis of Indian literary texts.
CLO 2.	The learner will be able to understand the connections between socio-historical contexts and literary texts.
CLO 3.	The learner will be able to apply contemporary theoretical approaches to the study of cultural texts.

UNIT 1	
1.1	Dipesh Chakrabarty: “The Climate of History: Four Theses”
1.2	Amitav Ghosh: Selections from *The Great Derangement: Climate Change and the Unthinkable*

UNIT 2	
2.1	Janice Pariat: “Diver Myths”
2.2	Temsula Ao: “Soul-bird”
2.3	Dheeraj Sarthak: *Sundarbans: Rising Water, Ebbing Life*

REFERENCES:

1. Ambai. *A Red-necked Bird*. G J V Prasad trans. Simon & Schuster, 2021.
2. Anupama, Chingangbam. "An Eco-Critical Approach: A Study of Selected North East Indian Poets." *The Criterion: An International Journal in English* 5.2 (2014): 59-67.
3. Chakrabarty, Dipesh. "The Climate of History: Four theses." *Critical Inquiry* 35.2 (2009): 197-222.
4. Chandra, N. D. R., and Nigamananda Das. *Ecology, Myth, and Mystery: Contemporary Poetry in English from Northeast India*. Sarup & Sons, 2007.
5. Dai, Mamang. *River Poems.* Writer’s Workshop, 2013.
6. Daruwalla, Keki N. *Winter Poems*. Allied Publishers, 1980.
7. Daruwalla, Keki. *Collected Poems: 1970-2005*. Penguin UK, 2006.
8. Dikshit, Kamal Ramprit, and Jutta K. Dikshit. *North-east India: Land, People and Economy*. Dordrecht: Springer, 2014.
9. Ghosh, Amitav. *The Great Derangement: Climate Change and the Unthinkable*. Penguin UK, 2018.
10. Karmakar, Goutam. "Revisiting the Ideological Stance of Naga People: An Interview with Easterine Kire." *South Asian Review* (2021): 1-7.
11. Kerketta, Jacinta. *Land of the Roots*. Bharatiya Jnanpith, 2018.
12. Kire, Easterine. *When the River Sleeps*. Zubaan, 2014.
13. Ngangom, Robin S., and Kynpham Singh Nongkynrih, eds. *Dancing Earth: An Anthology of Poetry from North-East India*. Penguin Books India, 2009.
14. Phuritshabam, Chaoba, Shreema Ningombam, and Soibam Haripriya. *Tattooed with Taboos: An Anthology of Poetry by Three Women from Northeast India*. Partridge Publishing, 2015.
15. Roy, Basudhara. "Book Review: Eastern Muse: Poems from the East and North-East India, edited by Malsawmi Jacob and Jaydeep Sarangi." *Education as Change* 24 (2020).
16. Selvamony, Nirmal, and Rayson K. Alex. *Essays in Ecocriticism*. Osle: Sarup & Sons, 2007.
17. Singh, Parasmita. *Centrepiece: New Writing and Art from Northeast India*. Zubaan, 2018
18. *Sundarbans: Rising Water, Ebbing Life.* Directed by Dheeraj Sarthak, 2017

NAME OF THE COURSE	**हिंदी साहित्य में मानवीय मूल्य**
CLASS	FYBA
COURSE CODE	**VEC103 and VEC203**
NUMBER OF CREDITS	2
NUMBER OF LECTURES PER WEEK	2
TOTAL NUMBER OF LECTURES PER SEMESTER	30
EVALUATION METHOD	CONTINUOUS ASSESSMENT
TOTAL MARKS	50
PASSING MARKS	20

COURSE OBJECTIVES:

CO 1.	विद्यार्थियों में कविताओं के माध्यम से मानव के प्रति संवेदनात्मक भाव निर्माण करना।
CO 2.	कहानियों के माध्यम से उनमें सदाचार, त्याग, सत्यनिष्ठा, शुद्ध-आचरण एवं शुद्ध-विचार आदि नैतिक मूल्यों का विकास करना।
CO 3.	कहानियों के माध्यम से विद्यार्थियों में आदर्श चरित्रों का निर्माण, पर्यावरण संरक्षण के प्रति सजगता का निर्माण करना।
CO 4.	राष्ट्र के प्रति समर्पण भाव निर्माण करना।

COURSE LEARNING OUTCOMES:

CLO 1.	साहित्य के माध्यम से विद्यार्थियों में आदर्श मूल्यों, सामाजिक दृष्टिकोण, मानवीय संवेदना, शुद्ध-आचरण आदि मूल्यों का विकास होगा।

CLO 2.	विद्यार्थियों में पर्यावरण सरंक्षण के प्रति आत्मीय भावना निर्माण होगी।
CLO 3	विद्यार्थियों में मानव-व्यवहार, कल्पनाशीलता में वृद्धि, सामूहिक सहयोग की भावना, समस्या-समाधान तथा आत्मविश्वास में वृद्धि होगी।

इकाई 1	**कविताएँ**
1.1	स्वदेश के प्रति – सुभद्रा कुमारी चौहान
1.2	हो गई है पीर पर्वत सी पिघलनी चाहिए-दुष्यंत कुमार
1.3	पिता के जूते-अशोक वाजपेयी
1.4	पेड़ की पुकार-शम्भुनाथ सिंह
इकाई 2	कहानियाँ-
2..1	भोलाराम का जीव- हरिशंकर परसाई
2.2	उसने कहा था-चंद्रधर शर्मा 'गुलेरी'
2.3	सलाम -ओमप्रकाश वाल्मीकि
2.4	बोलने वाली औरत – ममता कालिया

<u>संदर्भ</u>

1. साहित्य सौरभ - संपादक प्रो. डॉ.सदानंद भोसले हिंदी अध्ययन मंडल, सावित्रीबाई फुले पुणे विश्वविद्यालय. पुणे

2. आधुनिक हिंदी काव्य और कवि – डॉ, सुरेश चन्द्र निर्मल, भावना प्रकाशन
3. नई कविता के प्रतिमान -लक्ष्मीकांत वर्मा- लोकभारती प्रकाशन, इलाहबाद
4. नयी कहानी की भूमिका – कमलेश्वर, शब्दकार प्रकाशन, दिल्ली
5. हिंदी कहानी का समकालीन परिदृश्य – डॉ. वेदप्रकाश अमिताभ , जवाहर पुस्तकालय, मथुरा
6. कहानी स्वरुप और संवेदना- राजेंद्र यादव , नॅशनल पब्लिशिंग हाऊज, दिल्ली

NAME OF THE COURSE	**ELEMENTS OF ECOLOGY**
CLASS	FYBA & FYBSc
COURSE CODE	**VEC104 & VEC204**
NUMBER OF CREDITS	2
NUMBER OF LECTURES PER WEEK	2
TOTAL NUMBER OF LECTURES PER SEMESTER	30
EVALUATION METHOD	CONTINUOUS ASSESSMENT
TOTAL MARKS	50
PASSING MARKS	20

COURSE OBJECTIVES

CO 1.	Impart knowledge of different components of ecosystem
CO 2.	Impart awareness about significance of coexistence of human beings with all other living organisms.
CO 3.	Emphasize the importance of wild life conservation in India

COURSE LEARNING OUTCOMES:

CLO 1.	The learner will be able to interpret the concept of ecosystem and its types
CLO 2.	The learner will be able to evaluate the interdependence and interactions between abiotic and biotic factors in the environment
CLO 3.	The learner will be able to examine the scenario of wild life conservation in India in the light of guidelines from different relevant governing agencies

UNIT 1	Basic Concepts of Ecosystem (1 Credit)
1.1	Concept of ecosystems: Definition and components
1.2	Aquatic ecosystems: Freshwater, marine and estuarine
1.3	Terrestrial ecosystems: Grassland, Forest and Desert
1.4	Food chains and food webs in ecosystems: Freshwater, grassland and marine

1.5	Ecological pyramids of energy, biomass and number
UNIT 2	Conservation of Endangered Species (1Credit)
2.1	Introduction to National Parks and Sanctuaries in India
2.2	Red data Book
2.3	Conservation Projects in India

REFERENCES:

1. Fundamentals of Ecology- E. P. Odum, Sunders Publication
2. Fundamentals of Ecology- M.C.Dash, 2nd edition, Tata McGraw Hill
3. Essentials of Ecology and Environmental Science - S.V.S Rana
4. Biodiversity- S.V.S Rana- Prentice Hall Publications
5. Ecology and Environment- P. D. Sharma, R. K. Rastogi Publications
6. Introduction to Ecology- R. Dajoz
7. Wildlife Laws and its Impact on Tribes- Mona Purohit , Deep and Deep Publications
8. Biodiversity- K. C. Agarwal- Agro Botanica Publications

NAME OF THE COURSE	**UN SUSTAINABLE DEVELOPMENT GOALS**
CLASS	FYBA & FYBSc
COURSE CODE	**VEC105 & VEC205**
NUMBER OF CREDITS	2
NUMBER OF LECTURES PER WEEK	2
TOTAL NUMBER OF LECTURES PER SEMESTER	30
EVALUATION METHOD	CONTINUOUS ASSESSMENT
TOTAL MARKS	50
PASSING MARKS	20

COURSE OBJECTIVES

CO 1.	Understand historical perspective of UN SDGs
CO 2.	Understand the UN Sustainable Development Goals (SDGs) guidelines
CO 3.	Gain in-depth knowledge of SDG 7, 12, 13, 14 and 15

COURSE LEARNING OUTCOMES:

CLO 1.	The learner will be able to highlight the significance, targets and indicators of SDGs
CLO 2.	The learner will be able to analyse the national strategies and progress of implementation of SDGs
CLO 3.	The learner will be able to reflect on case studies related to SDG 7, 12, 13, 14 and 15
CLO 4.	The learner will be able to integrate sustainable practices in daily life

UNIT 1	Theme of UN Sustainable Development Goals (SDGs) (1 Credit)
1.1	Introduction to the SDGs – History, United Nations Conference on Sustainable Development, Rio+20 and its objectives

1.2	Overview of all the 17 SDGs
1.3	Targets and Key indicators of the SDGs
UNIT 2	Case Studies (1 Credit)
2.1	SDG 7 - Affordable and Clean Energy
2.2	SDG 12 – Ensure sustainable consumption and production patterns
2.3	SDG 13 - Take urgent action to combat climate change and its impacts
2.4	SDG 14 - Conserve and sustainably use the oceans, seas, and marine resources for sustainable development
2.5	SDG 15 - Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss

REFERENCES:

1. UN: https://sdgs.un.org/goals
2. https://sdgs.un.org/goals/goal7
3. https://sdgs.un.org/goals/goal12
4. https://sdgs.un.org/goals/goal13
5. https://sdgs.un.org/goals/goal14
6. https://sdgs.un.org/goals/goal15

NAME OF THE COURSE	**DIGITAL EMPOWERMENT**
CLASS	FYBA & FYBSc
COURSE CODE	**VEC106 & VEC206**
NUMBER OF CREDITS	2
NUMBER OF LECTURES PER WEEK	2
TOTAL NUMBER OF LECTURES PER SEMESTER	30
EVALUATION METHOD	CONTINUOUS ASSESSMENT
TOTAL MARKS	50
PASSING MARKS	20

COURSE OBJECTIVES

CO 1.	To familiarize the students with the digital world.
CO 2.	To make the students aware of the necessity of digital empowerment and to make the students digitally empowered.
CO 3.	To make the students aware of the skill programmes initiated under DIGITAL INDIA
CO 4.	To make the students aware of the careers and online jobs, and of the misuse of digital skills in copywriting, hacking and cybersecurity.

COURSE LEARNING OUTCOMES:

CLO 1.	The learner will have knowledge of the digital highway and the various modes in the digital knowledge arena.
CLO 2.	The learner will know about the initiatives of Digital India programme
CLO 3.	The learner will know about the various modes of social communication advancement and careers in the digital world.
CLO 4.	The student is aware of the misuse of digital skills and is able to protect themselves from digital scams.

UNIT 1	Digital Inclusion and Digital India Programmes
1.1	Digital inclusion and digital empowerment - Purposes and challenges
1.2	Services included under Digital India: DigiLocker, E-Hospitals, e-Pathshala, BHIM, e-Kranti (Electronic Delivery of Services), e-Health Campaigns .
1.3	Government of India's public utility websites such as RTI, Health, Finance, Income Tax Filing, and Education.
UNIT 2	Communication in the Digital World
2.1	Communication and Collaboration in Cyber space- Electronic communication, including email, blogs, and social media.
2.2	Collaborative Digital platforms.
2.3	Tools and platforms for online learning.
2.4	Collaboration through file sharing, messaging, and video conferencing.

REFERENCES:

1. Digital Empowerment: A Cornerstone for eGovernance by K S Vijaya Shekhar, G P Sahu and Prabhu Gollamude
2. Understanding Digital Literacies – A Practical Introduction Routledge Books 2nd edition, 2021
3. Conflict and Cooperation in Cyberspace – The challenge to National Security Routledge Books 2nd edition, 2021
4. Cybersecurity – A Practioner's guide David Sutton BCL Learning and Development Ltd UK, 2017

Websites for Reference:

1. https://www.digitalindia.gov.in
2. https://www.meity.gov.in/cyber-surakshit-bharat-programme
3. https://www.digilocker.gov.in
4. https://www.cybercrime.gov.in
5. https://www.cybersafeindia.gov.in
6. https://www.legalserviceindia.com/legal/article-429-a-comprehensive-study-of-cyber-security-and-e-surveillance.html

NAME OF THE COURSE	**INTRODUCTION OF ENERGY SOURCES**
CLASS	F Y BSc & FYBA
COURSE CODE	**VEC107**
NUMBER OF CREDITS	2
NUMBER OF LECTURES PER WEEK	2
TOTAL NUMBER OF LECTURES PER SEMESTER	30
EVALUATION METHOD TOTAL MARKS PASSING MARKS	CONTINUOUS ASSESSMENT 50 20

COURSE OBJECTIVES:

CO 1.	Introducing basic concepts related to energy sources (fossil fuels, renewables, nuclear) and energy conversion processes.
CO 2.	Overview of energy systems, including generation, distribution, and utilization.
CO 3.	Exploring the environmental impacts (e.g., greenhouse gas emissions, pollution) and social implications (e.g., energy access, equity) associated with various energy sources.
CO 4.	Learners will be able to understand the concepts of energy efficiency and sustainability in relation to energy sources, and strategies for promoting more sustainable energy systems.

COURSE LEARNING OUTCOMES:

CLO 1.	A foundational understanding of both conventional and renewable energy sources.
CLO 2.	To analyze and contribute discussions on sustainable energy solutions for the future.

UNIT 1	Conventional Energy Sources (15 LECTURES)
1.1	Introduction
1.2	Overview of Conventional energy sources
UNIT 2	Renewable Energy Sources (15 LECTURES)
2.1	Overview of Renewable energy sources

REFERENCES:

1. Renewable Energy Resources by John Twidell & Tony Weir
2. Introduction to Energy Systems, Hany Kasban,

NAME OF THE COURSE	**ENVIRONMENTAL SCIENCE**
CLASS	FYBA & FYBSc
COURSE CODE	**VEC207**
NUMBER OF CREDITS	2
NUMBER OF LECTURES PER WEEK	2
TOTAL NUMBER OF LECTURES PER SEMESTER	30
EVALUATION METHOD	CONTINUOUS ASSESSMENT
TOTAL MARKS	50
PASSING MARKS	20

COURSE OBJECTIVES

CO 1.	To get sensitized about the various types of pollution and their impact on the environment
CO 2.	To understand the concept of climate change and its effects

COURSE LEARNING OUTCOMES:

CLO 1.	The learner will be able to relate the types of pollution with their effects on the environment
CLO 2.	The learner will be able to understand the concept of climate change and the steps taken to mitigate its detrimental effects

UNIT 1	Pollution (1 Credit)
1.1	Air Pollution 1.1.1: Types and sources of air pollutants 1.1.2: Effects of air pollution on organisms, its control and abatement measures
1.2	Water Pollution 1.2.1: Types and sources of water pollutants

	1.2.2: Effects of water pollution on organisms, biomagnification, its control and abatement measures
1.3	Pollution by solid wastes 1.3.1: Types and sources 1.3.2: Effects of solid waste pollution, its control and abatement measures
1.4	Sound pollution 1.4.1: Different sources of sound pollution 1.4.2: Effects of sound pollution on organisms, its control and abatement measures
UNIT 2	Climate Change (1 Credit)
2.1	Biogeochemical cycle – Water, Oxygen, Nitrogen, Carbon dioxide, Sulphur, Phosphorus
2.2	Effect of anthropogenic activities on biogeochemical cycles
2.3	Impact of pollution on climate
2.4	Actions taken to mitigate effects of climate change – UN, carbon credits, carbon footprints, e-vehicles, CSR initiatives

REFERENCES:

1. Bhatia, S.C., Text book of Air pollution and its control, Atlantic publication.
2. Sharma, P.D., Ecology and environment, Rastogi publication.
3. Sharma, B.K. and Kaur, An introduction to environmental pollution, Goel publishing.
4. Khopkar, Environmental pollution analysis, New Age International (P) Ltd.
5. Benny Joseph, Environmental studies, Tata Mc Graw Hill publication.
6. Clark, R.S., Marine pollution, Clanderson press, Oxford.
7. Day, A.K., Environmental chemistry, Willey Eastern Pvt. Ltd.
8. Bharucha Erach, Text book of environmental studies for UG Course, University Press.
9. Cunningham W.P., M.A. Cunningham & B.W. Saigo, Environment Science, McGraw Hill

NAME OF THE COURSE	**MICROORGANISMS AND ENVIRONMENTAL SUSTAINABILITY**
CLASS	FYBA & FYBSc
COURSE CODE	**VEC108 & VEC208**
NUMBER OF CREDITS	2
NUMBER OF LECTURES PER WEEK	2
TOTAL NUMBER OF LECTURES PER SEMESTER	30
EVALUATION METHOD	CONTINUOUS ASSESSMENT
TOTAL MARKS	50
PASSING MARKS	20

COURSE OBJECTIVES:

CO 1.	To provide students with an understanding of the diversity of microbial cells and their roles in different environments.
CO 2.	To educate students on the methods and technologies used in sewage and solid waste treatment, with a focus on the role of microorganisms.
CO 3.	To examine the impact of microorganisms on climate change, particularly their role in greenhouse gas sequestration and biofuel production.
CO 4.	To analyze the contributions of microorganisms to environmental sustainability through waste management and clean energy solutions

COURSE LEARNING OUTCOMES:

CLO 1.	The learner will be able to describe the types of microbial cells and their diverse roles in natural environments.
CLO 2.	The learner will be able to describe the role of microorganisms in sewage treatment and the decomposition of solid waste.
CLO 3.	The learner will be able to list the causes of global warming, including the role of greenhouse gases and how microorganisms can sequester greenhouse gases
CLO 4.	The learner will be able to define biofuels and explain the production processes and sustainability of microbial biofuels like bioethanol and biodiesel.

UNIT 1	**Microorganisms and waste management**
1.1	Introduction to Microorganisms a. Microbial cells and diversity b. Microorganisms and their environments c. Microorganisms and environment sustainability
1.2	Waste management a. Sewage treatment i. Impact of raw sewage on receiving water and public health ii. Key steps in domestic sewage treatment iii. Design of a typical sewage treatment plant iv. Role of microorganisms in sewage treatment (overview of activated sludge process, trickling filter and oxidation ponds) b. Solid waste treatment – composting
UNIT 2	**Microorganisms and climate change**
2.1	Global warming a. Global temperature rise b. Causes of global warming c. Greenhouse gases d. Sources of Greenhouse gases e. Impact of Greenhouse gases on environment f. Sequestration of Greenhouse gases by microorganisms
2.2	Clean fuels- Biofuels a. Definition b. Generations of biofuels c. Microbial biofuels i. Bioethanol ii. Biodiesel

REFERENCES:

1. Madigan, M. T., Martinko, J. M., & Bender, K. S. (2018). *Brock Biology of Microorganisms*. Pearson.
2. Choudhary, D. K., Mishra A., & Varma A. (2021) Editors Climate Change and the Microbiome Sustenance of the Ecosphere, Springer.
3. Aneja K.R., Jain P. & Aneja R. (2008). A Textbook of Basic and Applied Microbiology, New Age International Publishers.
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Additional resources

1. https://youtu.be/OVWZyDz--30
2. https://youtu.be/1TmHlcMDIOQ
3. 3.https://www.ted.com/talks/penny_chisholm_the_tiny_creature_that_secretly_powers_the_planet?utm_campaign=tedspread&utm_medium=referral&utm_source=tedcomshare
4. 4.https://www.ted.com/talks/karen_lloyd_the_mysterious_microbes_living_deep_inside_the_earth_and_how_they_could_help_humanity