Dr. Vishwanath Karad
MIT WORLD PEACE UNIVERSITY | PUNE
TECHNOLOGY, RESEARCH, SOCIAL INNOVATION & PARTNERSHIPS

COURSE STRUCTURE

Course Code	SCI105B			
Course Category	Basic Science			
Course Title	Biology for Engineers			
Teaching Scheme and Credits	**Lectures**	**Tutorial**	**Laboratory**	**Credits**
Weekly load hrs	03 hours	--	--	02+00+00=02

Pre-requisites: HSC (Science), 12th Std CBSE/ICSE, Biology till 10th Std.

Course Objectives:

To equip the student with an appreciation for the interface between technology and the life sciences.

To communicate the relevance and importance of biology for engineering.

To acquaint the student with the influence of Physical, Chemical and Mathematical principles in the context of development of biology.

To emphasize the importance of interdisciplinary aspect of biology.

Course Outcomes:

After learning Biology, the engineering students shall demonstrate ability to:

1) to compare the approaches of science and engineering with reference to biology (Cognitive Level-II).
2) be able to apply the Physical, Chemical and Mathematical principles to predict the behavior of biological unit, systems and processes (CL-II).
3) to identify complexity and conservative and redundant approach of Life and biological processes at different levels from molecule to organism (CL-III).
4) to relate biological processes, adaptation, optimization, coordination and hierarchy and their technical aspects as engineering systems (CL-III).
5) to apply knowledge of scaling factors to predict structure, function, organization of biological systems across all levels (CL-IV)
6) to illustrate application of specific biological systems and processes in emerging frontiers of engineering, technology and vice versa (CL-III).

Course Contents:

Characteristics and purposes of Science and Engineering: Difference between scientific and engineering approaches to the study of Biology.

Principles from the Sciences: Cellular, molecular and elemental building blocks; The principles of Physics, Chemistry and Mathematics in understanding particular biological responses.

Principles of Biology: Cellular anatomy and physiology, Form and function. Modularity and incremental change; Genetic Basis, genetic code. Competition and Selection; Biological Hierarchies.

Biological responses in context: Need for water, oxygen, nutrients, heat sources and sinks; Adapting and responding to environments; Optimized use of resources.

Scaling factors: Allometric relationships; Fractal scaling within an organism. Self-similarity, control and stability.

Relationship between biology and engineering: Bionics, Biomimetics, Biomechanics, Biotechnology, Nanobiotechnology, Computational Biology, Bioprocess Engineering, Biomedical engineering.

Laboratory Exercises / Practical:

NIL

Learning Resources:

Reference Books:

1. Arthur T. Johnson, Biology for Engineers, CRC Press, 2010
2. Michael M. Domach, Introduction to Biomedical Engineering, Pearson Education India, 2nd Edition, 2015

Web Resources:

https://ocw.mit.edu/courses/biology/

MOOCs: Online courses for self-learning

https://www.edx.org/course/subject/biology-life-sciences

https://ocw.mit.edu/courses/biological-engineering/

http://nptel.ac.in/courses/121106008/

Supplementary Reading:

1. Jane B Reece, Lisa A Urry, Michael L Cain, Peter V Minorsky, Robert B Jackson. Campbell's Biology, Pearson, 10th Edition, 2010
2. Y C Fung. Introduction to Bioengineering, World Scientific, 2001
3. Current research articles and literature shared in the class

Pedagogy:

- Lectures through Co-teaching approach
- Power point presentations
- Videos

- Systematic use of group work and project-based learning

<u>Assessment Scheme</u>:

Class Continuous Assessment (CCA): 50 marks

Assignments	Test	Presentations (Group activity)	Case study	MCQ	Oral	Any other (Attendance and initiative)
15/50 marks (30%)	15/50 marks (30%)	15/50 marks (30%)	--	--	--	5/50 marks (10%)

Term End Examination: 50 marks

Syllabus:

Module No.	Contents	Workload in Hrs		
		Theory	Lab	Assess
1	**Characteristics and purposes of Science and Engineering:** Difference between scientific and engineering approaches to the study of Biology; The value of scientific models; Biological Engineering;	2	--	--
2	**Principles from the Sciences:** Cellular, molecular and elemental building blocks of living systems; The principles of Physics, Chemistry and Mathematics governing biological structure, function and responses.	6	--	--
3	**Principles of Biology:** Origins and divergence of basic cell types; Genetic Basis, genetic code; Biological Hierarchies; Form and function: from molecular to organism level. Modularity and incremental change; Competition and Selection.	6	--	--
4	**Biological responses in context:** Need for water, oxygen, nutrients, heat sources and sinks; Optimized use of resources; Effect of toxic substances and waste products; Adaptation and response to environments, chemical and mechanical stresses; Communication.	6	--	--
5	**Scaling factors:** Allometric relationships; Dimensional analysis. Golden ratio. Fractal scaling within an organism. Self-similarity of tissues and organs; Control and stability.	4	--	--
6	**Relationship between biology and engineering**: Systems approach; Bionics; Biomimetics; Biomechanics, Biotechnology; Nanobiotechnology, Computational Biology, Bioprocess Engineering, Biological engineering; Biomedical engineering.	6	--	--

Prepared by	Checked by		Approved by
	Head		
School of Biology MIT WPU	School of Biology MIT WPU	BoS Chairman MIT WPU	Associate Dean, Science MIT WPU