<table>
<tr><td>Course Title</td><td>Bio-inspired Design</td><td>Course No</td><td colspan="3">To be filled by the office</td></tr>
<tr><td>Specialization</td><td>Design (INT)</td><td>Structure (IPC)</td><td>3</td><td>0</td><td>3</td></tr>
<tr><td>Offered for</td><td>UG/PG/DD/PhD</td><td>Status (Core / Elective)</td><td colspan="3">Elective</td></tr>
<tr><td>Prerequisite</td><td>Concepts in engineering design</td><td>To take effect from</td><td colspan="3">January 2019</td></tr>
<tr><td>Course Objectives</td><td colspan="5">This course intended to give the student the exposure of bio-inspired design principles. Train the student in applying the bio-inspired methodologies for innovation. Introducing the student with different perspectives of bio-inspired design. Enlighten the future scope of this valuable domain.</td></tr>
<tr><td>Course Outcomes</td><td colspan="5">After completion of this course, the student is able to:
1. Describe methods for creative design,
2. Identify mechanical working principles of biological phenomena - explain their construction, motion, and/or processing mechanisms - formalize the essence of these mechanisms in models - derive non-conventional design principles from these models,
3. Implement these design principles in innovative technical devices - summarize the transition process from the biological to the mechanical domain - present their design in drawings and working models.</td></tr>
<tr><td>Contents of the course</td><td colspan="5">1. Introduction (6)
Basic principles, building blocks, material property charts, how the study of nature’s designs can help engineers, examples of successful biomimetic designs.
Mechanical design – hierarchical construction, bio-composites, structure & properties of bamboo, silks, bones, teeth, shells, antlers and beaks, impact resistance, fracture mitigation, damping, self-healing.
2. The Bio Inspired Design Approach (4)
Finding the biological information, Dealing with friction, Innovative designing with ACRREx (Abstracting, Categorizing, Reflecting, Reformulating and Extending) method.
3. Bio-inspired Design Methodology (5)
Problem solving, TRIZ, Innovation and efficiency, functions, Integration between biology design and innovation, methodology chart.
4. Bio-Designing Perspectives
• Materials and surfaces: Muscles and artificial muscles, lotus effect, gecko adhesion, Desert beetle, pitcher plants, bio-fouling, coatings. Silver ant and heat dissipation, insulation of fur and feathers, constructal theory. (6)
• Sensors: Biological sensors, Bio-inspired sensors. (4)
• Control: Neural control, Robot controllers, Running, Robustness, Crawling - Soft robotics, Gliding & Flapping flight, Swimming. (4)
• Bio-optics – structural colors, compound eyes, antireflection, stealth, imaging (5)
• Navigation – short & long range navigation techniques of bees, ants, turtles & migratory birds. (4)
• Bioconstruction: Mechanical stiffness and motion,
Hydrostatic stiffness and motion. (2)
• Biopropulsion: Macroscale walking, Macroscale flying. (2)

Bio-inspired design task</td></tr>
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Textbook	1. Yoseph Bar-Cohen, **Biomimetics: Nature-Based Innovation**, CRC Press, 2016 2. Ashok K G, Daniel A McAdams, Robert B. Stone, **Biologically inspired designs: computational methods and tools,** Springer London, 2013. 3. Lakhtakia A, Martin-Palma RJ (eds); **Engineered biomimicry**; Elsevier, 2013
References	1. Reich Y, **A critical review of General Design Theory**. Research in Engineering Design, 7 (1) 1-18 (1995). 2. Maria G. Trotta, **Bio-inspired Design Methodology**, International Journal of Information Science 1(1), pp 1-11 (2011).