Total No. of Questions: 6 *Total No. of Printed Pages:2*

Enrollment No.....

Faculty of Engineering
End Sem Examination May-2024
RA3EL15 Bio-Inspired Robotics

Programme: B.Tech. Branch/Specialisation: RA

Duration: 3 Hrs. **Maximum Marks: 60**

Note: All questions are compulsory. Internal choices, if any, are indicated. Answers of Q.1 (MCQs) should be written in full instead of only a, b, c or d. Assume suitable data if necessary. Notations and symbols have their usual meaning.

Q.1 i. Bio-inspired morphologies in robots draw inspiration from: **1**
(a) Mechanical structures (b) Biological organisms
(c) Industrial machinery (d) Digital algorithms

ii. Which of the following is NOT considered a bio-inspired sensor? **1**
(a) Vision (b) Touch (c) Radar (d) Smell

iii. Which of the following is a mode of locomotion typically seen in bio-inspired robots? **1**
(a) Teleportation (b) Rolling
(c) Time travel (d) Quantum tunneling

iv. Wall climbing robots are inspired by the locomotion of: **1**
(a) Sloths (b) Fish (c) Snakes (d) Geckos

v. Structural differences between hard and soft robots primarily lie in their: **1**
(a) Weight (b) Flexibility (c) Color (d) Size

vi. Muscular hydrostats are commonly found in: **1**
(a) Rocks (b) Jellyfish (c) Plants (d) Human muscles

vii. Behavior-based robotics focuses on: **1**
(a) Centralized control (b) Distributed control
(c) Randomized control (d) Static control

viii. Bio-inspired robot design considering load-bearing and kinematic ontogeny is inspired by: **1**
(a) Bees (b) Elephants (c) Sea turtles (d) Tigers

ix. Collective robotics emphasizes: **1**
(a) Individual behavior (b) Group behavior
(c) Hierarchical control (d) Singular decision-making

x. Energetic anatomy in robotics refers to: **1**
(a) Efficiency of movement (b) Source of power
(c) Structure of limbs (d) Heat dissipation

Q.2 i. Can you list the different types of bio-inspired sensors? **2**
ii. What are the key differences between traditional robots and biologically-inspired robots? **3**
iii. Explain the concept of morphologies in bio-inspired robots. **5**
OR iv. Propose a design for a bio-inspired robot for rescue operations. **5**

Q.3 i. Define bio-inspired actuator. **2**
ii. Compare and contrast the modes of movement in bio-inspired robots. What are the advantages and limitations of each mode? **8**
OR iii. Develop a bio-inspired robot capable of navigating various terrains. **8**

Q.4 i. Discuss the differences between hard and soft robots. **3**
ii. Explain how shape memory alloy can be integrated in robotic system, leveraging their unique properties to enhance functionality and performance. **7**
OR iii. Evaluate the effectiveness of artificial muscles in enhancing the movement, manipulation tasks and flexibility of robotic systems. **7**

Q.5 i. Can you explain the different types of learning approaches used in robotics, such as supervised learning and unsupervised learning? **4**
ii. Explain the bio-inspired sea turtle robot, considering its navigation and interaction with underwater environments. **6**
OR iii. Explain the concept of behaviour-based robot with a case study. **6**

Q.6 Attempt any two:
i. Evaluate the importance of understanding energetic anatomy in the design of bio-inspired robots. **5**
ii. Discuss the concept of a biohybrid robot to achieve a specific task. **5**
iii. Explain the swarm - bio-inspired robots to accomplish a collective goal. **5**

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Marking Scheme

RA3EL15 (T) Bio-Inspired Robotics

Q.1	i)	B		**1**
	ii)	C		**1**
	iii)	B		**1**
	iv)	D		**1**
	v)	B		**1**
	vi)	D		**1**
	vii)	B		**1**
	viii)	C		**1**
	ix)	B		**1**
	x)	B		**1**
Q.2	i.	Can you list the different types of bio-inspired sensors? types of bio-inspired sensors – 2 Marks		**2**
	ii.	What are the key differences between traditional robots and biologically-inspired robots? traditional robots – 1.5 Marks biologically-inspired robots– 1.5 Marks		**3**
	iii.	Explain the concept of morphologies in bio-inspired robots. morphologies in bio-inspired robots - 5 Marks		**5**
OR	iv.	Propose a design and provide brief explanation for a bio-inspired robot for rescue operations. Drawing – 3 Marks Description– 2 Marks		**5**
Q.3	i.	Define bio-inspired actuator. Definition – 2 Marks		**2**
	ii.	Compare and contrast the modes of movement in bio-inspired robots. What are the advantages and limitations of each mode? Various modes of movement in bio-inspired robots. – 4 Marks Advantages of each mode – 2 Marks Limitations of each mode – 2 Marks		**8**
OR	iii.	Develop a bio-inspired robot capable of navigating various terrains. Drawing – 4 Marks Description– 4 Marks		**8**
Q.4	i.	Discuss the differences between hard and soft robots Hard robots – 1.5 Marks Soft Robots – 1.5 Marks		**3**
	ii.	Explain how shape memory alloy can be integrated in robotic system, leveraging their unique properties to enhance functionality and performance. Concept of shape memory alloy – 4 Marks unique properties and performance of shape memory alloy – 3 Marks		**7**
OR	iii.	Evaluate the effectiveness of artificial muscles in enhancing the movement, manipulation tasks and flexibility of robotic systems. Concept of artificial muscles – 4 Marks Functionality of artificial muscles – 3 Marks		**7**
Q.5	i.	Can you explain the different types of learning approaches used in robotics, such as supervised learning and unsupervised learning? supervised learning Robot – 2 Marks Unsupervised learning Robot – 2 Marks		**4**
	ii.	Explain the bio-inspired sea turtle robot, considering its navigation and interaction with underwater environments. Concept of sea turtle robot – 3 Marks Functionality of sea turtle robot – 3 Marks		**6**
OR	iii.	Explain the concept of behaviour-based robot with a case study. concept of behaviour-based robot – 3 Marks Case Study – 3 Marks		**6**
Q.6		Attempt any two:		
	i.	Evaluate the importance of understanding energetic anatomy in the design of bio-inspired robots. Concept of energetic anatomy in robot – 2 Marks Functionality of energetic anatomy in robot – 3 Marks		**5**
	ii.	Discuss the concept of a biohybrid robot to achieve a specific task. concept of a biohybrid robot – 2 Marks Explanation – 3 Marks		**5**
	iii.	Explain the swarm - bio-inspired robots to accomplish a collective goal. Concept of a Collective robot – 2 Marks Explanation of Swarm Robot– 3 Marks		**5**

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