AMITY UNIVERSITY
KOLKATA

FORMAT FOR COURSE CURRICULUM

L	T	P/S	SW/FW	No. of PSDA	TOTAL CREDIT UNITS
3	0	0	0	0	3

Course Title: Principles of Robot Autonomy **Credit Units: 3**

Course Level: **UG** **Course Code:**

Course Objectives: The goal of the course is to familiarize the students with the concepts and techniques in robotic engineering and incorporate robotic technology in engineering systems. To make the students acquainted with the theoretical aspects of Robotics and enable them to acquire practical experience in the field of Robotics through design projects and case studies to understand the importance of robots in various fields of engineering to develop simple robot control systems integrating perception, planning, and actions.

Pre-requisites: (i) Linear Algebra
(ii) Probability Theory
(iii) Machine Vision and Image Processing
(iv) AI/ ML/ DL
(v) Sensor Technology

Course Contents/Syllabus:

	Weightage (%)
Module I	**20%**
Descriptors/Topics : Introduction to Robotics and Fundamentals • Robot classification with respect to geometrical configuration(anatomy) • Co-ordinate systems • Work envelope • Advantages and Disadvantages of Robot • Specifications • Joint Notations • Speed of Motions • Robot operating system (ROC) • Robotics parts and functions	
Module II	**20%**

Descriptors/Topics : Robot Drive Systems and End Effectors • Pneumatic Drives • Hydraulic Drives • Mechanical Drives • Electrical Drives • D.C. Servo Motors, Stepper Motors • A.C. Servo Motors-Salient Features • Applications and Comparison of all these Drives • End Effectors • Types of Grippers • Gripper mechanisms • Selection and Design Considerations	
Module III	**20%**
Descriptors/Topics : Sensor and Machine vision • Robotics sensor and introduction to computer vision • Camera models & camera calibration • Stereo vision and Requirements of a sensor • Non-optical position sensors, • Optical. Position sensors, • Velocity sensors, • Proximity sensors, • Contact and non-contact type, • Touch and slip sensors, • Force and torque sensors.	
Module IV	**20%**
Descriptors/Topics : Image Processing, Feature Detection, Feature Description in Robotics Application • Information extraction and Classic visual Recognition • Spatial transformations • Homogeneous coordinates • Homogeneous transformation and manipulator • Forward solution, inverse solution, motion generation,	
Module V	**20%**
Descriptors/Topics : Robot Control with Programming and Applications • Robot controls, Point to point control, Continuous path control • Intelligent robot, Control system for robot joint • Control actions, Feedback devices • Encoder, Resolver, LVDT,	

• Motion Interpolations, Adaptive control • Computational elements in robotic applications • Robot programming - sample programs, path planning, obstacle avoidance • AI and robotics • The future of robotics.	

Course Learning Outcomes:

- Model forward and inverse kinematics of robot manipulators to provide each student with an exposure to kinematic problems involving robot manipulators and mobile robots.
- Understand the basic components of robots.
- Familiarize with the most common robot sensors and understand fundamental sensor processing algorithms and their engineering trade-offs to design intelligent robots using sensors.
- Explore the computational challenges inherent in fundamental mobile robotic tasks (e.g. localization, mapping, motion planning).
- Providing solutions to various engineering problems through the interpretation of data using modern computational tools.
- Functioning competently as an individual and as a part of multi-disciplinary teams.
- Differentiate types of robots and robot grippers.
- Analyze forces in links and joints of a robot.
- Programed a robot to perform tasks in industrial applications.
- Apply and evaluate various mining models/algorithms with respect to model's accuracy.
- Use current techniques, skills and tools necessary for computing practice.

Pedagogy for Course Delivery:

The class will be taught using theory and case based method. In addition to assigning the case studies, the course instructor will spend considerable time in understanding the concept of innovation through the eyes of the consumer. The instructor will cover the ways to think innovatively liberally using thinking techniques such as:

- Online case based presentation with problem solving approach.
- Reviewing relevant, previously-learned topics.
- Presenting the new information by linking it to previous case studies.
- Providing learning guidance and assignments.
- Providing time for practice, problem solving sessions and feedback.
- Taking tests and quiz on a regular basis.
- Delivery of course will be covered using E-content based on 4-Quadrant approach.

List of Professional Skill Development Activities (PSDA):

NILL

Lab/ Practicals details, if applicable:

List of Experiments:

- **NA**

Assessment/ Examination Scheme:

Theory L/T (%)	Lab/Practical/Studio (%)
100%	NA

Theory Assessment (L&T):

Continuous Assessment/Internal Assessment 40%					End Term Examination 60%
Components (Drop down)	Attendance	Class Test	HA	Quiz	EE
Weightage (%)	5	15	10	10	60

Lab/ Practical/ Studio Assessment:

	Continuous Assessment/Internal Assessment (____ %)				End Term Examination (____ %)		
Components (Drop down	NA	NA	NA	NA	NA	NA	NA
Weightage (%)							

Text Reading:

- Mikell P Groover, Nicholas G Odrey, Mitchel Weiss, Roger N Nagel, Ashish Dutta, “Industrial Robotics, Technology programming and Applications", McGraw Hill, ISBN 13 9780070249899
- Klafter R.D., Chmielewski T.A and Negin M., Robotic Engineering – An Integrated Approach, Prentice Hall, ISBN-13 978-0134687520
- John Craig, “Introduction to Robotics, Mechanics and Control”, Pearson Education, ISBN-13 9780201543629
- James A Rehg, “Introduction to Robotics in CIM Systems”, Prentice Hall of India, ISBN-13 978-0130602435

References:

- Richaerd D Klafter, Thomas Achmielewski and Mickael Negin, “Robotic Engineering - An Integrated Approach”, Prentice Hall India, New Delhi, ISBN-13 978-0134687520
- Shiman Y Nof, “Handbook of Industrial Robotics”, John Wiley & Sons, New York, ISBN 0-13-123629-6

Additional Reading:

- https://www2.cs.duke.edu/courses/fall15/compsci590.1/
- http://asl.stanford.edu/aa274/

Any other Study Material:

- Video Material of NPTEL