UNIVERSITY OF TORONTO INSTITUTE FOR AEROSPACE STUDIES
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ROBOTICS (AER 525F) COURS SCHEDULE (Fall 2022)

Week	Date	Lecture	Subject	Laboratory	Tutorial
1	MON 09/12	1 & 2	***Introduction*** ➢ Course Outline ➢ Goals and Objectives ➢ History of Robotics ➢ Applications ➢ Manipulator Degrees of Freedom ➢ Robotic System Components ➢ Robot Joint and Arm Structure ➢ Classification of Robots		
	WED 09/14	3 & 4	***Introduction*** ➢ Manipulator Wrist Mechanisms ***Kinematics*** ➢ Position and Orientation ➢ Rotation Matrix ➢ Cascade of Rotations ➢ Euler and RPY Representations		Lecture (cntd.)
2	MON 09/19	5 & 6	***Kinematics*** ➢ Euler and RPY Representations ➢ Coordinate Transformation ➢ Homogeneous Transformation Operator ➢ Cascade of Transformations		
	WED 09/21	7	***Forward Kinematics*** ➢ Links & Joints: Numbers and Parameters ➢ Standard Denavit-Hartenberg Convention		Coordinate Transformation Examples
3	MON 09/26	8 & 9	***Forward Kinematics*** ➢ Examples ➢ Forward Kinematics Formulation ➢ Modified Denavit-Hartenberg Convention ➢ Computational Algorithm		
	WED 09/28	10	***Inverse Kinematics*** ➢ Manipulator Solvability		Forward Kinematics Examples
4	MON 10/03	11 & 12	***Inverse Kinematics*** ➢ Manipulator Workspace ➢ Algebraic Solution ➢ Example	A: Lab #1	
	TUE 10/04			B: Lab #1	
	WED 10/05	13	***Inverse Kinematics*:** ➢ Geometric Solution ➢ Example ➢ Repeatability and Accuracy		Inverse Kinematics Examples
5	MON 10/10	***THANKSGIVING DAY***			

	TUE 10/11			**D: Lab #1**	
	WED 10/12	**14**	***Differential Kinematics*** ➢ **Differentiation of Vectors and Matrices** ➢ **Differentiation of Rotation Matrix**		**Differential Kinematics Examples**
6	**MON 10/17**	**15 & 16**	***Differential Kinematics*** ➢ **Differentiation of Transformation Matrix** ➢ **Jacobian** ➢ **Formulation of Manipulator Jacobian**	**C: Lab #1**	
	TUE 10/18			**B: Lab #2**	
	WED 10/19	**17**	***Differential Kinematics*** ➢ **Formulation of Manipulator Jacobian**		**Differentiation Examples**
7	**MON 10/24**	**18 & 19**	***Differential Kinematics*** ➢ **Singularity** ➢ **Redundancy** ***Statics*:** ➢ **Transformation of Forces and Moments**	**A: Lab #2**	
	TUE 10/25			**D: Lab #2**	
	WED 10/26	**20**	***Statics*:** ➢ **Transformation of Forces and Moments** ➢ **Manipulator Static Relationship**		**Manipulator Jacobian and Singularity Examples**
	INTERIM COURSE SURVEY				
8	**MON 10/31**	**21 & 22**	***Statics*** ➢ **Duality Concept** ➢ **Manipulator Stiffness**	**C: Lab #2**	
	TUE 11/01			**B: Lab #3**	
	WED 11/02	***MID-TERM TEST***			
9	**11/07-11**	***STUDY BREAK***			
10	**MON 11/14**	**23 & 24**	***Dynamics*** ➢ **Rigid Body Dynamics** ➢ **Manipulator Inverse Dynamics**	**A: Lab #3**	
	TUE 11/15			**D: Lab #3**	
	WED 11/16	**25**	***Dynamics*** ➢ **Newton-Euler Formulation**		**Mid-term Solutions**
11	**MON 11/21**	**26 & 27**	***Dynamics*** ➢ **Newton-Euler Formulation** ➢ **Example** ➢ **Lagrangian Approach**	**C: Lab #3**	
	TUE 11/22			**B: Lab #4**	
	WED 11/23	**28**	***Controls*** ➢ **Motion Control**		**Manipulator Dynamics Examples**

12	**MON 11/28**	**29 & 30**	***Controls*** ➢ **Trajectory Generation** ➢ **Joint Actuator Dynamics** ➢ **Independent Joint Servo Control**	**A: Lab #4**	
	TUE 11/29			**D: Lab #4**	
	WED 11/30	**31**	***Controls*** ➢ **Model-Based Motion Control**		**Controls Examples**
13	**MON 12/05**	**32 & 33**	***Controls*** ➢ **Force Control** ***Design*** ➢ **Task-Based Design** ➢ **Kinematic Configuration**	**C: Lab #4**	
	WED 12/07	**34**	***Design*** ➢ **Workspace Attributes** ➢ **Actuation Schemes** ➢ **Sensor Specifications**		**Course Review**
FINAL EXAMINATION					