BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, Pilani
Pilani Campus
AUGS/ AGSR Division

SECOND SEMESTER 2020-21
COURSE HANDOUT

Date: 17.01.2021

In addition to part I (General Handout for all courses appended to the Time table) this portion gives further specific details regarding the course.

Course No. **: BITS F441**

Course title **: ROBOTICS**

Instruction-in-charge **: B.K. ROUT**

1. Scope and Objective of the course

Robotics is an interdisciplinary area ranging from mechanical & electrical component design to advanced sensor technology, incorporating computer systems and Artificial Intelligence (AI). With advances in AI-techniques & computational power in recent years, it has become one of the most interesting areas for multidisciplinary research, with lots of commercial applications already in market.

The included subject matter, aims at developing thorough understanding of Robotics & its applications in a unified and coherent manner; preparing students of engineering discipline for industries' requirements and applied research in the field. It will also make students capable of handling robot manipulator tasks in real, as well as in simulation environment.

2. Text Book:

T1. Mittal, R.K. and Nagrath, I.J., *Robotic and Control*, Tata McGraw Hill, New Delhi, 2003.

Reference Books:

a) Fu, K.S., Gonzalez, R.C., and Lee, C.S.G., *Robotics Control, Sensing, Vision and Intelligence*, McGraw Hill, 1988.
b) Craig, J.J., *Introduction to Robotics*: *Mechanism & Control.* Addison Wesley, 1986.
c) Paul, R.P., *Robot Manipulator*: *Mathematics Programming & Control.* MIT Press, 1981.
d) Groover, M.P., *Industrial Robotics Technology, programming & Application*, McGraw Hill, 1986
e) Siegwart, R. , Nourbakhsh, I.R. , Scaramuzza, D., Introduction To Autonomous Mobile Robots, 2nd Edition, PHI, New Delhi

3. Journals to be Referred:

a) IEEE Trans. Robotics & Automation.
b) IEEE Trans. System Man & Cybernetics
c) IEEE Trans. Automatic Control
d) International Journal of Robotics Research
e) ASME Trans. on Dynamics Measurement & Control.
f) ASME Trans. on Mechanical Design
g) ROBOTICA
h) Robotics and computer Integrated Manufacturing

4. Course Plan

Topic	No of Lectures	Text Book Chapter reference	Learning outcome
1. Introduction	2	Chapter 1	To know the state of the art development in the areas of Robotics
2. Transformations and Mapping	4	Chapter 2	To understand and apply the Linear Algebra to transform and map the description of the object in 3D space from one frame of description to another. Exposure to rigid body mechanics.
3. Forward Kinematics	5	Chapter 3	To learn the methods to develop kinematic models of Industrial Manipulator working in 3D workspace. (Application of DH Algorithm)
4. Inverse Kinematics	2	Chapter 4	To learn and apply the methods learnt to change the description available in Workspace to Joint space.
5. Differential Kinematics and Statics	6	Chapter 5	Develop the mathematical models to obtain the velocity and angular velocity of end-effector which performing a task and vice versa.
6. Dynamics	4	Chapter 6	Develop and apply the methods learnt to develop forward and Inverse dynamic model of manipulator.
7. Trajectory Planning	3	Chapter 7	Learn and develop the methods to develop trajectories to perform a task in workspace.
8. Sensors & Actuators	3	Chapter 6 (Ref. Book : Fu,Lee)	To understand the technologies involved in design of sensors and Actuators.
9. Robot Manipulator Control for motion	6	Chapter 10 (Ref. Book : Fu,Lee) Chapter 5 (Ref. Book : Fu, Lee)	To learn the methods required to control the joints of manipulator. How to design feedback and feedforward controllers.

Topic	No of Lectures	Text Book Chapter reference	Learning outcome
10. Mobile Robotics (Kinematics and Dynamics) & Navigation.	4	TEACH your Instructor	Learn the design aspect of mobile robots
11. Laboratory Classes (CRIS) for Demonstration and Practice and Robot Programming.	4	MATLAB Assignment/ Robotics Tool Box/ ABB 1410 programming / MATLAB Simulink Control System Toolbox	Experiential Learning Self study and study based on the assignments and Homework given in class. Learn the methods to program the manipulator available at CRIS
Total Lecture Hours	43		

5. Evaluation Scheme

Component	Duration	Weightage (%)	Date	Remarks
MIDSEMESTER	90 min	30		OB
Comprehensive	120 min	40		OB
Quiz/Assignment/ Seminar/Report/ Presentation, Software & Lab Assgn erc.	**	30	Will be announced in the class	TAKE HOME or CLASS ASSIGNMENT

**** (Unstructured) Submission dates will be announced in the class.**

6. **Chamber Consultation Hours,** will be announced in the class. Chamber No is 2225, FD –II.
Makeup policy is very strict and applicable for only genuine reasons and prior intimation.

7. **Notices:** All notices regarding the course will be put up on Google class room. Lack of active participation in the class will lead to award of NC report.

Instructor-in-Charge
BITS F441