2023
TP-153

Course Specification
(Bachelor)

Course Title:	Robotics
Course Code:	496A-MEC-3
Program:	Bachelor of Science in Engineering
Department:	Mechanical Engineering
College:	College of Engineering
Institution:	Najran University
Version:	1.0
Last Revision Date:	27 February 2024

Table of Contents

A. General information about the course:

1. Course Identification

1. Credit hours: (3)					
2. Course type					
A.	☐University	☐College	☒ Department	☐Track	☐Others
B.	☐Required		☒ Elective		
3. Level/year at which this course is offered: (Fifth Year \ Level 10)					
4. Course general Description:					
Fundamentals of Robotics: Automation and Robotics, Brief History of Robotics, Laws & Definition of Robot Anatomy, Classification of Robots, Human System and Robotics, Social Issues and Future Prospects. Robot Arm Kinematics: Introduction, Homogeneous Coordinate Transformations, Direct & Inverse Kinematics, Composite Homogeneous Transformation Matrix, Link, Joint and Parameters, Denavit Harten Berg Notation, D-H Matrix, Kinematic Equations, Exercises. Robot Grippers: Classification of End Effectors, Mechanical Grippers, Magnetic Gripper, Vaccum Gripper, Adhesive Gripper, Multi Fingered Gripper- Utah, Okada, Stanford, DGIT Hands, Considerations in Gripper Selection, Force Analysis and Design. Robot Drives, Sensors, Actuators and Control: Robot Drive Systems- Hydraulic, Pneumatic and Electric, Robot Sensors- Contact and Non-Contact types, Force and Torque Sensor, Robotic Vision System, Basic Control Systems and Models, Control Systems Analysis. Robot Programming Languages & Applications: Methods of Robot Programming, Lead Through Programming Methods, Robot Language and Classification, Robot Application- Material Transfer, Machine Loading/Unloading, Processing Operations, Assembly and Inspection					
5. Pre-requirements for this course (if any)**:**					
342-MEC-3 (Mechanical Engineering Design (2))					
6. Co-requisites for this course (if any)**:**					
NIL					
7. Course Main Objective(s):					
1.The student shall become familiar with the historical developments of robotics. 2.The student shall be able to understand and evaluate kinematic laws of robotics.					

3.The student shall know the different types of grippers that are used in robotics for various applications.
4.Develop the understanding of different types of drives, sensors and actuators and their use in a particular environment.
5.The student shall be able to learn the programming languages so as to attain complete command over the robotic manipulators.

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	60	100%
2	E-learning		
3	Hybrid • Traditional classroom • E-learning		
4	Distance learning		

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	30
2.	**Laboratory/Studio**	15
3.	**Field**	
4.	**Tutorial**	15
5.	**Others (specify)**	
Total		60

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	Teach the basics of robotics and its anatomy.	1	TS:1-Interactive lectures using PowerPoint slides with more	-Test performance evaluation

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
			examples in the class TS:2- Engaging the students in problem-based learning through tutorials TS:3- Lab Demonstrations TS: 4 – Recall the topics discussed in the last lecture by asking questions to the students. TS: 5 – Associating the topics in each chapter with the CLO. TS:6 –Giving more example programs in the lecture TS: 7 – Discussion with the students in the class hours	-Evaluation through assignments -Evaluating programming skills for different conditions
1.2	Teach the concept of robotic design and analysis.	7	TS:1-Interactive lectures using PowerPoint slides with more examples in the class TS:2- Engaging the students in problem-based learning through tutorials TS:3- Lab Demonstrations TS: 4 – Recall the topics discussed in the last lecture by asking questions to the students.	-Test performance evaluation -Evaluation through assignments -Evaluating programming skills for different conditions

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
			TS: 5 – Associating the topics in each chapter with the CLO. TS:6 –Giving more example programs in the lecture TS: 7 – Discussion with the students in the class hours	
2.0	**Skills**			
2.1	Develop the skills to perform kinematic link analysis for robotic arm design and reachability.	2	TS:1-Interactive lectures using PowerPoint slides with more examples in the class TS:2- Engaging the students in problem-based learning through tutorials TS:3- Lab Demonstrations TS: 4 – Recall the topics discussed in the last lecture by asking questions to the students. TS: 5 – Associating the topics in each chapter with the CLO. TS:6 –Giving more example programs in the lecture TS: 7 – Discussion with the students in the class hours	-Test performance evaluation -Evaluation through assignments -Evaluating programming skills for different conditions
2.2	Learn the control and drive system of robots and use of	6	TS:1-Interactive lectures using PowerPoint slides	-Test performance evaluation

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
	robotic language for different applications.		with more examples in the class TS:2- Engaging the students in problem-based learning through tutorials TS:3- Lab Demonstrations TS: 4 – Recall the topics discussed in the last lecture by asking questions to the students. TS: 5 – Associating the topics in each chapter with the CLO. TS:6 –Giving more example programs in the lecture TS: 7 – Discussion with the students in the class hours	-Evaluation through assignments -Evaluating programming skills for different conditions
3.0	**Values, autonomy, and responsibility**			
3.1	Learn the art of using robots for the benefit of humans and ease of comfort.	4	TS:1-Interactive lectures using PowerPoint slides with more examples in the class TS:2- Engaging the students in problem-based learning through tutorials TS:3- Lab Demonstrations TS: 4 – Recall the topics discussed in the last lecture by	-Test performance evaluation -Evaluation through assignments -Evaluating programming skills for different conditions

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
			asking questions to the students. TS: 5 – Associating the topics in each chapter with the CLO. TS:6 –Giving more example programs in the lecture TS: 7 – Discussion with the students in the class hours	
3.2	Select and use appropriate grippers and actuators depending upon the work environment.	5	TS:1-Interactive lectures using PowerPoint slides with more examples in the class TS:2- Engaging the students in problem-based learning through tutorials TS:3- Lab Demonstrations TS: 4 – Recall the topics discussed in the last lecture by asking questions to the students. TS: 5 – Associating the topics in each chapter with the CLO. TS:6 –Giving more example programs in the lecture TS: 7 – Discussion with the students in the class hours	-Test performance evaluation -Evaluation through assignments -Evaluating programming skills for different conditions

C. Course Content

No	List of Topics	Contact Hours
1.	**Fundamentals of Robotics:** Automation and Robotics, Brief History of Robotics, Laws & Definition of Robot Anatomy, Classification of Robots, Human System and Robotics, Social Issues and Future Prospects.	10
2.	**Robot Arm Kinematics:** Introduction, Homogeneous Coordinate Transformations, Direct & Inverse Kinematics,	8
3.	Composite Homogeneous Transformation Matrix, Link, Joint and Parameters, Denavit Harten Berg Notation, D-H Matrix, Kinematic Equations, Exercises.	7
4.	**Robot Grippers:** Classification of End Effectors, Mechanical Grippers, Magnetic Gripper, Vaccum Gripper, Adhesive Gripper,	7
5.	Multi Fingered Gripper- Utah, Okada, Stanford, DGIT Hands, Considerations in Gripper Selection, Force Analysis and Design.	8
6.	**Robot Drives, Sensors, Actuators and Control:** Robot Drive Systems- Hydraulic, Pneumatic and Electric, Robot Sensors- Contact and Non-Contact types, Force and Torque Sensor	5
7.	Robotic Vision System, Basic Control Systems and Models, Control Systems Analysis.	5
8.	**Robot Programming Languages & Applications:** Methods of Robot Programming, Lead Through Programming Methods	5
9.	Robot Language and Classification, Robot Application- Material Transfer, Machine Loading/Unloading, Processing Operations, Assembly and Inspection	5
Total		**60**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Assignments	1-12	10%
2.	Quizzes	1-12	10%
3.	Mid-term	6 & 12	20%
4.	labs	1-12	10%
5.	Lab final exam	-	-
6.	Final exam	15	50%

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	"**Robotics** by S. K. Saha, Tata McGraw Hill Publications
Supportive References	**1.** **Industrial Robotics** by M. P. Groover, McGraw Hill International Editions

	2. **Introduction to Robotics** by J. J. Craig, Addison Wesley, New Delhi 3. **Robotics** by K. S. Fu, McGraw Hill International Editions
Electronic Materials	Online custom books
Other Learning Materials	N/A

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	Classrooms and laboratories
Technology equipment (projector, smart board, software)	Smart Projector,
Other equipment (depending on the nature of the specialty)	

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Program Leaders and Peer Reviewer	Direct, Indirect
Effectiveness of Students assessment	Students & Faculty	Direct and Indirect
Quality of learning resources	Students & Faculty	Direct and Indirect
The extent to which CLOs have been achieved	Students & Faculty	Direct and Indirect
Other		

Assessors (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	**DEPARTMENT OF MECHANICAL ENGINEERING**
REFERENCE NO.	
DATE	**27/02/2024**