	National Institute of Technology Meghalaya An Institute of National Importance	CURRICULUM

Programme	**Bachelor of Technology in Mechanical Engineering**	Year of Regulation	**2018**
Department	**Mechanical Engineering**	Semester	**VIII**

Course Code	Course Name	Credit Structure				Marks Distribution			
		L	T	P	C	INT	MID	END	Total
ME 414	**ROBOTICS**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives	
	To introduces different robots and its subsystems.
	To introduces kinematic and dynamic modelling of different robots.
	To familiarizes path planning and control technique for industrial robots.

Course Outcomes	
CO1	Able to explain the importance of robotics (Understanding)
CO2	Able to illustrate robot configuration and its subsystems (Understanding)
CO3	Able to solve problem of robot kinematics (Applying)
CO4	Able to analyze the robot dynamics using Lagrangian and Eulerian approach (Analyzing)
CO5	Able to utilize the concepts of path planning and control (Applying)

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	CO1	**3**	**2**	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1.5**	**2**	**0**
2	CO2	**3**	**2**	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1.5**	**2**	**0**
3	CO3	**3**	**2**	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1.5**	**2**	**0**
4	CO4	**3**	**2**	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1.5**	**2**	**0**
5	CO5	**3**	**2**	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1.5**	**2**	**0**

SYLLABUS

No.	Content	Hours	COs
I	**Introduction** History of robotics, classification and usages of robot, workspace, specification, application - material handling, manufacturing and assembly.	**03**	**CO1**
II	**Components of Robots** Links: Definition, classification and use, Joints: classification of the joints, operation. End effectors / grippers: Classification, force analysis and design, dexterous hand, Remote Centre Compliance (RCC) Actuators: Definition, classification, mechanical actuator, electrical actuator, hydraulic actuator, pneumatic actuator, linear and rotary actuator. Servo and non-servo drive Sensors: Purpose, characteristics and principle of operation of encoders, tachometers, 6 axis force-torque sensors, touch and slip sensor, robot vision - pre and post processing, feature extraction.	**06**	**CO2**
III	**Kinematics of Robots** Position Analysis: Matrix transformation, representation of pure translation and pure rotation, combined translation and rotation, direct and inverse kinematics problems, examples of serial and parallel robots. Velocity Analysis: Differential analysis, Jacobian, homogenous transformation, DH parameters, solution of kinematics.	**09**	**CO3**
IV	**Dynamics of Robots** Dynamic analysis of the manipulator robot, Lagrange-Euler dynamic formulation, static force analysis, transformation of force and moment.	**10**	**CO4**
V	**Motion Planning and Control** Basics of trajectory planning, Multi-waypoint trajectory, Cartesian space trajectory, basics of control, block diagram, Laplace transform, PID control, trajectory planning – position, velocity and force control. Robot programming – Lead through and teach pendent method, VAL programming language and programming exercise.	**06**	**CO5**
VI	**Case Studies and Future Trend** Mobile robots – navigation and guidance, tele-robotics, bio-robotics, social robotics and humanoid robots.	**02**	**CO1** **CO2** **CO4**
	Total Hours	**36**	

Essential Readings

1. M. P. Groover, “Industrial Robotics – Technology, Programming and Applications”, McGraw-Hill, 2nd Edition, 2012.
2. K. S. Fu, R. C. Gonzalez and C.S.G. Lee, “Robotics Control, Sensing, Vision and Intelligence”, McGraw-Hill, 1st Edition, 1987.

Supplementary Readings

1. Y. Koren, “Robotics for Engineers”, McGraw-Hill, 1st Edition 1985.
2. J. J. Craig, “Introduction to Robotics: Mechanics and Control”, Pearson Education International, 3rd Edition, 2005.
3. M. W. Spong and M. Vidyasagar, “Robot Dynamics and Control”, Wiley, 1st Edition, 2008.
4. R. J. Schilling, “Fundamentals of Robotics Analysis and Control”, Prentice Hall of India Pvt. Ltd., 1st Edition, 1996