# DEN408

## Robotics for 2017/18

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| **Units:** 1 **Credits:** 15 **Semesters:** B **Level:** 7 **Fulltime:** Yes **QM Model Compliant:** TBC | |
| **Organiser:** | Dr Ranjan Vepa |
| **Deputy Organiser:** | Dr Hasan Shaheed |
| **Overlap:** | DENM011 |
| **Prerequisites:** | DEN5109, DEN5108, DEN5200 |
| **Description:** | The course introduces robotics as an integral part of modern automation, provides an introductory insight into the engineering design and application of robot manipulator systems. It also provides an understanding of kinematics, dynamics and trajectory planning of robotic manipulators, actuators and sensors, principles and roles in robotics. It introduces various aspects of robot modelling and control and problems encountered in robot programming and their remedies. |
| **Method of Delivery (Teaching and Learning Profile):** | |
| Course Type: | Taught |
| Approx hours to be spent by students in: | **Lectures:** 33 **Seminars:** 0 **Fieldwork/visits:** 0 **Lab work:** 0 **Timetabled project/coursework:** 0 **tutorials:** 5 |
| **Formative Feedback** | Coursewrok feedback |
| **Methods of Assessment:** | |
| | **Examination Papers:** 1 **Duration:** 2.5 hours |
| | **Coursework or other Assessment:**<br>**Formative Assessment:** None<br>**Summative Assessment:** 70% exam<br>30% coursework |

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| **Percentage Credit for Examination:** 70% **Credit for Coursework:** 30% | |
| **Organising Dept:** | SEMS |
| **Board of Examiners:** | Engineering |
| **Sub-board:** | 2751 |
| **Aims:** | This is a comprehensive course covering the fundamental areas of robotics technology. The aims of this course are to introduce robotics as an integral part of modern automation, to provide an introductory insight into the engineering design and application of robot manipulator systems, to provide an understanding of kinematics, dynamics and trajectory planning of robotic manipulators, to explain the actuators, and sensors, principles and roles in robotics, to introduce various aspects of robot modelling and control and to introduce problems encountered in robot programming and their remedies. |
| **Objectives:** | After successfully completing the course, the student will be able to:<br><br>1. explain the influence of robots on a production process and society;<br>2. analyse the engineering of robot manipulator systems, including geometrical configurations, coordinate systems, drive actuators, programming and control;<br>3. explain and apply the kinematics of a robot including inverse-kinematics phenomenon;<br>4. explain and apply the dynamics of a robot;<br>5. solve robot planning problems by applying path and trajectory calculations;<br>6. explain the role of actuators and sensors in robot design and control;<br>7. explain, analyse and apply different control strategies addressing both rigid body and fle xible dynamics<br>8. explain and apply robot programming considering important aspects such as real- time requirements and their remedy using high performance computing and parallel processing. |
| **Syllabus:** | Robots: past, present and future, application and social impact.<br>2. Robot fundamentals and components: Components: arm/manipulator, end effectors, joints, actuators and sensors; degrees of freedom, coordinates, reference frames, programming modes, characteristics, workspace and robot languages.<br>3. Robot Coordinates: coordinate systems, coordinate |

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| | transformations.<br>4. Kinematics: position gripper, direct and inverse kinematics.<br>5. Kinematics: velocity gripper, direct and inverse Jacobian matrices.<br>6. Dynamics: virtual work, Newton-Euler, Lagrange.<br>7. Motion planning: paths, trajectories and obstacles.<br>8. Actuators: Characteristics, different types of actuators: hydraulic devices, pneumatic devices, electric motors, magnetostrictive actuators.<br>9. Sensors and measurement systems : sensor characteristics, position, velocity, acceleration, force& pressure, and torque sensors, microswitches, light and infrared sensors, touch and tactile sensors, proximity sensors, range finders, sniff sensors.<br>10. Vision systems and Image processing & analysis: vision systems, image acquisition, sampling and quantisation, sampling theorem, image processing techniques, image analysis, realtime image processing.<br>11. Dynamic modelling and control of robots: modelling concepts and types, control of position and vibrations, model-based and AI-based control techniques.<br>12. Programming of robots: operating systems, real-time requirements, parallel processing, event detection. |