

DISCIPLINE SPECIFIC ELECTIVE (DSE) COURSES

Name of the Programme : M.Sc. in Data Science

Course Code : CSD-523

Title of the : Signal

Course Processing

Number of : 4(2L-2T-0P)

Credits

Contact hours : 60 hours (30L-30T-0P)

Effective from : 2023-24
AY

Pre-requisites for the Course	<ol style="list-style-type: none">1. Linear algebra,2. Calculus and multivariable calculus,3. At least high school math on trigonometry,4. Complex number5. A little bit familiarity with programming, especially for numerical computation, such as GNU Octave.
Course Objectives	<ol style="list-style-type: none">1. To study various types of signals and its characteristics.2. To study various operations on the signals.3. To analyse the signals using Fourier transform and Laplace Transform.4. To learn the fundamentals of robotics and sensor technology.5. To understand the controlling applications of robotics using sensor responses.

<p>Content for Theory</p>	<p>Unit1: Introduction to Signals Continuous-time and Discrete-time Signals: Representation of signals, Signal classification, Types of Signals, Operations on signals - Scaling, Shifting. Fourier Analysis of Continuous-time Signals Introduction to Fourier series, Gibbs Phenomenon, and Continuous-time Fourier transform (CTFT), Existence, Magnitude and phase response, Parseval's theorem, Inverse Fourier transform. Relation between Laplace and Fourier transforms, Laplace Transform, Magnitude and phase response Signal conditioning Sensing - Pre-processing – Noise reduction, enhancement of details. Signal Conversion – Sampling, Quantization, Encoding Data Acquisition and sensing in Robotics Data Acquisition: Analogy and digital data acquisition, single channel and multi-channel data acquisition Image processing in Robotics: Vision sensor, Introduction to computer vision, Point operators, Linear Filters, More neighbourhood operators, Fourier transforms, Pyramids and wavelets, Geometric transformations.</p>	<p>15 hours</p>
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	Unit II Fundamentals of Robotics Basic components of robotic system. Basic terminology- Accuracy, Repeatability, Resolution, Degree of freedom. Mechanisms and transmission, End effectors, Grippersdifferent methods of gripping, Mechanical grippers-Slider crank mechanism, Screw type, Rotary actuators, Cam type gripper, Magnetic grippers, Vacuum grippers, Air operated grippers; Specifications of robot. Drive Systems and Sensors in Robotics Drive system- hydraulic, pneumatic and electric systems. Sensors in robot – Touch sensors, Tactile sensor, Proximity and range sensors, Robotic vision sensor, Force sensor, Light sensors, and Pressure sensors. Signal processing application in Robotics Robot applications: Application of robots in surgery, Manufacturing industries, space and underwater. Humanoid robots, Micro robots, Social issues and Future of robotics.	15 hours
Content for Tutorial:	1. To find Discrete Fourier Transform and Inverse Discrete Fourier Transform of given digital signal using MATLAB software.	3 hours
	2. To obtain Linear Convolution of two finite length sequences using MATLAB software.	3 hours
	3. To compute auto correlation between two sequences using MATLAB software.	3 hours
	4. AIM: To find frequency response of a given system in differential equation form using MATLAB software.	3 hours
	5. AIM: To find the FFT of a given sequence using MATLAB software.	3 hours
	6. Determination of Power Spectrum of a given signal using MATLAB software.	3 hours
	7. To implement LP FIR filter for a given sequence using MATLAB software.	6 hours
	8. To implement HP FIR filter for a given sequence using MATLAB software.	6 hours
Pedagogy	Lectures/ Tutorials/Hands-on assignments/Self-study/Flipped classroom	

References/ Readings	Text Book(s) <ol style="list-style-type: none"> 1. Deb, S. R., & Deb, S. (2010). Robotics technology and flexible automation. McGraw-Hill Education. 2. Groover, M. P., Weiss, M., & Nagel, R. N. (1986). Industrial robotics: technology, programming and application. McGraw-Hill Higher Education. 3. Haykin, S., & Van Veen, B. (2007). Signals and systems. John Wiley & Sons. 4. Oppenheim, A. V., Willsky, A. S., Nawab, S. H., & Ding, J. J. (1997). Signals and systems (Vol. 2, pp. 74-102). Upper Saddle River, NJ: Prentice hall. 5. Pallas-Areny, R., & Webster, J. G. (2012). Sensors and signal conditioning. John Wiley & Sons.. 6. Rao R.K., Prakriya S. (2013). Signals and Systems. Mc-Graw Hill. 7. Saha,S. K. (2008). Introduction to Robotics. Tata McGraw-Hill Publishing Company Ltd.
Course Outcomes	<ol style="list-style-type: none"> 1. To differentiate continuous and discrete time signals and to analyse the sensor response using Fourier transform 2. To analyse the trajectory of sensor signal using Laplace transform and to understand the signal conditioning and acquisition mechanism 3. To learn the fundamentals and peripherals of robots and to explore sensor responses in controlling robots 4. To explore various real-time application of sensor signal in robotics

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