INDIANINSTITUTE OF INFORMATION TECHNOLOGY
DESIGN AND MANUFACTURING (IIITDM) KANCHEEPURAM

INTRODUCTION OF NEW COURSE

Course Title	**Inverse problems in Engineering**	Course No	YYY5XXX			
Specialization	Mechanical Engineering	Structure (LTPC)	3	0	0	3
To be offered for	UG / PG	Status	Core ☐		Elective ■	
FacultyProposing the course	Dr. Shubhankar Chakraborty	Type	New ■		Modification ☐	
Date of DAC	05.12.2018	Members Present in DAC	All Faculty Members of the Dept. External Member: None			
Pre-requisite	Consent of the faculty is required	Submitted for approval	39th Senate			
Learning Objectives	As inverse heat transfer finds many real life applications, the main objective of this course will be to make the students familiar to different real life ill-posed problems and the solution methodology through a platform of heat transfer. The assignments will be solved using Matlab or Python programming.					
Learning Outcomes	The students will be able to solve different ill-posed problem of different fields of mechanical engineering (heat transfer, fluid mechanics, dynamics and manufacturing) using Matlab or Python programming.					
Contents of the course *(With approximate break-up of hours)*	**Introduction: (2)** Forward problem – inverse problem - Scope of inverse problems - Determination of unknown boundary conditions – material property etc. **Methodologies: (32)** 1. Classical Methods – **Regularization method** (The Regularized Form of Inverse Problems, The Construction of a Regularizing Operator, Regularization of the Inverse Problem Finite-dimensional Form, The Admissible Degree of Smoothing and Approximation Sampling Procedures, The Reconstruction Accuracy Analysis of Boundary Conditions, By-Interval Regularization of a Nonlinear Inverse Problem, Regularized Continuation of the Solution of a Nonlinear Equation, The Regularization of a Two-Dimensional Inverse Problem), **Conjugant gradient method** (The Conjugate Gradient Method for parameter Estimation, The Conjugate Gradient Method with Adjoint Problem for Parameter Estimation, The Conjugate Gradient Method with Adjoint Problem for Function Estimation), **The Levenberg-Marquardt Method[10]** 2. Statistical Methods – **Bayesian inference techniques** (The Bayesian Approach, The Multivariate Normal Case, The Markov Chain Monte Carlo Method, Analyzing MCMC Output), **Maximum likelihood method** (Introduction to Linear Regression, Statistical Aspects of Least Squares, An Alternative View of the 95% Confidence Ellipsoid, Unknown Measurement Standard Deviations, *L*1 Regression, Monte Carlo Error Propagation), **Kalman filter** (introduction to state-space model, formulation of Simple Kalman filter, introduction to Ensemble Kalman Filter)**[10]** 3. Soft computing Method – Neural network (Multilayer Feedforward Neural networks with Sigmoidal activation functions, Backpropagation Algorithm, Representational abilities of feedforward networks) and Genetic Algorithm (introduction, formulation) **[8]** 4. Hybrid Method – Bayesian inference with Kalman filter. **[4]** **Case studies: (8)** Various areas of engineering such as Mechanical, etc.					
Text Books	1. Ozisik, M. N. Inverse heat transfer: fundamentals and applications. CRC Press, 2000. 2. Neto, F.D.M. and da Silva Neto, A.J., *An introduction to inverse problems with applications*. Springer Science & Business Media, 2012					
Reference Books	3. Alifanov, Oleg M., and Oleg M. Alifanov. Inverse heat transfer problems. Berlin: Springer-Verlag, 1994. 4. Beck, James V. Inverse heat conduction: Ill-posed problems. James Beck, 1985. 5. Orlande, Helcio RB, et al., eds. *Thermal measurements and inverse techniques*. CRC Press, 2011.					