INDIAN INSTITUTE OF INFORMATION TECHNOLOGY
DESIGN AND MANUFACTURING (IIITDM)
KANCHEEPURAM

INTRODUCTION OF NEW COURSE

<table>
<tr><td>Course Title</td><td colspan="2">Machining dynamics and adaptive control</td><td>Course Code</td><td colspan="4">ME xxxx</td></tr>
<tr><td>Dept./ Specialization</td><td colspan="2">Mechanical Engineering</td><td>Structure (LTPC)</td><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>To be offered for</td><td colspan="2">UG/PG</td><td>Status</td><td colspan="2">Core</td><td colspan="2">Elective</td></tr>
<tr><td>Faculty Proposing the course</td><td colspan="2">Dr. Kashfull Orra</td><td>Type</td><td colspan="2">New</td><td colspan="2">Modification</td></tr>
<tr><td colspan="3">Recommendation from the DAC: Yes</td><td>Date of DAC</td><td colspan="4">01-06-2021</td></tr>
<tr><td>External Expert(s)</td><td colspan="6">Prof. S. K. Choudhury, Department of Mechanical Engineering IIT Kanpur</td></tr>
<tr><td>Pre-requisite</td><td colspan="2">Manufacturing process I and II</td><td colspan="3">Submitted for approval</td><td>46th Senate</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">● To understand mechanics of machining process and mathematical models of metal cutting: turning, milling and drilling operations.
● To analyse chatter and stability in machining dynamics and vibration of metal cutting.
● To introduce the use of modal analysis and the concept of adaptive control systems in machining to enhance stability in machining operation</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">● At the end of the course, the students will gain fundamentals of machining on orthogonal cutting and oblique cutting.
● The theoretical model will help the students to solve machining vibration problem accurately, will develop analytical skills to tackle the research related problems.
● They will have the ability for designing and analyzing adaptive control systems in the machining process, will have the ability to implement the adaptive control system for industrial use.</td></tr>
<tr><td>Contents of the course

(With approximate break-up of hours for L/T/P)</td><td colspan="6">Machining process and modelling: Orthogonal cutting-Mechanistic modelling of cutting force, Shear angle. Oblique cutting-cutting geometry and parameters, prediction of cutting forces. Mechanics of turning, milling and drilling process, Tool wear and Tool breakage. (10 L + 3 T)

Machining dynamics and vibration: Fundamentals of free, forced and self-excited vibrations, regenerative effect in 1-DOF, mode coupling effect in 2-DOF. Stability analysis in orthogonal cutting-regenerative chatter vibration, stability lobe diagram, stability in turning operation. Analytical prediction of chatter vibration in milling and drilling operation-dynamics of milling model, dynamics of drilling force model, Time delay model, Frequency and time domain stability solution. (12 L + 4 T)

Modal analysis: Introduction to modal analysis, Frequency response function, Identification of modal parameters, modal analysis for multi-degree-of-freedom systems, Numerical methods and computational dynamics of modal analysis. (8 L + 3 T)

Adaptive Control: Models for dynamic systems-open loop and closed loop systems, Laplace transformation, Transfer functions, Review of control design concepts for single input single output systems, Extension to multi-input multi-output systems. Adaptive control system-direct and indirect adaptive control, model reference adaptive control, design of on-line parameter estimators. Design formulations using state-space and frequency domain, Stability analysis in feedback controls using Lyapunov function, Feedback linearization, and Small gain theorem. Case study and Numerical problem</td></tr>
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	solving. (12 L + 4 T)
Text Book	1. A. Bhattacharyya, Metal cutting: Theory and Practice, 8th Ed. New Central Book Agency (P) Ltd, 2012. 2. P.A. Ioannou and J. Sun, Robust Adaptive control, 1st Ed. 1995
Reference Books	1. K.Ogata, Modrern Cpntrol Engineering, 4th Ed. Pearson Education Int. 2002