National Institute of Technology Rourkela

Defence Seminar

Seminar Title	: Dynamic Analysis and Stability studies in Functionally graded porous microstructures
Speaker	: Uttam Kumar Kar (Rollno : 519me1017)
Supervisor	: Jonnalagadda Srinivas
Venue	: Seminar Hall ME (Ground floor)
Date and Time	: 10 Jul 2025 (10.00 am)
Abstract	: Micro and nano-sized resonators are widely used in various micro and nano electromechanical systems as vibration sensors, micro-actuators, microswitches etc. The elastic behavior in various substances depend on the size of body and such micro resonators made of porous functionally graded materials have great application potential in micro/nano-electromechanical, micro/nano-electronics, physics and biology due to their unique properties of lightness and strength. Present work deals with the dynamic analysis, optimal design and control studies of functionally graded porous micro-structural components and assemblies subjected to different loads. Initially, basic structural elements including functionally graded microbeams and microplates are analyzed thoroughly using modified couple stress theory taking into account the length scale factor. Finite element modeling is employed for microbeams and Rayleight-Ritz method is employed for microplate analysis. In order to enhance dynamic characteristics, optimum material and geometric configurations are obtained using Firefly metaheuristic technique. The analysis and identification of cracked functionally graded microbeams resting on elastic foundations are illustrated by considering the thermal shock loads. Free vibration analysis was conducted for sandwich functionally graded microbeams and plates containing metallic core with nanoparticle reinforcements & functionally graded face layers. Further, sound insulation characteristics of porous functionally graded microplates using vibro-acoustic Rayleigh model were studied. Mechanical and dynamic characteristics of the fabricated functionally graded micro samples were tested experimentally. Two application case studies were analyzed. (i) coupled FG microbeam mass sensor (ii) functionally graded MEMS folded beam accelerometer for their effectiveness. In order to control the instabilities in FG microbeam resonators and enhance operating range, nonlinear adaptive back-stepping sliding mode controller with neural network disturbance observer model was proposed and the results are illustrated.