Annexure-B

Summary of the work done under

Minor Research Project

Principal Investigator:	**Dr. Kishor R. Gaikwad**
Title of the Project:	Study of Some Thermo-elastic Problems and its Applications Using Integral Transform Techniques and Computational Software.

In this project we carried out the following results.

In first result, we analyzed thermal stresses in a non-homogeneous semi-infinite hollow circular disc due to internal heat generation under unsteady-state temperature distribution. Initially the circular disc is at arbitrary temperature $F(r,z)$. For times $t>0$ heat is generated within the circular disk at a rate of $g(r,z,t)$ Btu/hr ft^3, while the boundary surfaces at $(r=a),\ (r=b)$ and $(z=0)$ are kept temperatures $f_1(z,t),\ f_2(z,t)$ and $f_3(r,t)$ respectively. The governing heat conduction equation has been solved by using integral transform technique. The results are obtained in series form in terms of Bessel's functions. As an illustration, we carried out numerical calculations for a hollow circular disc made up of Aluminum and examined the thermo-elastic behavior in the state for the temperature, displacement and thermal stresses and illustrated graphically. We conclude that, the temperature, displacement and thermal stresses occur near heat source, due to internal heat generation in a non-homogeneous semi-infinite hollow circular disc under unsteady-state temperature distribution.

In second result, we analyzed the steady-state thermoelastic problem and determined the expressions of temperature, displacement, and thermal stresses of a thin circular plate due to uniform internal energy generation at a constant rate $g_0 = 1 \times 10^6$ W/m^3. The fixed circular edge (r = a) is kept at zero temperature and the upper (z = h) and lower (z = 0) surfaces are thermally insulated. The governing heat conduction equation has been solved using finite Hankel transform technique. The results are obtained in a series form in terms of Bessel's functions. As a special case, a mathematical model is constructed for aluminum (pure) a thin circular plate, with the material properties specified as above and examined the thermoelastic behaviors in the steady-state field for temperature change, displacement, thermal stresses in radial direction and illustrated graphically. We conclude that, the displacement and the stress components occur near heat region. Due to the uniform internal energy generation of a thin circular plate at a constant rate $g_0 = 1 \times 10^6$ W/m^3, the radial stress and axial stress develops the tensile stresses in radial direction. Also, it can be observed from the figure, temperature and displacement, the direction of heat flow and direction of body displacement are the same and they are proportionate. In the plane state of stress, the stress components σ_{rz} , σ_{zz}, $\sigma_{\theta z}$ are zero.

In third result, we analyzed the steady-state heat conduction problem in a thick circular plate which is free from traction subjected to an arbitrary temperature on the outer circular edge and determined the expressions for temperature, displacement and thermal stresses in radial direction with different axial thickness. The present method is based on the direct method, using the finite Fourier sine transform and using their inversion. As a special case, a mathematical model is constructed for Aluminum (pure), thick circular plate with the

material properties specified as above and examined the behaviors in the steady-state for the temperature change, the displacement and the thermal stresses.

The results, obtained here mainly applicable in engineering problems, particularly for industrial machines subjected to the heating such as the main shaft of a lathe, turbines, the roll of rolling mill and practical applications in air-craft structures.

The following paper has been published in International Journal.

1. **Gaikwad K. R.:** Thermal stresses in a non-homogeneous semi-infinite hollow circular disk due to internal heat generation, International Journal of Advanced Research in Basic and Applied Sciences, Vol-2, Issue-1, 130-133, 2015.

2. **Gaikwad K. R.:** Two dimensional steady state temperature distribution of a thin circular plate due to uniform internal energy generation, Cogent Mathematics, Taylor & Francis Group, Volume-3, Issue-1, pp. 1-10, 2016.

3. **Gaikwad K. R.:** Steady-state heat conduction problem in a thick circular plate and its thermal stresses, Accepted for publication in International Journal of Pure and applied Mathematics, Indexed by Scopus.

The following paper has been presented in International conferences.

1. **Gaikwad K. R.:** Mathematical modeling of non homogeneous steady state heat conduction problem in a thin circular plate with uniform heat source, "International conference on Mathematical modeling and computational methods in science and engineering" , Algappa university, Karaikudi, Tamilnadu, 20-22 February, 2017

2. **Gaikwad K. R.:** Axisymmeric thermoelastic stress analysis of a thin circular plate due to heat generation, "International Conference on Mathematical Analysis and Applications" Dayanand Science College, Latur, 05-09, March, 2017.

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