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PLANE STRAIN PROBLEM IN A ROTATING MICROSTRETCH THERMOELASTIC SOLID WITH MICROTEMPERATURES

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Abstract. A two-dimensional problem in an infinite microstretch thermoelastic solid with microtemperatures subjected to a mechanical source is studied. The medium is rotating with a uniform angular velocity $\vec{\Omega}$. The normal mode analysis is used to obtain the exact expressions for the component of normal displacement, microtemperature, normal force stress, microstress tensor, temperature distribution, heat flux moment tensor and tangential couple stress. The effect of microrotation and stretch on the considered variables are illustrated graphically.

1. Introduction

The dynamical interaction between the thermal and mechanical response has great practical applications in modern aeronautics, astronatics, nuclear reactors, and high-energy particle accelerators. Classical elasticity is not adequate to model the behavior of materials possessing internal structure. Furthermore, the micropolar elastic model is more realistic than the purely elastic theory for studying the response of materials to external stimuli. Eringen and Suhubi [1] and Suhubi and Eringen [2] developed a nonlinear theory of micro-elastic solids. Later Eringen [3–5] developed a theory for the special class of micro-elastic materials and called it the "linear theory of micropolar elasticity". Under this theory, solids can undergo macro-deformations and micro-rotations. Eringen [6] developed a theory of thermo microstretch elastic solids in which he included microstructural expansions and contractions. The material points of microstretch solids can stretch and contract independently of their translations and rotations. Microstretch continuum is a model for Bravais lattice with a basis on the atomic level and a two phase dipolar solid with a core on the macroscopic level. For example, composite materials reinforced with chopped elastic fibres, porous media whose pores are filled with gas or inviscid

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liquid, other elastic inclusions and 'solid-liquid' crystals, etc., should be characterizable by microstretch solids. Eringen [7] developed a theory of microstretch elastic solid in which he included microstructural expansions and contractions, Singh [8] studied reflection of plane waves from free surface of a microstretch elastic solid, Singh and Kumar [9] studied wave propagation in a generalized thermo-microstretch elastic solid, Ciarletta and Scalia [10] derived some result in linear theory of thermo-microstretch elastic solids, Iesan and Quintanilla [11] discussed thermal stresses in microstretch elastic plates, Kumar and Rupender [12] studied the reflection at free surface of magneto-thermo-microstretch elastic solid, Kumar and Partap [13] studied the elastodynamic behavior of waves in thermo-microstretch elastic plate bordered with layers of inviscid liquid, Kumar and Partap [14] discussed wave propagation in microstretch thermoelastic plate bordered with layers of inviscid liquid, Tomar and Khurana [15] discussed reflection and transmission of elastic waves from a plane interface between two thermo-microstretch solid half-spaces, Passarella and Tibullo [16] gives some results in linear theory of thermoelasticity backward in time for microstretch materials, Marin [17] studied a partition of energy in thermoelasticity of microstretch bodies. Marin [18] discussed Lagrange identity method for microstretch thermoelastic materials, Othman and Lofty [19] studied the plane waves of generalized thermomicrostretch elastic half space under three theories, Kumar and Partap [20] conducted an analysis of free vibrations for Rayleigh–Lamb waves in a microstretch thermoelastic plate with two relaxation times, Othman and Lofty [21] studied generalized thermo-microstretch elastic medium with temperature dependent properties for different theories, Kumar and Kansal [22] studied fundamental solution in the theory of thermomicrostretch elastic diffusive solids, Othman and Lofty [23] studied the effect of rotation on plane waves in generalized thermo-microstretch elastic solid with one relaxation time, Kumar et. al. [24] discussed the generalized thermoelastic waves in microstretch plates loaded with fluid of varying temperature. Abbas and Othman [25] studied the plane waves in generalized thermo-microstretch elastic solid with thermal relaxation using finite element method, Kumar and Rupender [26] discussed the propagation of plane waves at imperfect boundary of elastic and elctro-microstretch generalized thermoelastic solids, Shaw and Mukhopadhayay [27] studied the electromagnetic effects on Rayleigh surface wave propagation in a homogeneous isotropic thermo-microstretch elastic half-space and Passarella et. al. [28] discussed the microstretch thermoviscoelastic composite materials.

Assuming that the microelements of a thermoelastic body have different temperatures, the concept of microtemperatures was derived. Microtemperatures depend homogeneously on microcoordinates of the microelements, which are based on the microstructure of the continuum. The theory of microtemperatures is widely used in nano materials which is of great importance in the current research area. Grot [29] discussed a theory of thermodynamics of elastic bodies with microstructure whose microelements possess microtemperatures. In this theory the inverse of the microelement temperature is supposed to be a linear function of microcoordinates. Riha [30] studied heat conduction in materials with microtemperatures. Iesan and Quintanilla [33] studied a theory of thermoelasticity with microtemperatures. Iesan [34] proposed the theory of micromorphic elastic solids with microtemperatures. Exponential stability in thermoelasticity with microtemperatures was studied by Casas and Quintanilla [35]. Scalia and Svandze [36] gave the solutions of the theory of thermoelasticity with microtemperatures. Iesan [37, 38] discussed thermoelasticity of bodies with microstructure and microtemperatures. Aouadi [39] discussed some theorems in the isotropic theory of microstretch thermoelasticity with microtemperatures. Quintanilla [40] discussed thermoelastic bodies with inner structure and microtemperatures. Scalia et al. [41] studied basic theorems in the equilibrium theory of thermoelasticity with microtemperatures. Quintanilla [42] discussed the growth and continuos dependence in thermoelasticity with microtemperatures. Steeb et al. [43] studied time harmonic waves in thermoelastic material with microtemperatures. Chirita et. al. [44] studied the theory of thermoelasticity with microtemperatures. Singh et. al. [45] discussed a problem in microstretch thermoelastic diffusive medium. Kumar et. al. [46] studied the Reflection and refraction of plane waves at the interface of an elastic solid and microstretch thermoelastic solid with microtemperatures.

Various authors [48–53] have discussed the effect of rotation in thermoelastic medium. It is not possible to name all the contributors. Hence the authors have mentioned a few names in the field of thermoelasticity.

In the present problem the authors have discussed deformation due to rotation in microstretch thermoelastic medium with microtemperature. A mechanical force is applied in the interior of infinite microstretch thermoelastic medium with microtemperatures. The normal mode analysis technique has been applied to obtain the exact expressions for component of normal displacement, microtemperature, normal force stress, microstress moment tensor, temperature distribution, heat flux moment tensor and tangential couple stress. The distributions of the considered variables are then represented graphically.

2. Fundamental model

A homogeneous isotropic, microstretch thermoelastic medium with microtemperatures is considered. The medium is rotating uniformly with an angular velocity $\vec{\Omega} = \Omega\hat{n}$, where $\hat{n}$ is a unit vector representing the direction of the axis of rotation. All quantities considered will be functions of the time variable t and of the coordinates x and z respectively. The displacement equation of motion in the rotating frame has two additional terms (Schoenberg and Censor [47]): centripetal acceleration, $\vec{\Omega} \times (\vec{\Omega} \times \vec{u})$ due to time varying motion only and Corioli's acceleration, $2\vec{\Omega} \times \dot{\vec{u}}$ where $\vec{u}$ is dynamical displacement vector.

We consider a mechanical force applied in the interior of infinite microstretch thermoelastic medium with microtemperatures. A rectangular coordinate system (x, y, z) having origin on the surface $z = 0$ and z-axis pointing vertically into the medium is considered. To analyze the component of normal displacement, microtemperature, normal force stress, microstress tensor, temperature distribution, heat flux moment tensor and tangential couple stress at the interface of the medium, the continuum is divided into two half spaces defined by

(i) half space I, $|x| < \infty$, $\infty < z \leqslant 0$. $|y| < \infty$
(ii) half space II, $|x| < \infty$, $0 < z \leqslant \infty$. $|y| < \infty$

The system of governing equations for a rotating homogeneous, isotropic microstretch thermoelastic solid with microtemperatures without body forces, body couples, stretch force, heat sources, and first heat source moment following Eringen [6], Iesan [38] and Schoenberg and Censor [47] are,

Stress equation of motion:

$$(2.1)\quad (\lambda+2\mu+K)\nabla(\nabla.\vec{u}) - (\mu+K)\nabla\times(\nabla\times\vec{u}) + K(\nabla\times\vec{\varphi}) + \lambda_0\nabla\phi^* - \nu\nabla T = \rho(\ddot{\vec{u}} + \{\vec{\Omega}\times(\vec{\Omega}\times\vec{u})\} + 2\vec{\Omega}\times\dot{\vec{u}})$$

Couple Stress equation of motion:

$$(2.2)\quad (\alpha+\beta+\gamma)\nabla(\nabla.\vec{\varphi}) - \gamma\nabla\times(\nabla\times\vec{\varphi}) + K(\nabla\times\vec{u}) - 2K\vec{\varphi} - \mu_1(\nabla\times\vec{w}) = \rho J\frac{\partial^2\vec{\varphi}}{\partial t^2},$$

Equation of balance of stress moments:

$$(2.3)\quad \alpha_0\nabla^2\phi^* + \nu_1 T - \lambda_1\phi^* - \lambda_0(\nabla\cdot\vec{u}) - \mu_2(\nabla.\vec{w}) = \rho\frac{j_0}{2}\frac{\partial^2\phi^*}{\partial t^2},$$

Equation of balance of energy:

$$(2.4)\quad K^*\nabla^2 T - \rho c^*\frac{\partial T}{\partial t} - \nu_1 T_0\frac{\partial\phi^*}{\partial t} - \nu T_0(\nabla\cdot\vec{u}) + k_1(\nabla.\vec{w}) = 0,$$

Equation of balance of first moment of energy:

$$(2.5)\quad k_6\nabla^2\vec{w} + (k_4+k_5)\nabla(\nabla\cdot\vec{w}) + \mu_1\frac{\partial}{\partial t}(\nabla\times\vec{\varphi}) - \mu_2\frac{\partial}{\partial t}(\nabla\phi^*) - b\frac{\partial\vec{w}}{\partial t} - k_2\vec{w} - k_3\nabla T = 0,$$

Constitutive relations:

$$(2.6)\quad \sigma_{ij} = \lambda u_{r,r}\delta_{ij} + \mu(u_{i,j}+u_{j,i}) + K(u_{j,i} - \varepsilon_{ijr}\phi_r) - \nu T\delta_{ij} + \lambda_0\phi^*\delta_{ij},$$

$$(2.7)\quad m_{ij} = \alpha\phi_{r,r}\delta_{ij} + \beta\phi_{i,j} + \gamma\phi_{j,i} + b_0\varepsilon_{mji}\phi^*_{,m},$$

$$(2.8)\quad \lambda^*_i = \alpha_0\phi^*_{,i} + b_0\varepsilon_{ijm}\phi_{j,m},$$

$$(2.9)\quad q_{ij} = -k_4 w_{r,r}\delta_{ij} - k_5 w_{i,j} - k_6 w_{j,i}.$$

where, $\nu = (3\lambda+2\mu+K)\alpha_{t_1}$, $\nu_1 = (3\lambda+2\mu+K)\alpha_{t_2}$, α_{t_1} and $\alpha_{t_2}$are coefficents of linear thermal expansion; λ and μ are Lame's constants; K, α, β, γ are the micropolar constants of the solid; α_0, λ_0, λ_1 are the stretch constants; j_0, μ_1, μ_2, k_1, k_2, k_3, k_4, k_5, k_6 are constitutive coefficients; σ_{ij} is component of stress tensor; m_{ij} is couple stress tensor; λ^*_i is microstress tensor; q_{ij} is first heat flux moment tensor; $\vec{u}$ is displacement vector; $\vec{\varphi}$ is microrotation vector; $\vec{w}$ is microtemperature vector and ϕ^* is scalar microstretch; ρ is density; J is microinertia; c^* is specific heat at constant strain; K^* is thermal conductivity and T is thermodynamic temperature above reference temperature T_0.

We have restricted our analysis to the plane strain parallel to xz-plane with displacement vector $\vec{u} = (u_1, 0, u_3)$, microtemperature vector $\vec{w} = (w_1, 0, w_3)$, microrotation vector $\vec{\varphi} = (0, \phi_2, 0)$ and angular velocity $\vec{\Omega} = (0, \Omega_2, 0)$ respectively.

For convenience the following non-dimensional variables are used: $x' = \frac{1}{L}x$, $z' = \frac{1}{L}z$, $u_1' = \frac{1}{L}u_1$, $u_3' = \frac{1}{L}u_3$, $w_1' = Lw_1$, $w_3' = Lw_3$, $t' = \frac{c_1}{L}t$, $\sigma_{ij}' = \frac{\sigma_{ij}}{\nu T_0}$, $\phi_2' = \phi_2$, $\phi^{*'} = \phi^*$, $m_{ij}' = \frac{m_{ij}}{L\nu T_0}$, $q_{ij}' = \frac{q_{ij}}{Lc_1\nu T_0}$, $\lambda_i^{*'} = \frac{\lambda_i^*}{L\nu T_0}$, $T' = \frac{T}{T_0}$, $\Omega' = \frac{L}{c_1}\Omega$, where $L = \left(\frac{b}{\rho c^* T_0}\right)^{1/2}$, $c_1^2 = \frac{\lambda+2\mu+K}{\rho}$. Assuming the scalar potential functions $\psi_1(x,z,t)$, $\psi_2(x,z,t)$, $\psi_3(x,z,t)$ and $\psi_4(x,z,t)$ defined by the relation in non dimensional form as,

$$u_1 = \frac{\partial \psi_1}{\partial x} - \frac{\partial \psi_2}{\partial z}; u_3 = \frac{\partial \psi_1}{\partial z} + \frac{\partial \psi_2}{\partial x}; w_1 = \frac{\partial \psi_3}{\partial x} - \frac{\partial \psi_4}{\partial z}; w_3 = \frac{\partial \psi_3}{\partial z} + \frac{\partial \psi_4}{\partial x}. \tag{2.10}$$

Using above non dimensional variables and potential functions given by equation (2.10) the equations (2.1)–(2.5) reduces to (after dropping superscripts),

$$\left\{(A_1+1)\nabla^2 + A_2\left(\Omega^2 - \frac{\partial^2}{\partial t^2}\right)\right\}\psi_1 + 2\Omega A_2 \frac{\partial \psi_2}{\partial t} + A_3\phi^* - A_4 T = 0, \tag{2.11}$$

$$\left\{\nabla^2 + A_2\left(\Omega^2 - \frac{\partial^2}{\partial t^2}\right)\right\}\psi_2 - 2\Omega A_2 \frac{\partial \psi_1}{\partial t} + A_5\phi_2 = 0, \tag{2.12}$$

$$\left(\nabla^2 - 2A_6 - A_7\frac{\partial^2}{\partial t^2}\right)\phi_2 - A_6\nabla^2\psi_2 + A_8\nabla^2\psi_4 = 0, \tag{2.13}$$

$$\left(\nabla^2 - A_9 - A_{10}\frac{\partial^2}{\partial t^2}\right)\phi^* - A_{11}\nabla^2\psi_1 - A_{12}\nabla^2\psi_3 + A_{13}T = 0, \tag{2.14}$$

$$\left(\nabla^2 - A_{14}\frac{\partial}{\partial t}\right)T - A_{15}\frac{\partial \phi^*}{\partial t} - A_{16}\nabla^2\psi_1 + A_{17}\nabla^2\psi_3 = 0, \tag{2.15}$$

$$\left(\nabla^2(1+A_{18}) - A_{19} - A_{20}\frac{\partial}{\partial t}\right)\psi_3 - A_{21}\frac{\partial \phi^*}{\partial t} - A_{22}T = 0, \tag{2.16}$$

$$\left(\nabla^2 - A_{19} - A_{20}\frac{\partial}{\partial t}\right)\psi_4 + A_{23}\frac{\partial \phi_2}{\partial t} = 0, \tag{2.17}$$

where $A_1 = \frac{\lambda+\mu}{\mu+K}$, $A_2 = \frac{\rho c_1^2}{\mu+K}$, $A_3 = \frac{\lambda_0}{\mu+K}$, $A_4 = \frac{\nu T_0}{\mu+K}$, $A_5 = \frac{K}{\mu+K}$, $A_6 = \frac{KL^2}{\gamma}$, $A_7 = \frac{\rho j c_1^2}{\gamma}$, $A_8 = \frac{\mu_1}{\gamma}$, $A_9 = \frac{\lambda_1 L^2}{\alpha_0}$, $A_{10} = \frac{\rho j_0 c_1^2}{2\alpha_0}$, $A_{11} = \frac{\lambda_0 L^2}{\alpha_0}$, $A_{12} = \frac{\mu_2}{\alpha_0}$, $A_{13} = \frac{\nu_1 T_0 L^2}{\alpha_0}$, $A_{14} = \frac{\rho c^* c_1 L}{K^*}$, $A_{15} = \frac{\nu_1 c_1 L}{K^*}$, $A_{16} = \frac{\nu c_1 L}{K^*}$, $A_{17} = \frac{k_1}{K^* T_0}$, $A_{18} = \frac{k_4+k_5}{k_6}$, $A_{19} = \frac{k_2 L^2}{k_6}$, $A_{20} = \frac{b c_1 L}{k_6}$, $A_{21} = \frac{\mu_2 c_1 L}{k_6}$, $A_{22} = \frac{k_3 T_0 L^2}{k_6}$, $A_{23} = \frac{\mu_1 c_1 L}{k_6}$.

3. Solution of the Problem

The solution of the considered physical variable can be decomposed in terms of normal mode and can be considered in the following form,

$$(\psi_i, \phi^*, T, \phi_2, \sigma_{ij}, q_{ij}, m_{ij}, \lambda_i^*)(x,z,t) = (\bar{\psi}_i, \bar{\phi}^*, \bar{T}, \bar{\phi}_2, \bar{\sigma}_{ij}, \bar{q}_{ij}, \bar{m}_{ij}, \bar{\lambda}_i^*)(z)e^{\omega t + iax}$$

where ω is complex frequency, a is wave number in x-direction and $\bar{\psi}_i(z)$, $\bar{\phi}^*(z)$, $\bar{T}(z)$, $\bar{\phi}_2(z)$, $\bar{\sigma}_{ij}(z)$, $\bar{q}_{ij}(z)$, $\bar{m}_{ij}(z)$, $\bar{\lambda}_i^*(z)$ are the amplitudes of field quantities.

Using normal mode in (2.11)–(2.17), we get

$$(D^2 - B_8)\bar{\psi}_1 + B_9\bar{\psi}_2 + B_2\bar{\phi}^* - B_3\bar{T} = 0, \tag{3.1}$$

$$(D^2 - B_{10})\bar{\psi}_2 - B_{11}\bar{\psi}_1 + A_5\bar{\phi}_2 = 0, \tag{3.2}$$

$$(D^2 - B_{12})\bar{\phi}_2 - A_6(D^2 - a^2)\bar{\psi}_2 + A_8(D^2 - a^2)\bar{\psi}_4 = 0, \tag{3.3}$$

$$(D^2 - B_{13})\bar{\phi}^* - A_{11}(D^2 - a^2)\bar{\psi}_1 - A_{12}(D^2 - a^2)\bar{\psi}_3 + A_{13}\bar{T} = 0, \tag{3.4}$$

$$(D^2 - B_{14})\bar{T} - B_{17}\bar{\phi}^* - A_{16}(D^2 - a^2)\bar{\psi}_1 + A_{17}(D^2 - a^2)\bar{\psi}_3 = 0, \tag{3.5}$$

$$(D^2 - B_{15})\bar{\psi}_3 - B_6\bar{\phi}^* - B_7\bar{T} = 0, \tag{3.6}$$

$$(D^2 - B_{16})\bar{\psi}_4 + B_{18}\bar{\phi}_2 = 0, \tag{3.7}$$

where $D \equiv \frac{d}{dz}$, $B_1 = \frac{A_2}{A_1+1}$, $B_2 = \frac{A_3}{A_1+1}$, $B_3 = \frac{A_4}{A_1+1}$, $B_4 = \frac{A_{19}}{A_{18}+1}$, $B_5 = \frac{A_{20}}{A_{18}+1}$, $B_6 = \frac{A_{21}\omega}{A_{18}+1}$ $B_7 = \frac{A_{22}}{A_{18}+1}$, $B_8 = a^2 + B_1(\omega^2 - \Omega^2)$, $B_9 = a^2 + A_2\omega^2$, $B_{10} = a^2 + A_2(\omega^2 - \Omega^2)$, $B_{11} = 2\Omega A_2\omega$, $B_{12} = a^2 + 2A_6 + A_7\omega^2$, $B_{13} = a^2 + A_9 + A_{10}\omega^2$, $B_{14} = a^2 + A_{14}\omega$, $B_{15} = a^2 + B_4 + B_5\omega$, $B_{16} = a^2 + A_{19} + A_{20}\omega$, $B_{17} = A_{15}\omega$, $B_{18} = A_{23}\omega$.

The constitutive relations (2.6)–(2.9) becomes,

$$\begin{aligned}
\bar{\sigma}_{xx} &= \left(A_{25}D^2 - a^2A_{24}\right)\bar{\psi}_1 + ia\left(A_{25} - A_{24}\right)D\bar{\psi}_2 - \bar{T} + A_{26}\bar{\phi}^*,\\
\bar{\sigma}_{zx} &= ia\left(A_{27} + A_{28}\right)D\bar{\psi}_1 - \left(A_{27}D^2 + a^2A_{28}\right)\bar{\psi}_2 - \left(A_{28} - A_{27}\right)\bar{\phi}_2,\\
\bar{\sigma}_{zz} &= \left(A_{24}D^2 - a^2A_{25}\right)\bar{\psi}_1 + ia\left(A_{24} - A_{25}\right)D\bar{\psi}_2 - \bar{T} + A_{26}\bar{\phi}^*,\\
\bar{q}_{xx} &= \left(A_{29}a^2 - A_{30}D^2\right)\bar{\psi}_3 + ia\left(A_{29} - A_{30}\right)D\bar{\psi}_4,\\
\bar{q}_{zx} &= -ia\left(A_{31} + A_{32}\right)D\bar{\psi}_3 + \left(A_{32}D^2 + a^2A_{31}\right)\bar{\psi}_4,\\
\bar{q}_{zz} &= \left(A_{30}a^2 - A_{29}D^2\right)\bar{\psi}_3 + ia\left(A_{30} - A_{29}\right)D\bar{\psi}_4,\\
\bar{m}_{zy} &= A_{33}D\bar{\phi}_2 - iaA_{34}\bar{\phi}^*,\\
\bar{\lambda}_3^* &= A_{35}D\bar{\phi}^* - iaA_{34}\bar{\phi}_2,
\end{aligned}$$

where $A_{24} = \frac{\lambda+2\mu+K}{\nu T_0}$, $A_{25} = \frac{\lambda}{\nu T_0}$, $A_{26} = \frac{\lambda_0}{\nu T_0}$, $A_{27} = \frac{\mu}{\nu T_0}$, $A_{28} = \frac{\mu+K}{\nu T_0}$, $A_{29} = \frac{k_4+k_5+k_6}{L^3c_1\nu T_0}$, $A_{30} = \frac{k_4}{L^3c_1\nu T_0}$, $A_{31} = \frac{k_5}{L^3c_1\nu T_0}$, $A_{32} = \frac{k_6}{L^3c_1\nu T_0}$, $A_{33} = \frac{\beta}{L^2\nu T_0}$, $A_{34} = \frac{b_0}{L^2\nu T_0}$, $A_{35} = \frac{\alpha_0}{L^2\nu T_0}$.

Eliminating $\bar{\phi}^*(z)$, $\bar{\psi}_2(z)$, $\bar{\psi}_3(z)$, $\bar{\psi}_4(z)$, $\bar{T}(z)$ and $\bar{\phi}_2(z)$ from (3.1)–(3.7), we get the equation for $\bar{\psi}_1(z)$ as,

$$(D^{14} + PD^{12} + QD^{10} + RD^8 + SD^6 + ED^4 + FD^2 + G)\bar{\psi}_1(z) = 0.$$

where,

$$\begin{aligned}
P = [&A_5A_6 + B_2A_{11} - B_3A_{16} - B_6A_{12} + B_7A_{17}\\
&- B_8 - B_{10} - B_{12} - B_{13} - B_{14} - B_{15} - B_{16} - B_{18}A_8]
\end{aligned}$$

$$Q = [Q_{11} + Q_{12} + Q_{13} + Q_{14} + Q_{15} + Q_{16} + Q_{17} + Q_{18} + Q_{19}]$$

$$R = [R_{11} + R_{12} + R_{13} + R_{14} + R_{15} + R_{16} + R_{17} + R_{18} + R_{19} + R_{20} + R_{21} + R_{22} + R_{23} + R_{24} + R_{25} + R_{26} + R_{27} + R_{28} + R_{29} + R_{30} + R_{31} + R_{32} + R_{33} + R_{34} + R_{35} + R_{36} + R_{37} + R_{38} + R_{39} + R_{40} + R_{41} + R_{42} + R_{43} + R_{44} + R_{45}],$$

$$S = [S_{11} + S_{12} + S_{13} + S_{14} + S_{15} + S_{16} + S_{17} + S_{18} + S_{19} + S_{20} + S_{21} + S_{22} + S_{23} + S_{24} + S_{25} + S_{26} + S_{27} + S_{28} + S_{29} + S_{30} + S_{31} + S_{32} + S_{33} + S_{34} + S_{35} + S_{36} + S_{37} + S_{38} + S_{39} + S_{40} + S_{41} + S_{42} + S_{43} + S_{44} + S_{45} + S_{46} + S_{47} + S_{48} + S_{49} + S_{50} + S_{51} + S_{52} + S_{53} + S_{54} + S_{55} + S_{56} + S_{57} + S_{58} + S_{59} + S_{60} + S_{61} + S_{62} + S_{63} + S_{64} + S_{65} + S_{66} + S_{67} + S_{68} + S_{69} + S_{70} + S_{71} + S_{72} + S_{73} + S_{74} + S_{75} + S_{76} + S_{77} + S_{78} + S_{79} + S_{80}],$$

$$E = [E_{11} + E_{12} + E_{13} + E_{14} + E_{15} + E_{16} + E_{17} + E_{18} + E_{19} + E_{20} + E_{21} + E_{22} + E_{23} + E_{24} + E_{25} + E_{26} + E_{27} + E_{28} + E_{29} + E_{30} + E_{31} + E_{32} + E_{33} + E_{34} + E_{35} + E_{36} + E_{37} + E_{38} + E_{39} + E_{40} + E_{41} + E_{42} + E_{43} + E_{44} + E_{45} + E_{46} + E_{47} + E_{48} + E_{49} + E_{50} + E_{51} + E_{52} + E_{53} + E_{54} + E_{55} + E_{56} + E_{57} + E_{58} + E_{59} + E_{60} + E_{61} + E_{62} + E_{63} + E_{64} + E_{65} + E_{66} + E_{67} + E_{68} + E_{69} + E_{70} + E_{71} + E_{72} + E_{73} + E_{74} + E_{75} + E_{76} + E_{77} + E_{78} + E_{79} + E_{80} + E_{81} + E_{82} + E_{83} + E_{84} + E_{85} + E_{86} + E_{87}],$$

$$F = [F_{11} + F_{12} + F_{13} + F_{14} + F_{15} + F_{16} + F_{17} + F_{18} + F_{19} + F_{20} + F_{21} + F_{22} + F_{23} + F_{24} + F_{25} + F_{26} + F_{27} + F_{28} + F_{29} + F_{30} + F_{31} + F_{32} + F_{33} + F_{34} + F_{35} + F_{36} + F_{37} + F_{38} + F_{39} + F_{40} + F_{41} + F_{42} + F_{43} + F_{44} + F_{45} + F_{46} + F_{47} + F_{48} + F_{49} + F_{50} + F_{51} + F_{52} + F_{53} + F_{54} + F_{55} + F_{56} + F_{57} + F_{58} + F_{59} + F_{60} + F_{61}],$$

$$G = [G_{11} + G_{12} + G_{13} + G_{14} + G_{15} + G_{16} + G_{17} + G_{18} + G_{19} + G_{20} + G_{21} + G_{22} + G_{23} + G_{24}],$$

where $Q_{ij}, R_{ij}, S_{ij}, E_{ij}, F_{ij}$ and G_{ij} are given as in appendix.

In a similar manner we can show that $\bar{\phi}^*(z)$, $\bar{\psi}_2(z)$, $\bar{\psi}_3(z)$, $\bar{\psi}_4(z)$, $\bar{T}(z)$, $\bar{\phi}_2(z)$ satisfies the equation,

$$(D^{14} + PD^{12} + QD^{10} + RD^8 + SD^6 + ED^4 + FD^2 + G)\big(\bar{\phi}^*(z),\ \bar{\psi}_i(z), \bar{T}(z),\ \bar{\phi}_2(z)\big) = 0 \tag{3.8}$$

which can be factorized as follows,

$$(D^2 - r_1^2)(D^2 - r_2^2)(D^2 - r_3^2)(D^2 - r_4^2)(D^2 - r_5^2)(D^2 - r_6^2)(D^2 - r_7^2)\bar{\psi}_1(z) = 0,$$

where, r_n^2; $(n = 1, 2, \ldots, 7)$ are the roots of equation (3.8).

The series solution of equation (3.8) can be expressed in the form,

$$\bar{\psi}_1(z) = \sum_{n=1}^{7}[M_n(a,\omega)e^{-r_n z}] + \sum_{n=1}^{7}[M_{n+7}(a,\omega)e^{r_n z}], \tag{3.9}$$

$$\bar{\psi}_2(z) = \sum_{n=1}^{7}[M'_n(a,\omega)e^{-r_n z}] + \sum_{n=1}^{7}[M'_{n+7}(a,\omega)e^{r_n z}], \tag{3.10}$$

$$\bar{\psi}_3(z) = \sum_{n=1}^{7}[M''_n(a,\omega)e^{-r_n z}] + \sum_{n=1}^{7}[M''_{n+7}(a,\omega)e^{r_n z}], \tag{3.11}$$

$$\bar{\psi}_4(z) = \sum_{n=1}^{7}[M'''_n(a,\omega)e^{-r_n z}] + \sum_{n=1}^{7}[M'''_{n+7}(a,\omega)e^{r_n z}], \tag{3.12}$$

$$\bar{T}(z) = \sum_{n=1}^{7}[M''''_n(a,\omega)e^{-r_n z}] + \sum_{n=1}^{7}[M''''_{n+7}(a,\omega)e^{r_n z}], \tag{3.13}$$

$$\bar{\phi}^*(z) = \sum_{n=1}^{7}[M^v_n(a,\omega)e^{-r_n z}] + \sum_{n=1}^{7}[M^v_{n+7}(a,\omega)e^{r_n z}], \tag{3.14}$$

$$\bar{\phi}_2(z) = \sum_{n=1}^{7}[M^{vi}_n(a,\omega)e^{-r_n z}] + \sum_{n=1}^{7}[M^{vi}_{n+7}(a,\omega)e^{r_n z}], \tag{3.15}$$

where $M_n(a,\omega)$, $M'_n(a,\omega)$, $M''_n(a,\omega)$, $M'''_n(a,\omega)$, $M''''_n(a,\omega)$, $M^v_n(a,\omega)$, $M^{vi}_n(a,\omega)$ are specific function depending upon a, and ω.

Using equation (3.9)–(3.15) in (3.1)–(3.7), we get

$$\begin{aligned}
M''_n(a,\omega) &= H_{1n}M_n(a,\omega), M''_{n+7}(a,\omega) = H_{1(n+7)}M_{n+7}(a,\omega),\\
M^v_n(a,\omega) &= H_{2n}M_n(a,\omega), M^v_{n+7}(a,\omega) = H_{2(n+7)}M_{n+7}(a,\omega),\\
M''''_n(a,\omega) &= H_{3n}M_n(a,\omega), M''''_{n+7}(a,\omega) = H_{3(n+7)}M_{n+7}(a,\omega),\\
M'_n(a,\omega) &= H_{4n}M_n(a,\omega), M'_{n+7}(a,\omega) = H_{4(n+7)}M_{n+7}(a,\omega),\\
M^{vi}_n(a,\omega) &= H_{5n}M_n(a,\omega), M^{vi}_{n+7}(a,\omega) = H_{5(n+7)}M_{n+7}(a,\omega),\\
M'''_n(a,\omega) &= H_{6n}M_n(a,\omega), M'''_{n+7}(a,\omega) = H_{6(n+7)}M_{n+7}(a,\omega).
\end{aligned}$$

Thus we have,

$$\bar{\psi}_2(z) = \sum_{n=1}^{7}[H_{4n}M_n(a,\omega)e^{-r_n z}] + \sum_{n=1}^{7}[H_{4(n+7)}M_{n+7}(a,\omega)e^{r_n z}], \tag{3.16}$$

$$\bar{\psi}_3(z) = \sum_{n=1}^{7}[H_{1n}M_n(a,\omega)e^{-r_n z}] + \sum_{n=1}^{7}[H_{1(n+7)}M_{n+7}(a,\omega)e^{r_n z}], \tag{3.17}$$

$$\bar{\psi}_4(z) = \sum_{n=1}^{7}[H_{6n}M_n(a,\omega)e^{-r_n z}] + \sum_{n=1}^{7}[H_{6(n+7)}M_{n+7}(a,\omega)e^{r_n z}], \tag{3.18}$$

$$\bar{T}(z) = \sum_{n=1}^{7}[H_{3n}M_n(a,\omega)e^{-r_nz}] + \sum_{n=1}^{7}[H_{3(n+7)}M_{n+7}(a,\omega)e^{r_nz}], \tag{3.19}$$

$$\bar{\phi}^*(z) = \sum_{n=1}^{7}[H_{2n}M_n(a,\omega)e^{-r_nz}] + \sum_{n=1}^{7}[H_{2(n+7)}M_{n+7}(a,\omega)e^{r_nz}], \tag{3.20}$$

$$\bar{\phi}_2(z) = \sum_{n=1}^{7}[H_{5n}M_n(a,\omega)e^{-r_nz}] + \sum_{n=1}^{7}[H_{5(n+7)}M_{n+7}(a,\omega)e^{r_nz}], \tag{3.21}$$

$$\bar{\sigma}_{xx}(z) = \sum_{n=1}^{7}[H_{7n}M_n(a,\omega)e^{-r_nz}] + \sum_{n=1}^{7}[H_{7(n+7)}M_{n+7}(a,\omega)e^{r_nz}], \tag{3.22}$$

$$\bar{\sigma}_{zx}(z) = \sum_{n=1}^{7}[H_{8n}M_n(a,\omega)e^{-r_nz}] + \sum_{n=1}^{7}[H_{8(n+7)}M_{n+7}(a,\omega)e^{r_nz}], \tag{3.23}$$

$$\bar{\sigma}_{zz}(z) = \sum_{n=1}^{7}[H_{9n}M_n(a,\omega)e^{-r_nz}] + \sum_{n=1}^{7}[H_{9(n+7)}M_{n+7}(a,\omega)e^{r_nz}], \tag{3.24}$$

$$\bar{q}_{xx}(z) = \sum_{n=1}^{7}[H_{10n}M_n(a,\omega)e^{-r_nz}] + \sum_{n=1}^{7}[H_{10(n+7)}M_{n+7}(a,\omega)e^{r_nz}], \tag{3.25}$$

$$\bar{q}_{zz}(z) = \sum_{n=1}^{7}[H_{11n}M_n(a,\omega)e^{-r_nz}] + \sum_{n=1}^{7}[H_{11(n+7)}M_{n+7}(a,\omega)e^{r_nz}], \tag{3.26}$$

$$\bar{q}_{zx}(z) = \sum_{n=1}^{7}[H_{12n}M_n(a,\omega)e^{-r_nz}] + \sum_{n=1}^{7}[H_{12(n+7)}M_{n+7}(a,\omega)e^{r_nz}], \tag{3.27}$$

$$\bar{m}_{zy}(z) = \sum_{n=1}^{7}[H_{13n}M_n(a,\omega)e^{-r_nz}] + \sum_{n=1}^{7}[H_{13(n+7)}M_{n+7}(a,\omega)e^{r_nz}], \tag{3.28}$$

$$\bar{\lambda}_3^*(z) = \sum_{n=1}^{7}[H_{14n}M_n(a,\omega)e^{-r_nz}] + \sum_{n=1}^{7}[H_{14(n+7)}M_{n+7}(a,\omega)e^{r_nz}], \tag{3.29}$$

where,

$$H_{1n} = \frac{\{(A_{11}B_6B_7 + A_{16}B_7^2)r_n^4 + B_{19}r_n^2 + B_{20}\}}{\{B_7r_n^6 - B_{21}r_n^4 + (B_{22}+B_{23})r_n^2 + B_{24}\}},$$

$$H_{2n} = \frac{\{[B_{25}H_{1n} - B_{26}]r_n^2 + a^2B_7(A_{11} + A_{12}H_{1n}) - A_{13}B_{15}H_{1n}\}}{\{B_7B_{13} + A_{13}B_6 - B_7r_n^2\}},$$

$$H_{3n} = \frac{\{(r_n^2 - B_{15})H_{1n} - B_6H_{2n}\}}{B_7},$$

$$H_{4n} = \frac{\{B_3H_{3n} - B_2H_{2n} - (r_n^2 - B_8)\}}{B_9},$$

$$H_{5n} = \frac{\{B_{11} - (r_n^2 - B_{10})H_{4n}\}}{A_5},$$

$$
\begin{aligned}
H_{6n} &= \frac{B_{18}H_{5n}}{(B_6 - r_n^2)},\\
H_{7n} &= [A_{25}r_n^2 - a^2A_{24} - ia(A_{25} - A_{24})r_nH_{4n} - H_{3n} + A_{26}H_{2n}],\\
H_{8n} &= -ia(A_{27} + A_{28})r_n - (A_{27}r_n^2 + A_{28}a^2)H_{4n} - (A_{28} - A_{27})\,H_{5n},\\
H_{9n} &= [A_{24}r_n^2 - a^2A_{25} - ia(A_{24} - A_{25})r_nH_{4n} - H_{3n} + A_{26}H_{2n}],\\
H_{10n} &= [(A_{29}a^2 - A_{30}r_n^2)H_{1n} - ia(A_{29} - A_{30})r_nH_{6n}],\\
H_{11n} &= [(A_{30}a^2 - A_{29}r_n^2)H_{1n} - ia(A_{30} - A_{29})r_nH_{6n}],\\
H_{12n} &= [ia(A_{31} + A_{32})r_nH_{1n} + (A_{32}r_n^2 + A_{31}a^2)H_{6n}],\\
H_{13n} &= -[r_nA_{33}H_{5n} + iaA_{34}H_{2n}],\\
H_{14n} &= -[r_nA_{35}H_{2n} + iaA_{34}H_{5n}],\\
H_{1(n+7)} &= \frac{\{(A_{11}B_6B_7 + A_{16}B_7^2)r_n^4 + B_{19}r_n^2 + B_{20}\}}{\{B_7r_n^6 - B_{21}r_n^4 + (B_{22} + B_{23})r_n^2 + B_{24}\}},\\
H_{2(n+7)} &= \frac{\{[B_{25}H_{1(n+7)} - B_{26}]r_n^2 + a^2B_7(A_{11} + A_{12}H_{1(n+7)}) - A_{13}B_{15}H_{1(n+7)}\}}{\{B_7B_{13} + A_{13}B_6 - B_7r_n^2\}},\\
H_{3(n+7)} &= \frac{\{(r_n^2 - B_{15})H_{1(n+7)} - B_6H_{2(n+7)}\}}{B_7},\\
H_{4(n+7)} &= \frac{\{B_3H_{3(n+7)} - B_2H_{2(n+7)} - (r_n^2 - B_8)\}}{B_9},\\
H_{5(n+7)} &= \frac{\{B_{11} - (r_n^2 - B_{10})H_{4(n+7)}\}}{A_5},\\
H_{6(n+7)} &= \frac{B_{18}H_{5(n+7)}}{(B_6 - r_n^2)},\\
H_{7(n+7)} &= [A_{25}r_n^2 - a^2A_{24} + ia(A_{25} - A_{24})r_nH_{4(n+7)} - H_{3(n+7)} + A_{26}H_{2(n+7)}],\\
H_{8(n+7)} &= ia(A_{27} + A_{28})r_n - (A_{27}r_n^2 + A_{28}a^2)H_{4(n+7)} - (A_{28} - A_{27})\,H_{5(n+7)},\\
H_{9(n+7)} &= [A_{24}r_n^2 - a^2A_{25} + ia(A_{24} - A_{25})r_nH_{4(n+7)} - H_{3(n+7)} + A_{26}H_{2(n+7)}],\\
H_{10(n+7)} &= [(A_{29}a^2 - A_{30}r_n^2)H_{1(n+7)} + ia(A_{29} - A_{30})r_nH_{6(n+7)}],\\
H_{11(n+7)} &= [(A_{30}a^2 - A_{29}r_n^2)H_{1(n+7)} + ia(A_{30} - A_{29})r_nH_{6(n+7)}],\\
H_{12(n+7)} &= [-ia(A_{31} + A_{32})r_nH_{1(n+7)} + (A_{32}r_n^2 + A_{31}a^2)H_{6(n+7)}],\\
H_{13(n+7)} &= [r_nA_{33}H_{5(n+7)} - iaA_{34}H_{2(n+7)}],\\
H_{14(n+7)} &= [r_nA_{35}H_{2(n+7)} - iaA_{34}H_{5(n+7)}],\\
B_{19} &= A_{11}B_7^2B_{17} - A_{11}B_7B_6B_{14} - A_{11}B_7B_6a^2 + A_{16}B_7^2B_{13} - B_{27},\\
B_{20} &= -A_{11}B_7^2B_{17}a^2 + A_{11}B_7B_6B_{14}a^2 + A_{16}B_7^2B_{13}a^2 + A_{16}B_7B_6A_{13}a^2,\\
B_{21} &= B_7B_{13} + A_{13}B_6 + B_7(B_{14} + B_{15} - A_{17}B_7) - A_{13}B_6 + A_{12}B_7B_6,\\
B_{22} &= (B_{14}B_{15} - A_{17}B_7)(B_7B_{13} + A_{13}B_6) + (B_{14}B_{15} - A_{17}B_7a^2) + B_{28},\\
B_{23} &= A_{12}B_6B_7a^2 + A_{12}B_7B_6B_{14} - A_{12}B_{17}B_7^2,
\end{aligned}
$$

$$B_{24} = A_{13}B_{15}B_6B_{14} - A_{13}B_{15}B_7B_{17} + A_{12}B_7^2B_{17}a^2 - B_{29},$$
$$B_{25} = (A_{13} - A_{12}B_7),$$
$$B_{26} = A_{11}B_7,$$
$$B_{27} = A_{16}B_7B_6A_{13} - a^2A_{16}B_7^2,$$
$$B_{28} = A_{13}B_7B_{17} - A_{13}B_6B_{14} - A_{13}B_6B_{15},$$
$$B_{29} = A_{12}B_7a^2B_6B_{14} - (B_7B_{13} + A_{13}B_6)(B_{14}B_{15} - A_{17}B_7a^2).$$

4. Boundary Conditions

In this section we determine the parameters M_n ; $(n = 1, 2, \dots 14)$. For this boundary conditions at the interface $z = 0$ have been taken as,

$$\sigma_{zz}(x, 0^+, t) = \sigma_{zz}(x, 0^-, t) - P_1e^{\omega t + iax};$$
$$\sigma_{zx}(x, 0^+, t) = \sigma_{zx}(x, 0^-, t);$$
$$m_{zy}(x, 0^+, t) = m_{zy}(x, 0^-, t);$$
$$\lambda_3^*(x, 0^+, t) = \lambda_3^*(x, 0^-, t);$$
$$u_1(x, 0^+, t) = u_1(x, 0^-, t);$$
$$u_3(x, 0^+, t) = u_3(x, 0^-, t);$$
$$q_{zz}(x, 0^+, t) = q_{zz}(x, 0^-, t);$$
$$q_{zx}(x, 0^+, t) = q_{zx}(x, 0^-, t);$$
$$T(x, 0^+, t) = T(x, 0^-, t);$$
$$\frac{\partial T}{\partial z}(x, 0^+, t) = \frac{\partial T}{\partial z}(x, 0^-, t);$$
$$w_1(x, 0^+, t) = w_1(x, 0^-, t);$$
$$w_3(x, 0^+, t) = w_3(x, 0^-, t);$$
$$\phi_2(x, 0^+, t) = \phi_2(x, 0^-, t);$$
$$\phi^*(x, 0^+, t) = \phi^*(x, 0^-, t).$$

where P_1 is the magnitude of mechanical force.

Using the expressions of σ_{zz}, σ_{zx}, m_{zy}, u_1, u_3, λ_3^*, q_{zz}, q_{zx}, T, w_1, w_3, ϕ_2, ϕ^* from (3.16)–(3.29) into the above boundary conditions, we obtain a system of fourteen non homogenous linear equations. After solving these system of equations, we get the values of constants M_n; $(n = 1, 2, \dots 14)$ and hence obtain the component of normal displacement, microtemperature, normal force stress, microstress moment tensor, temperature distribution, heat flux moment tensor and tangential couple stress for microstretch thermoelastic solid with microtemperatures.

5. Particular Cases

(i) If we neglect micropolarity effect i.e $\alpha = \beta = \gamma = b_0 = \mu = K = J = 0$, we obtain the results for microstretch thermoelastic solid with microtemperatures without microrotational effect (TSMWM).

(ii) If we neglect stretch effect i.e $\alpha_0 = \lambda_0 = \lambda_1 = \nu_1 = b_0 = \mu_2 = J_0 = 0$, we obtain the results for thermoelastic solid with microtemperatures without stretch effect (TSMWS).

(iii) If we neglect both micropolarity effect and stretch effect i.e $\alpha = \beta = \gamma = 0$, $\mu = K = J = \alpha_0 = \lambda_0 = \lambda_1 = \nu_1 = b_0 = \mu_2 = J_0 = 0$, we obtain the results for thermoelastic solid with microtemperatures (TSM).

6. Numerical Results, Discussion And Conclusion

In order to illustrate the theoretical results obtained in the preceding section, we take the following values of parameters for,

a) micropolar constants are given by [32]:
$\lambda = 9.4\times10^{10} N/m^2$, $\mu = 4.0\times10^{10} N/m^2$, $\rho = 1.74\times10^3 kg/m^3$, $K = 10^{10} Nm^{-2}$, $\gamma = 7.79 \times 10^{-10} N$, $J = 0.0000002 \times 10^{-14} m^2$, $\beta = 0.32 \times 10^{10} N/m^2K$, $b_0 = 0.0098 \times 10^{10} N$.

b) thermal parameters are given by [31]:
$c^* = 0.104 \times 10^4 Nm/Kg/K$, $T_0 = 298K$, $K^* = 1.7 \times 10^2 Ns^{-1}K^{-1}$, $\alpha_{t_1} = 0.05K^{-1}$, $\alpha_{t_2} = 0.05K^{-1}$, $\tau_1 = 0.613 \times 10^3 s$.

c) micro stretch parameters and microtemperature parameters are given by [46]:
$j_0 = 0.000019 \times 10^{-13} m^2$, $\lambda_0 = 0.21 \times 10^{11} N/m^2$, $\lambda_1 = 0.007 \times 10^{12} N/m^2$, $\alpha_0 = 0.008 \times 10^{-7} N$, $b = 0.15 \times 10^{-10} N$, $k_1 = 0.0035 Ns^{-1}$, $k_2 = 0.045 Ns^{-1}$, $k_3 = 0.055 NK^{-1}s^{-1}$, $k_4 = 0.065 Ns^{-1}m^2$, $k_5 = 0.076 Ns^{-1}m^2$, $k_6 = 0.096 Ns^{-1}m^2$, $\mu_1 = 0.0085N$, $\mu_2 = 0.0095N$.

The computations are carried out for the value of non-dimensional time $t = 0.2$ in the range $0 \leqslant x \leqslant 10$ and on the surface $z = 1.3$. The variations for normal displacement, microtemperature, normal force stress, microstress moment tensor, temperature distribution, heat flux moment tensor and tangential couple stress are shown in figures 1–7 for mechanical force with magnitude, $P_1 = 1.0$, $\omega = \omega_0 + \iota\xi$, $\omega_0 = -0.3$, $\xi = 0.1$, $\Omega = 0.5$ and $a = 0.9$ for

(a) Microstretch thermoelastic solid with microtemperatures (MTSM) by solid line with centered symbol ♦.
(b) Microstretch thermoelastic solid with microtemperatures without microrotational effect (TSMWM) by dashed line with centered symbol ■.
(c) Thermoelastic solid with microtemperatures without stretch effect (TSMWS) by dashed line with centered symbol ▲.
(d) Thermoelastic solid with microtemperatures (TSM) by dotted line with centered symbol ×.

Discussion. The variation of normal displacement for MTSM and TSM are opposite in nature and mirror images of each other. These values of normal displacement for MTSM and TSM coincide at $x = 0$, 3.5 and 7.6 respectively. Also the values of normal displacement for TSMWM and TSMWS lie in a short range and are more uniform in nature. These variations of normal displacement are shown in figure 1.

From figure 2, we observe that the variations of microtemperature are highly oscillatory in nature for TSMWS. The variations for MTSM and TSMWM are quite similar in nature with slight variation in magnitude. The values of microtemperature for TSM are very less.

Similar to the variation of microtemperature, the variations of normal force stress are similar in nature for MTSM and TSMWM. But in this case the variations for TSMWS and TSM are reversed i.e. the variation of normal force stress for TSM are highly oscillatory in nature. These variations of normal force stress for different medium is shown in figure 3.

It is interesting to observe from figure 4 that the variation of microstress tensor for both the medium (MTSM & TSMWM) are exactly opposite to each other. The variations of temperature distribution shown in figure 5, is similar to the variation of microtemperature for different medium.

In the absence of stretch effect (TSMWS & TSM), the variations of heat flux moment tensor are identical in nature. These variations for heat flux moment tensor are also similar in the presence of stretch effect (MTSM & TSMWM), but the degree of similarity is less as compared to the medium without stretch effect. These variations of heat flux moment tensor are shown in figure 6.

Figure 7 depicts the variation of tangential couple stress in MTSM & TSMWS. These variations show that the values for both the medium near the application of source is close to each other. However with increase in horizontal distance the difference between the values of couple stress becomes significant.

Conclusion. The problem of a rotating microstretch thermoelastic solid with microtemperatures has wide applications in mechanics. It is observed from graphical results that microrotation and stretch has significant effect on thermoelastic medium. The variations of microtemperatures and temperature distribution are similar in nature. It is also observed that the variations of normal displacement for MTSM and TSM are opposite to each other whereas the variations of micro stress tensor are opposite in nature for MTSM and TSMWM.

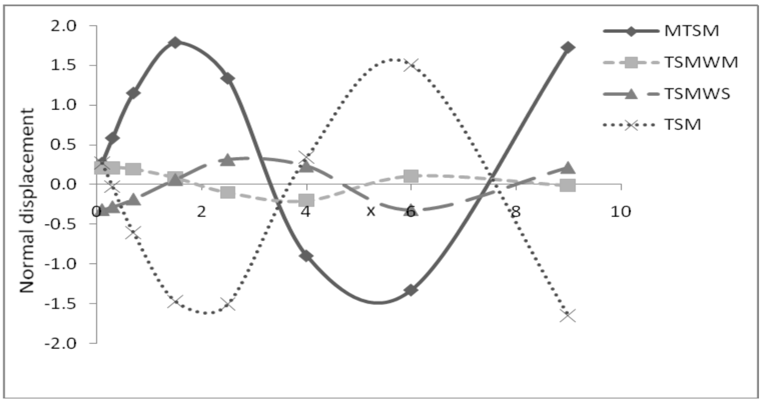

FIGURE 1. Variation of normal displacement with horizontal distance

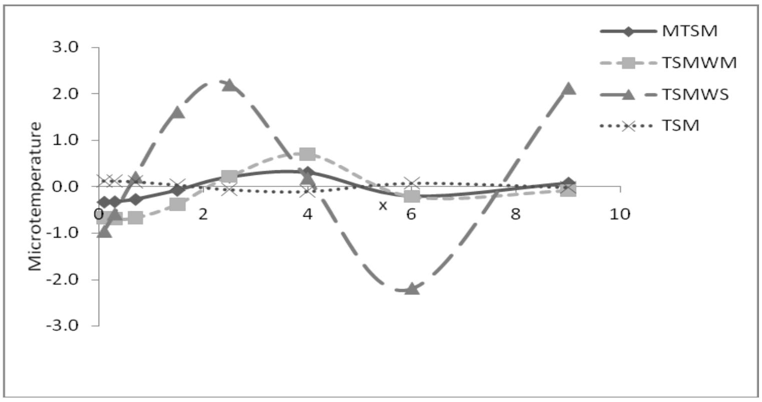

FIGURE 2. Variation of microtemperature with horizontal distance

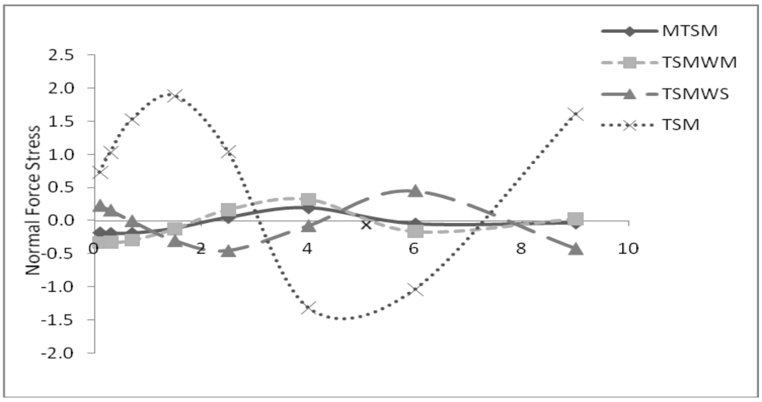

FIGURE 3. Variation of normal force stress with horizontal distance

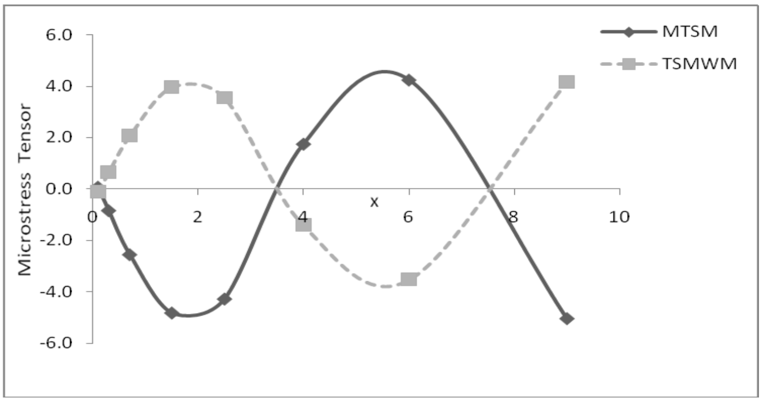

FIGURE 4. Variation of microstress tensor with horizontal distance

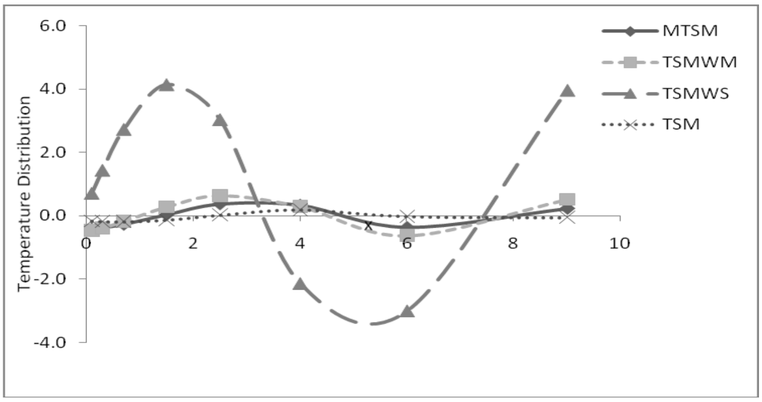

FIGURE 5. Variation of temperature distribution with horizontal distance

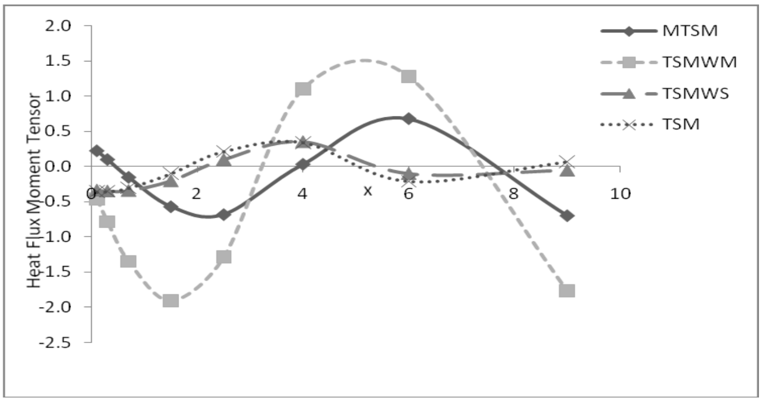

FIGURE 6. Variation of heat flux moment tensor with horizontal distance

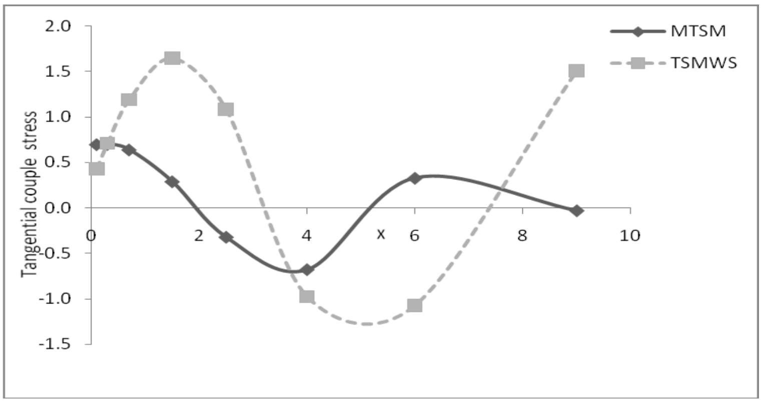

FIGURE 7. Variation of tangential couple stress with horizontal distance

Appendix

$$
\begin{aligned}
Q_{11} =& - A_5A_6a^2 - A_{11}B_2a^2 + A_5A_6A_{11}B_2 - A_{13}A_{16}B_2 + A_{16}B_3a^2\\
&- A_5A_6A_{16}B_3A_{12}B_6a^2 - A_5A_6A_{12}B_6 + B_2A_{16}A_{12}B_7\\
&+ B_2A_{11}A_{17}B_7 - A_{17}B_7B_{10} + B_8B_{10},\\
Q_{12} =& -A_{13}A_{17}B_6 + B_3A_{16}A_{12}B_6 + A_{11}A_{17}B_3B_6 - A_{17}B_7a^2 + A_5A_6A_{17}B_7,\\
Q_{13} =& -A_5A_6B_8 + A_{12}B_6B_8 - A_{17}B_7B_8 - A_{11}B_2B_{10} + A_{16}B_3B_{10} + A_{12}B_6B_{10},\\
Q_{14} =& - A_{11}B_2B_{12} + A_{16}B_3B_{12} + A_{12}B_6B_{12} - A_{17}B_7B_{12} + B_8B_{12} + B_{10}B_{12}\\
&- A_5A_6B_{13} + A_{16}B_3B_{13} - A_{17}B_7B_{13} + B_{10}B_{14}\\
&+ B_{12}B_{14} + B_{13}B_{14} + B_{14}B_{15} - A_5A_6B_{16},\\
Q_{15} =& B_8B_{13} + B_{10}B_{13} + B_{12}B_{13} - A_5A_6B_{14} - A_{11}B_2B_{14} + A_{12}B_6B_{14} + B_8B_{14},\\
Q_{16} =& -A_5A_6B_{15} - A_{11}B_2B_{15} + A_{16}B_3B_{15} + B_8B_{15} + B_{10}B_{15} + B_{12}B_{15} + B_{13}B_{15},\\
Q_{17} =& - A_{11}B_2B_{16} + A_{16}B_3B_{16} + A_{12}B_6B_{16} - A_{17}B_7B_{16} + B_8B_{16} + B_{10}B_{16}\\
&+ B_{12}B_{16} + B_{13}B_{16} + B_{14}B_{16} + A_8B_6A_{12}B_{18}\\
&- A_8B_7A_{17}B_{18} + B_9B_{11} + B_{15}B_{16},\\
Q_{18} =& A_{13}B_{17} - A_{11}B_3B_{17} - A_{12}B_7B_{17} + A_8B_{18}a^2 - A_8B_2A_{11}B_{18} + A_8B_3A_{16}B_{18},\\
Q_{19} =& A_8B_8B_{18} + A_8B_{10}B_{18} + A_8B_{13}B_{18} + A_8B_{14}B_{18} + A_8B_8B_{18} + A_8B_{15}B_{18},\\
R_{11} =& - 2a^2A_5A_6A_{11}B_2 + a^2A_{13}A_{16}B_2 - A_5A_6A_{13}A_{16}B_2 + 2a^2A_5A_6A_{16}B_3\\
&+ 2a^2A_5A_6A_{12}B_6 + a^2A_{13}A_{17}B_6 + A_5A_6A_{11}A_{17}B_3B_6 + A_5A_6A_{11}A_{17}B_2B_7,\\
R_{12} =& -A_5A_6A_{13}A_{17}B_6 - 2a^2A_{12}A_{16}B_3B_6 + A_5A_6A_{12}A_{16}B_3B_6 - 2a^2A_{11}A_{17}B_3B_6,\\
R_{13} =& -2a^2A_5A_6A_{17}B_7 - 2a^2A_{12}A_{16}B_2B_7 + A_5A_6A_{12}A_{16}B_2B_7 - 2a^2A_{11}A_{17}B_2B_7,\\
R_{14} =& a^2A_5A_6B_8 - a^2A_{12}B_6B_8 + A_5A_6A_{12}B_6B_8 + A_{13}A_{17}B_6B_8 + a^2A_{17}B_7B_8\\
&- A_5A_6A_{17}B_7B_8 + a^2A_{11}B_2B_{10} - A_{12}A_{16}B_3B_6B_{10} - A_{11}A_{17}B_3B_6B_{10},\\
R_{15} =& A_{13}A_{16}B_2B_{10} - a^2A_{16}B_3B_{10} - a^2A_{12}B_6B_{10} + A_{13}A_{17}B_6B_{10},\\
R_{16} =& a^2A_{17}B_7B_{10} - A_{12}A_{16}B_2B_7B_{10} - A_{11}A_{17}B_2B_7B_{10} - A_{12}B_6B_8B_{10}\\
&+ A_{17}B_7B_8B_{10} - A_{12}B_6B_9B_{11} - A_{11}A_{17}B_3B_6B_{12} + a^2A_{17}B_7B_{12},\\
R_{17} =& a^2A_{16}B_3B_{12} - a^2A_{12}B_6B_{12} + A_{13}A_{17}B_6B_{12} - A_{12}A_{16}B_3B_6B_{12},\\
R_{18} =& - A_{12}A_{16}B_2B_7B_{12} - A_{11}A_{17}B_2B_7B_{12} - A_{12}B_6B_8B_{12} + A_{17}B_7B_8B_{12}\\
&+ A_{11}B_2B_{10}B_{12} - A_{16}B_3B_{10}B_{12} + A_5A_6A_{16}B_3B_{13} + a^2A_{17}B_7B_{13},\\
R_{19} =& A_{17}B_7B_{10}B_{12} - B_8B_{10}B_{12} - B_9B_{11}B_{12} + a^2A_5A_6B_{13} - a^2A_{16}B_3B_{13},\\
R_{20} =& - A_5A_6A_{17}B_7B_{13} + A_5A_6B_8B_{13} + A_{17}B_7B_8B_{13} - A_{16}B_3B_{10}B_{13}\\
&+ A_{17}B_7B_{10}B_{13} - B_8B_{10}B_{13} - B_9B_{11}B_{13} + a^2A_{11}B_2B_{14} - A_5A_6A_{11}B_2B_{14},\\
R_{21} =& -A_{16}B_3B_{12}B_{13} + A_{17}B_7B_{12}B_{13} - B_8B_{12}B_{13} - B_{10}B_{12}B_{13} + a^2A_5A_6B_{14},\\
R_{22} =& - a^2A_{12}B_6B_{14} + A_5A_6A_{12}B_6B_{14} + A_5A_6B_8B_{14} - A_{12}B_6B_8B_{14}\\
&+ A_{11}B_2B_{10}B_{14} - A_{12}B_6B_{10}B_{14} + A_5A_6B_{13}B_{14} - B_8B_{13}B_{14},
\end{aligned}
$$

$$R_{23} = -B_9B_{11}B_{14} + A_{11}B_2B_{12}B_{14} - A_{12}B_6B_{12}B_{14} - B_8B_{12}B_{14} - B_{10}B_{12}B_{14},$$

$$R_{24} = - B_{12}B_{13}B_{14} + a^2A_5A_6B_{15} + a^2A_{11}B_2B_{15} - A_5A_6A_{11}B_2B_{15} + A_{13}A_{16}B_2B_{15} - a^2A_{16}B_3B_{15} - B_{12}B_{13}B_{15} + A_{11}B_2B_{12}B_{15} - A_{16}B_3B_{12}B_{15},$$

$$R_{25} = A_5A_6B_8B_{15} + A_{11}B_2B_{10}B_{15} - A_{16}B_3B_{10}B_{15} - B_8B_{10}B_{15} - B_9B_{11}B_{15},$$

$$R_{26} = - B_8B_{12}B_{15} - B_{10}B_{12}B_{15} + A_5A_6B_{13}B_{15} - A_{16}B_3B_{13}B_{15} - B_8B_{13}B_{15} - B_{10}B_{13}B_{15} - A_8A_{12}B_6B_{10}B_{18} + a^2A_5A_6B_{16} + a^2A_{11}B_2B_{16},$$

$$R_{27} = A_{11}B_2B_{14}B_{15} - B_8B_{14}B_{15} - B_{10}B_{14}B_{15} - B_{12}B_{14}B_{15} - B_{13}B_{14}B_{15},$$

$$R_{28} = A_{13}A_{16}B_2B_{16} - a^2A_{16}B_3B_{16} + A_5A_6A_{16}B_3B_{16} - a^2A_{12}B_6B_{16} + A_5A_6A_{12}B_6B_{16} + A_{13}A_{17}B_6B_{16} - A_{12}B_6B_{10}B_{16} + A_{17}B_7B_{10}B_{16} - B_8B_{10}B_{16},$$

$$R_{29} = - A_{11}A_{17}B_3B_6B_{16} + a^2A_{17}B_7B_{16} - A_5A_6A_{17}B_7B_{16} - A_{12}A_{16}B_2B_7B_{16} - A_{11}A_{17}B_2B_7B_{16} + A_5A_6B_8B_{16} + A_{17}B_7B_{12}B_{16} - B_8B_{12}B_{16} - B_{10}B_{12}B_{16},$$

$$R_{30} = -A_{12}B_6B_8B_{16} + A_{17}B_7B_8B_{16} + A_{11}B_2B_{10}B_{16} - A_{16}B_3B_{10}B_{16},$$

$$R_{31} = -B_9B_{11}B_{16} + A_{11}B_2B_{12}B_{16} - A_{16}B_3B_{12}B_{16} - A_{12}B_6B_{12}B_{16},$$

$$R_{32} = - A_{16}B_3B_{13}B_{16} + A_{17}B_7B_{13}B_{16} - B_8B_{13}B_{16} - B_{10}B_{13}B_{16} - B_{12}B_{13}B_{16} + A_5A_6B_{14}B_{16} + A_{11}B_2B_{14}B_{16} + A_{11}B_2B_{15}B_{16} - A_{16}B_3B_{15}B_{16},$$

$$R_{33} = -B_8B_{14}B_{16} - B_{10}B_{14}B_{16} - B_{12}B_{14}B_{16} - B_{13}B_{14}B_{16} + A_5A_6B_{15}B_{16},$$

$$R_{34} = - B_{10}B_{15}B_{16} - B_{12}B_{15}B_{16} - B_{13}B_{15}B_{16} - B_{14}B_{15}B_{16} + A_5A_6A_{13}B_{17} + a^2A_{11}B_3B_{17} - A_5A_6A_{11}B_3B_{17} + A_{12}B_7B_{10}B_{17} - A_{13}B_{12}B_{17} + A_8A_{13}A_{17}B_6B_{18},$$

$$R_{35} = - A_5A_6A_{12}B_7B_{17} - A_{13}B_7B_{17} + A_{12}B_7B_8B_{17} - A_{13}B_{10}B_{17} + A_{11}B_3B_{10}B_{17},$$

$$R_{36} = A_{11}B_3B_{12}B_{17} + A_{12}B_7B_{12}B_{17} - A_{13}B_{15}B_{17} + A_{11}B_3B_{15}B_{17} - A_{13}B_{16}B_{17} + A_{11}B_3B_{16}B_{17} + A_{12}B_7B_{16}B_{17} - A_8A_{11}A_{17}B_2B_7B_{18} - a^2A_8B_8B_{18},$$

$$R_{37} = 2a^2A_8A_{11}B_2B_{18} + A_8A_{13}A_{16}B_2B_{18} - 2a^2A_8A_{16}B_3B_{18} - 2a^2A_8A_{12}B_6B_{18},$$

$$R_{38} = -A_8A_{11}A_{17}B_3B_6B_{18} + 2a^2A_8A_{17}B_7B_{18} - A_8A_{12}A_{16}B_2B_7B_{18},$$

$$R_{39} = - A_8A_{12}B_8B_6B_{18} + A_8A_{17}B_8B_7B_{18} - a^2A_8B_{10}B_{18} + A_8A_{11}B_2B_{10}B_{18} - A_8A_{16}B_3B_{10}B_{18} - B_8B_{10}B_{14} - A_8A_{16}B_3B_{13}B_{18} + A_8A_{17}B_7B_{13}B_{18},$$

$$R_{40} = A_8A_{17}B_{10}B_7B_{18} - A_8B_8B_{10}B_{18} - A_8B_9B_{11}B_{18} - a^2A_8B_{13}B_{18},$$

$$R_{41} = - A_8B_8B_{13}B_{18} - A_8B_{10}B_{13}B_{18} - a^2A_8B_{14}B_{18} + A_8A_{11}B_2B_{14}B_{18} - A_8A_{12}B_6B_{14}B_{18} - A_8B_8B_{14}B_{18} - A_8B_8B_{15}B_{18} - A_8B_{10}B_{15}B_{18},$$

$$R_{42} = -A_8B_{13}B_{14}B_{18} - a^2A_8B_{15}B_{18} + A_8A_{11}B_2B_{15}B_{18} - A_8A_{16}B_3B_{15}B_{18},$$

$$R_{43} = - A_8B_{14}B_{15}B_{18} - A_8A_{13}B_{17}B_{18} + A_8A_{11}B_3B_{17}B_{18} + A_8A_{12}B_7B_{17}B_{18}$$
$$- A_8B_{13}B_{15}B_{18} - A_8B_{10}B_{14}B_{18} - A_5A_6A_{11}B_2B_{16} + A_5A_6B_{14}B_{15},$$
$$R_{44} = A_{17}B_7B_9B_{11} - A_{12}B_6B_{10}B_{12} - B_{10}B_{13}B_{14} - A_{12}A_{16}B_3B_6B_{16},$$
$$R_{45} = A_5A_6A_{16}B_3B_{15} + A_5A_6B_{13}B_{16} - A_{12}B_6B_{14}B_{16} - B_8B_{15}B_{16}$$
$$+ a^2A_{12}B_7B_{17} - A_8A_{12}A_{16}B_3B_6B_{18},$$
$$S_{11} = a^4A_5A_6A_{11}B_2 + 2a^2A_5A_6A_{13}A_{16}B_2 - a^4A_5A_6A_{16}B_3 - a^4A_5A_6A_{12}B_6$$
$$+ 2a^2A_5A_6A_{13}A_{17}B_6 + a^4A_{12}A_{16}B_6B_3 + a^4A_5A_6A_{17}B_7 + a^4A_{12}A_{16}B_2B_7,$$
$$S_{12} = -3a^2A_5A_6A_{12}A_{16}B_3B_6 + a^4A_{11}A_{17}B_6B_3 - 3a^2A_5A_6A_{11}A_{17}B_3B_6,$$
$$S_{13} = - 3a^2A_5A_6A_{12}A_{16}B_2B_7 + a^4A_{11}A_{17}B_2B_7 - 3a^2A_5A_6A_{11}A_{17}B_2B_7$$
$$- 2a^2A_5A_6A_{12}B_6B_8 - a^2A_{13}A_{17}B_6B_8 + 2a^2A_{12}A_{16}B_3B_6B_{10},$$
$$S_{14} = A_5A_6A_{13}A_{17}B_6B_8 + 2a^2A_5A_6A_{17}B_7B_8 - a^2A_{13}A_{16}B_2B_{10} - a^2A_{13}A_{17}B_6B_{10},$$
$$S_{15} = 2a^2A_{11}A_{17}B_3B_6B_{10} + 2a^2A_{12}A_{16}B_2B_7B_{10} + 2a^2A_{11}A_{17}B_2B_7B_{10}$$
$$+ a^2A_{12}B_8B_6B_{10} - A_{13}A_{17}B_8B_6B_{10} - a^2A_{13}A_{16}B_2B_{12} - a^2A_{13}A_{17}B_6B_{12},$$
$$S_{16} = - a^2A_{17}B_7B_8B_{10} + a^2A_{12}B_6B_9B_{11} - A_{13}A_{17}B_9B_6B_{11} - a^2A_{17}B_7B_9B_{11},$$
$$S_{17} = 2a^2A_{12}A_{16}B_3B_6B_{12} + 2a^2A_{11}A_{17}B_3B_6B_{12} + 2a^2A_{12}A_{16}B_2B_7B_{12}$$
$$+ 2a^2A_{11}A_{17}B_2B_7B_{12} + a^2A_{12}B_8B_6B_{12} + a^2A_{16}B_3B_{10}B_{12},$$
$$S_{18} = -A_{13}A_{17}B_8B_6B_{12} - a^2A_{17}B_7B_8B_{12} - a^2A_{11}B_2B_{10}B_{12} - A_{13}A_{16}B_2B_{10}B_{12},$$
$$S_{19} = - A_{13}A_{17}B_6B_{10}B_{12} + A_{12}A_{16}B_3B_6B_{10}B_{12} + A_{11}A_{17}B_3B_6B_{10}B_{12}$$
$$- a^2A_{17}B_7B_{10}B_{12} + A_{12}A_{16}B_2B_7B_{10}B_{12},$$
$$S_{20} = A_{11}A_{17}B_2B_7B_{10}B_{12} + A_{12}B_8B_6B_{10}B_{12} - A_{17}B_8B_7B_{10}B_{12}$$
$$+ A_{12}B_9B_6B_{11}B_{12} - A_{17}B_7B_9B_{11}B_{12} + a^2A_{16}B_3B_{10}B_{13},$$
$$S_{21} = 2a^2A_5A_6A_{17}B_7B_{13} - a^2A_5A_6B_8B_{13} - a^2A_{17}B_7B_8B_{13} + A_5A_6A_{17}B_7B_8B_{13},$$
$$S_{22} = - A_{17}B_7B_8B_{10}B_{13} - A_{17}B_7B_9B_{11}B_{13} + a^2A_{16}B_3B_{12}B_{13}$$
$$- a^2A_{17}B_7B_{12}B_{13} - A_{17}B_7B_8B_{12}B_{13} + A_{12}B_6B_{10}B_{12}B_{14}$$
$$+ a^2A_{12}B_6B_8B_{10}B_{14} - 2a^2A_5A_6A_{12}B_6B_{14},$$
$$S_{23} = -A_{17}B_7B_{10}B_{12}B_{13} + B_8B_{10}B_{12}B_{13} + B_9B_{11}B_{12}B_{13} + 2a^2A_5A_6A_{11}B_2B_{14},$$
$$S_{24} = a^2A_{12}B_6B_8B_{14} - A_5A_6A_{12}B_6B_8B_{14} - a^2A_{11}B_2B_{10}B_{14} + a^2A_{12}B_6B_{10}B_{14},$$
$$S_{25} = -a^2A_{11}B_2B_{12}B_{14} + a^2A_{12}B_6B_{12}B_{14} + A_{12}B_6B_8B_{12}B_{14} - A_{11}B_2B_{10}B_{12}B_{14},$$
$$S_{26} = B_9B_{11}B_{12}B_{14} - a^2A_5A_6B_{13}B_{14} - A_5A_6B_{14}B_8B_{13} + B_8B_{10}B_{13}B_{14}$$
$$+ B_9B_{11}B_{13}B_{14} + B_8B_{12}B_{13}B_{14} - 2a^2A_5A_6A_{16}B_3B_{15} - a^2A_5A_6B_8B_{15},$$
$$S_{27} = 2a^2A_5A_6A_{11}B_2B_{15} - a^2A_{13}A_{16}B_2B_{15} + A_5A_6A_{13}A_{16}B_2B_{15},$$
$$S_{28} = - A_{13}A_{16}B_2B_{10}B_{15} + a^2B_{10}A_{16}B_3B_{15} - a^2B_2A_{11}B_{12}B_{15}$$
$$- A_{13}A_{16}B_2B_{12}B_{15} + a^2B_3A_{16}B_{12}B_{15} + a^2A_{16}B_3B_{13}B_{15} + B_8B_{13}B_{14}B_{15},$$

$$S_{29} = A_{16}B_3B_{10}B_{12}B_{15} + B_8B_{10}B_{12}B_{15} + B_9B_{11}B_{12}B_{15} - a^2A_5A_6B_{13}B_{15},$$
$$S_{30} = - A_5A_6B_8B_{13}B_{15} + A_{16}B_3B_{10}B_{13}B_{15} + B_8B_{10}B_{13}B_{15} + B_9B_{11}B_{13}B_{15} + A_{16}B_3B_{12}B_{13}B_{15} + B_8B_{12}B_{13}B_{15} - A_{13}A_{17}B_6B_{10}B_{16} - a^2A_{17}B_7B_{10}B_{16},$$
$$S_{31} = - a^2A_5A_6B_{14}B_{15} - a^2A_{11}B_2B_{14}B_{15} + A_5A_6A_{11}B_2B_{14}B_{15} - A_5A_6B_8B_{14}B_{15} - A_{11}B_2B_{10}B_{14}B_{15} - A_5A_6B_{13}B_{14}B_{15} - a^2A_5A_6B_8B_{16},$$
$$S_{32} = B_9B_{11}B_{14}B_{15} - A_{11}B_2B_{12}B_{14}B_{15} + B_8B_{12}B_{14}B_{15} + B_{10}B_{12}B_{14}B_{15},$$
$$S_{33} = B_{12}B_{13}B_{14}B_{15} + 2a^2A_5A_6A_{11}B_2B_{16} - a^2A_{16}A_{13}B_2B_{16} + A_5A_6A_{13}A_{16}B_2B_{16} - 2a^2A_5A_6A_{16}B_3B_{16} + 2a^2A_{12}A_{16}B_3B_6B_{16} - A_8A_{11}B_3B_{15}B_{17}B_{18},$$
$$S_{34} = -2a^2A_5A_6A_{12}B_6B_{16} - a^2A_{13}A_{17}B_6B_{16} + A_5A_6A_{13}A_{17}B_6B_{16},$$
$$S_{35} = - A_5A_6A_{12}A_{16}B_3B_6B_{16} + 2a^2A_{11}A_{17}B_3B_6B_{16} - A_5A_6A_{11}A_{17}B_3B_6B_{16} + 2a^2A_5A_6A_{17}B_7B_{16} + A_5A_6A_{17}B_8B_7B_{16} - A_5A_6A_{11}A_{17}B_2B_7B_{16},$$
$$S_{36} = 2a^2A_{12}A_{16}B_2B_7B_{16} - A_5A_6A_{12}A_{16}B_2B_7B_{16} + 2a^2A_{11}A_{17}B_2B_7B_{16},$$
$$S_{37} = a^2A_{12}B_6B_8B_{16} - A_5A_6A_{12}A_{16}B_6B_8B_{16} - A_{13}A_{17}B_6B_8B_{16} - a^2A_{17}B_7B_8B_{16},$$
$$S_{38} = -a^2A_{11}B_2B_{10}B_{16} - A_{13}A_{16}B_2B_{10}B_{16} + a^2A_{16}B_3B_{10}B_{16} + a^2A_{12}B_6B_{10}B_{16},$$
$$S_{39} = A_{11}A_{17}B_3B_6B_{10}B_{16} + A_{12}A_{16}B_2B_7B_{10}B_{16} + A_{12}B_8B_6B_{10}B_{16},$$
$$S_{40} = - A_{17}B_8B_7B_{10}B_{16} + A_{12}B_9B_6B_{11}B_{16} - A_{17}B_7B_9B_{11}B_{16} - a^2A_{11}B_2B_{12}B_{16} - A_{13}A_{16}B_2B_{12}B_{16} + A_{11}A_{17}B_2B_7B_{10}B_{16} + B_9B_{11}B_{13}B_{16} + A_{16}B_3B_{12}B_{13}B_{16},$$
$$S_{41} = a^2A_{12}B_6B_{12}B_{16} - A_{13}A_{17}B_6B_{12}B_{16} + A_{12}A_{16}B_3B_6B_{12}B_{16} + A_{11}A_{17}B_3B_6B_{12}B_{16} - a^2A_{17}B_7B_{12}B_{16},$$
$$S_{42} = A_{12}A_{16}B_2B_7B_{12}B_{16} + A_{11}A_{17}B_2B_7B_{12}B_{16} + A_{12}B_8B_6B_{12}B_{16} - A_{17}B_8B_7B_{12}B_{16} - A_{11}B_2B_{10}B_{12}B_{16} - A_5A_6B_8B_{13}B_{16},$$
$$S_{43} = A_{16}B_3B_{10}B_{12}B_{16} + A_{12}B_6B_{10}B_{12}B_{16} - A_{17}B_{10}B_7B_{12}B_{16} + B_8B_{10}B_{12}B_{16} + B_9B_{11}B_{12}B_{16} - a^2A_5A_6B_{13}B_{16} + A_5A_6A_{17}B_7B_{13}B_{16},$$
$$S_{44} = a^2A_{16}B_3B_{13}B_{16} - A_5A_6A_{16}B_3B_{13}B_{16} - a^2A_{17}B_7B_{13}B_{16},$$
$$S_{45} = -A_{17}B_7B_8B_{13}B_{16} + A_{16}B_3B_{10}B_{13}B_{16} - A_{17}B_7B_{12}B_{13}B_{16} + B_{10}B_8B_{13}B_{16},$$
$$S_{46} = - A_{17}B_7B_{12}B_{13}B_{16} + B_{12}B_8B_{13}B_{16} - B_{10}B_{12}B_{13}B_{16} - a^2A_5A_6B_{14}B_{16} - a^2A_{11}B_2B_{14}B_{16} + A_5A_6A_{11}B_2B_{14}B_{16},$$
$$S_{47} = a^2A_{12}B_6B_{14}B_{16} - A_5A_6A_{12}B_6B_{14}B_{16} - A_5A_6B_8B_{14}B_{16} + A_{12}B_6B_8B_{14}B_{16} - A_{11}B_2B_{10}B_{14}B_{16} - A_5A_6A_{16}B_3B_{15}B_{16} - A_5A_6B_8B_{15}B_{16},$$
$$S_{48} = B_8B_{10}B_{14}B_{16} + B_9B_{11}B_{14}B_{16} - A_{11}B_2B_{12}B_{14}B_{16} + A_{12}B_6B_{12}B_{14}B_{16} + B_8B_{12}B_{14}B_{16} + B_{10}B_{12}B_{14}B_{16} - a^2A_5A_6B_{15}B_{16} - a^2A_{11}B_2B_{15}B_{16},$$
$$S_{49} = -A_5A_6B_{13}B_{14}B_{16} + B_8B_{13}B_{14}B_{16} + B_{10}B_{13}B_{14}B_{16} + B_{12}B_{13}B_{14}B_{16},$$

$$S_{50} = A_5A_6A_{11}B_2B_{15}B_{16} - A_{13}A_{16}B_2B_{15}B_{16} + a^2A_{16}B_3B_{15}B_{16},$$

$$S_{51} = - A_{11}B_2B_{10}B_{15}B_{16} + A_{16}B_3B_{10}B_{15}B_{16} + B_8B_{10}B_{15}B_{16} + B_9B_{11}B_{15}B_{16} - A_{11}B_2B_{12}B_{15}B_{16} + A_{16}B_3B_{12}B_{15}B_{16} + B_8B_{13}B_{15}B_{16} + B_{10}B_{13}B_{15}B_{16},$$

$$S_{52} = B_8B_{12}B_{15}B_{16} + B_{10}B_{12}B_{15}B_{16} - A_5A_6B_{13}B_{15}B_{16} + A_{16}B_3B_{13}B_{15}B_{16},$$

$$S_{53} =B_{12}B_{13}B_{15}B_{16} - A_5A_6B_{14}B_{15}B_{16} - A_{11}B_2B_{14}B_{15}B_{16} + B_8B_{14}B_{15}B_{16} + B_{10}B_{14}B_{15}B_{16} + B_{12}B_{14}B_{15}B_{16} + A_{13}B_8B_{10}B_{17} - A_{12}B_7B_8B_{10}B_{17},$$

$$S_{54} =B_{13}B_{14}B_{15}B_{16} - a^2A_5A_6A_{13}B_{17} + 2a^2A_5A_6A_{11}B_3B_{17} + 2a^2A_5A_6A_{12}B_7B_{17} - A_5A_6A_{13}B_8B_{17} + A_5A_6A_{12}B_7B_{16}B_{17} + A_{13}B_8B_{16}B_{17},$$

$$S_{55} = -a^2A_{12}B_7B_8B_{17}+A_5A_6A_{12}B_7B_8B_{17} - a^2A_{11}B_3B_{10}B_{17} - a^2A_{12}B_7B_{10}B_{17},$$

$$S_{56} =A_{13}B_9B_{11}B_{17} - A_{12}B_7B_9B_{11}B_{17} - a^2A_{11}B_3B_{12}B_{17} - a^2A_{12}B_7B_{12}B_{17} + A_{13}B_8B_{12}B_{17} - A_{12}B_7B_8B_{12}B_{17},$$

$$S_{57} =A_{13}B_{10}B_{12}B_{17} - A_{11}B_3B_{10}B_{12}B_{17} - A_{12}B_7B_{10}B_{12}B_{17} - A_5A_6A_{13}B_{15}B_{17} - a^2A_{11}B_3B_{15}B_{17} - A_{11}B_3B_{12}B_{15}B_{17} - A_5A_6A_{13}B_{16}B_{17},$$

$$S_{58} = A_{13}B_8B_{15}B_{17} + A_{13}B_{10}B_{15}B_{17} - A_{11}B_3B_{10}B_{15}B_{17} + A_{13}B_{12}B_{15}B_{17},$$

$$S_{59} = -a^2A_{11}B_3B_{16}B_{17} + A_5A_6A_{11}B_3B_{16}B_{17} - a^2A_{12}B_7B_{16}B_{17},$$

$$S_{60} = - A_{12}B_7B_8B_{16}B_{17}+A_{13}B_{10}B_{16}B_{17} - A_{11}B_3B_{10}B_{16}B_{17} - A_{12}B_7B_{10}B_{16}B_{17} + A_{13}B_{12}B_{16}B_{17} - A_{11}B_3B_{12}B_{16}B_{17} - A_8A_{13}A_{17}B_8B_6B_{18},$$

$$S_{61} = - A_{12}B_7B_{12}B_{16}B_{17} + A_{13}B_{15}B_{16}B_{17} - A_{11}B_3B_{15}B_{16}B_{17} - a^4A_8A_{11}B_2B_{18} - 2a^2A_8A_{13}A_{16}B_2B_{18} + 3a^2A_8A_{11}A_{17}B_3B_6B_{18} - a^4A_8A_{17}B_7B_{18},$$

$$S_{62} = a^4A_8A_{12}B_6B_{18} - 2a^2A_8A_{13}A_{17}B_6B_{18} + 3a^2A_8A_{12}A_{16}B_3B_6B_{18},$$

$$S_{63} = 3a^2A_8A_{12}A_{16}B_2B_7B_{18} + 3a^2A_8A_{11}A_{17}B_2B_7B_{18} + 2a^2A_8A_{12}B_6B_8B_{18},$$

$$S_{64} = - 2a^2A_8A_{11}B_2B_{10}B_{18} - A_8A_{13}A_{16}B_2B_{10}B_{18} + 2a^2A_8A_{16}B_3B_{10}B_{18} + 2a^2A_8A_{12}B_6B_{10}B_{18} - 2a^2A_8A_{17}B_7B_{13}B_{18} + a^2A_8B_8B_{13}B_{18},$$

$$S_{65} =A_8A_{12}A_{16}B_3B_6B_{10}B_{18} + A_8A_{11}A_{17}B_3B_6B_{10}B_{18} - 2a^2A_8A_{17}B_7B_{10}B_{18} + A_8A_{12}A_{16}B_2B_7B_{10}B_{18} - A_8A_{17}B_8B_7B_{10}B_{18} + a^2A_8B_9B_{11}B_{18},$$

$$S_{66} = A_8A_{11}A_{17}B_2B_7B_{10}B_{18} + a^2A_8B_8B_{10}B_{18} + A_8A_{12}B_8B_6B_{10}B_{18},$$

$$S_{67} = A_8A_{12}B_9B_6B_{11}B_{18} - A_8A_{17}B_9B_7B_{11}B_{18} + 2a^2A_8A_{16}B_3B_{13}B_{18},$$

$$S_{68} = - A_8A_{17}B_8B_7B_{13}B_{18} + a^2A_8B_{10}B_{13}B_{18} + A_8A_{16}B_3B_{10}B_{13}B_{18} - A_8A_{17}B_{10}B_7B_{13}B_{18} + A_8B_8B_{13}B_{10}B_{18} + A_8B_9B_{11}B_{14}B_{18},$$

$$S_{69} =A_8B_9B_{13}B_{11}B_{18} - 2a^2A_8A_{11}B_2B_{14}B_{18} + 2a^2A_8A_{12}B_6B_{14}B_{18} + a^2A_8B_8B_{14}B_{18} + A_8A_{12}B_6B_8B_{14}B_{18} + A_8B_8B_{10}B_{14}B_{18},$$

$$S_{70} = a^2A_8B_{10}B_{14}B_{18} - A_8A_{11}B_2B_{10}B_{14}B_{18} + A_8A_{12}B_6B_{10}B_{14}B_{18},$$

$$S_{71} = a^2 A_8 B_{13} B_{14} B_{18} + A_8 B_8 B_{13} B_{14} B_{18} + A_8 B_{13} B_{10} B_{14} B_{18} - 2a^2 A_8 A_{11} B_2 B_{15} B_{18} - A_8 A_{13} A_{16} B_2 B_{15} B_{18} + A_8 B_8 B_{13} B_{15} B_{18},$$

$$S_{72} = 2a^2 A_8 A_{16} B_3 B_{15} B_{18} + a^2 A_8 B_8 B_{15} B_{18} + a^2 A_8 B_{10} B_{15} B_{18} - A_8 A_{11} B_2 B_{10} B_{15} B_{18} + A_8 A_{16} B_3 B_{10} B_{15} B_{18} + A_8 A_{16} B_3 B_{13} B_{15} B_{18},$$

$$S_{73} = A_8 B_8 B_{10} B_{15} B_{18} + A_8 B_9 B_{11} B_{15} B_{18} + a^2 A_8 B_{13} B_{15} B_{18},$$

$$S_{74} = A_8 B_{10} B_{13} B_{15} B_{18} + a^2 A_8 B_{14} B_{15} B_{18} - A_8 A_{11} B_2 B_{14} B_{15} B_{18} + A_8 B_8 B_{14} B_{15} B_{18} + A_8 B_{10} B_{14} B_{15} B_{18} + A_8 A_{13} B_{15} B_{17} B_{18},$$

$$S_{75} = A_8 B_{13} B_{14} B_{15} B_{18} + a^2 A_8 A_{13} B_{17} B_{18} - 2a^2 A_8 A_{11} B_3 B_{17} B_{18} - 2a^2 A_8 A_{12} B_7 B_{17} B_{18} + A_8 A_{13} B_8 B_{17} B_{18} - A_8 A_{12} B_7 B_{10} B_{17} B_{18},$$

$$S_{76} = -A_8 A_{12} B_7 B_8 B_{17} B_{18} + A_8 A_{13} B_{10} B_{17} B_{18} - A_8 A_{11} B_3 B_{10} B_{17} B_{18},$$

$$S_{77} = a^2 A_{12} B_6 B_{10} B_{12} - 2a^2 A_5 A_6 A_{16} B_3 B_{13} - a^2 A_{17} B_7 B_{10} B_{13} + A_{16} B_3 B_{10} B_{12} B_{13} - a^2 A_5 A_6 B_8 B_{14} - A_{11} B_2 B_{10} B_{12} B_{15} + B_{12} B_{10} B_{13} B_{15},$$

$$S_{78} = A_{12} B_6 B_9 B_{11} B_{14} + B_8 B_{10} B_{12} B_{14} + B_{10} B_{12} B_{13} B_{14} - a^2 A_{11} B_2 B_{10} B_{15},$$

$$S_{79} = B_8 B_{10} B_{14} B_{15} + B_{10} B_{13} B_{14} B_{15} + A_{12} A_{16} B_3 B_6 B_{10} B_{16} + a^2 A_{16} B_3 B_{12} B_{16} - A_5 A_6 A_{16} B_3 B_{13} B_{15} + A_5 A_6 A_{11} B_3 B_{15} B_{17} - A_8 A_{13} A_{17} B_6 B_{10} B_{18},$$

$$S_{80} = A_{12} B_6 B_{10} B_{14} B_{16} + a^4 A_8 A_{16} B_3 B_{18} - 2a^2 A_8 A_{17} B_7 B_8 B_{18},$$

$$E_{11} = -a^4 A_5 A_6 A_{13} A_{16} B_2 - a^4 A_5 A_6 A_{13} A_{17} B_6 + 3a^4 A_5 A_6 A_{13} A_{12} B_3 B_6 + 3a^4 A_5 A_6 A_{11} A_{17} B_3 B_6 + a^2 A_{11} B_2 B_{10} B_{14} B_{16},$$

$$E_{12} = 3a^4 A_5 A_6 A_{11} A_{17} B_2 B_7 + a^4 A_5 A_6 A_{12} B_6 B_8 - 2a^2 A_5 A_6 A_{13} A_{17} B_6 B_8 - a^4 A_5 A_6 A_{17} B_7 B_8 - a^4 A_{12} A_{16} B_3 B_6 B_{10},$$

$$E_{13} = -a^4 A_{11} A_{17} B_3 B_6 B_{10} - a^4 A_{12} A_{16} B_2 B_7 B_{10} - a^4 A_{11} A_{17} B_2 B_7 B_{10} + a^2 A_{13} A_{17} B_6 B_8 B_{10} + a^2 A_{13} A_{17} B_6 B_9 B_{11} - 2a^2 A_{11} A_{17} B_3 B_6 B_{10} B_{12},$$

$$E_{14} = -a^4 A_{12} A_{16} B_3 B_6 B_{12} - a^4 A_{11} A_{17} B_3 B_6 B_{12} - a^4 A_{12} A_{16} B_2 B_7 B_{12} - a^4 A_{11} A_{17} B_2 B_7 B_{12} + a^2 A_{13} A_{17} B_6 B_8 B_{12} + a^2 A_{17} B_7 B_8 B_{10} B_{12},$$

$$E_{15} = a^4 A_{13} A_{16} B_2 B_{10} B_{12} + a^2 A_{13} A_{17} B_6 B_{10} B_{12} - 2a^2 A_{12} A_{16} B_3 B_6 B_{10} B_{12},$$

$$E_{16} = -2a^2 A_{11} A_{17} B_2 B_7 B_{10} B_{12} - a^2 A_{12} B_6 B_8 B_{10} B_{12} + A_{13} A_{17} B_6 B_8 B_{10} B_{12},$$

$$E_{17} = A_{13} A_{17} B_6 B_9 B_{11} B_{12} + a^2 A_{17} B_7 B_9 B_{11} B_{12} + a^4 A_5 A_6 A_{16} B_3 B_{13} - a^4 A_5 A_6 A_{17} B_7 B_{13} - 2a^2 A_5 A_6 A_{17} B_7 B_8 B_{13} + 2a^2 A_5 A_6 A_{12} B_6 B_8 B_{14},$$

$$E_{18} = a^2 A_{17} B_7 B_8 B_{10} B_{13} + a^2 A_{17} B_7 B_9 B_{11} B_{13} + a^2 A_{17} B_7 B_8 B_{13} B_{12} - a^2 A_{16} B_3 B_{10} B_{12} B_{13} + a^2 A_{17} B_7 B_{10} B_{13} B_{12} + a^4 A_5 A_6 A_{12} B_6 B_{14},$$

$$E_{19} = A_{17} B_7 B_8 B_{10} B_{12} B_{13} + A_{17} B_7 B_9 B_{11} B_{12} B_{13} - a^4 A_5 A_6 A_{11} B_2 B_{14},$$

$$E_{20} = -\, a^2A_{12}B_6B_8B_{10}B_{14} - a^2A_{12}B_6B_9B_{11}B_{14} - a^2A_{12}B_6B_8B_{12}B_{14} + a^2A_{11}B_2B_{12}B_{10}B_{14} - a^2A_{12}B_6B_{12}B_{10}B_{14} + a^2A_{13}A_{16}B_2B_{15}B_{12},$$

$$E_{21} = -\, A_{12}B_6B_8B_{12}B_{10}B_{14} - A_{12}B_6B_9B_{12}B_{11}B_{14} + a^2A_5A_6B_8B_{13}B_{14} - B_8B_{12}B_{10}B_{13}B_{14} - B_9B_{12}B_{11}B_{13}B_{14} + a^2A_{13}A_{16}B_2B_{10}B_{15},$$

$$E_{22} = -a^4A_5A_6A_{11}B_2B_{15} - 2a^2A_5A_6A_{13}A_{16}B_2B_{15} + a^4A_5A_6A_{16}B_3B_{15},$$

$$E_{23} = a^2A_{11}B_2B_{10}B_{12}B_{15} + A_{13}A_{16}B_2B_{10}B_{12}B_{15} - a^2A_{16}B_3B_{10}B_{12}B_{15} + 2a^2A_5A_6A_{16}B_3B_{13}B_{15} + a^2A_5A_6B_8B_{13}B_{15} + a^2A_{11}B_2B_{12}B_{14}B_{15},$$

$$E_{24} = -\, a^2A_{16}B_3B_{10}B_{13}B_{15} - a^2A_{16}B_3B_{12}B_{13}B_{15} - A_{16}B_3B_{10}B_{12}B_{13}B_{15} - B_8B_{10}B_{12}B_{13}B_{15} - B_9B_{11}B_{12}B_{13}B_{15} - B_8B_{10}B_{14}B_{13}B_{15},$$

$$E_{25} = -2a^2A_5A_6A_{11}B_2B_{14}B_{15} + a^2A_5A_6B_8B_{14}B_{15} + a^2A_{11}B_2B_{10}B_{14}B_{15},$$

$$E_{26} = -B_8B_{10}B_{12}B_{14}B_{15} - B_9B_{11}B_{12}B_{14}B_{15} + a^2A_5A_6B_{13}B_{14}B_{15},$$

$$E_{27} = -\, B_9B_{11}B_{14}B_{13}B_{15} - B_8B_{12}B_{14}B_{13}B_{15} - B_{10}B_{12}B_{14}B_{13}B_{15} - a^4A_5A_6A_{11}B_2B_{16} - 2a^2A_5A_6A_{13}A_{16}B_2B_{16} + A_5A_6B_8B_{13}B_{14}B_{15},$$

$$E_{28} = a^4A_5A_6A_{16}B_3B_{16} + a^4A_5A_6A_{12}B_6B_{16} - 2a^2A_5A_6A_{13}A_{17}B_6B_{16} - a^4A_{12}A_{16}A_3B_6B_{16} - a^2A_{12}B_6B_9B_{11}B_{12},$$

$$E_{29} = -a^4A_{11}A_{17}B_{16}B_3B_6 + 3a^2A_5A_6A_{11}A_{17}B_3B_6B_{16} - a^4A_5A_6A_{17}B_7B_{16},$$

$$E_{30} = -\, a^4A_{11}A_{17}B_2B_7B_{16} + 3a^2A_5A_6A_{11}A_{17}B_2B_7B_{16} + 2a^2A_5A_6A_{12}B_6B_8B_{16} + a^2A_{13}A_{17}B_6B_8B_{16} - a^4A_{12}A_{16}B_2B_7B_{16},$$

$$E_{31} = -A_5A_6A_{13}A_{17}B_6B_6B_{16} - 2a^2A_5A_6A_{17}B_7B_8B_{16} + a^2A_{13}A_{16}B_2B_{10}B_{16},$$

$$E_{32} = -\, 2a^2A_{11}A_{17}B_3B_6B_{10}B_{16} - 2a^2A_{12}A_{16}B_2B_7B_{10}B_{16} + a^2A_{13}A_{17}B_6B_{10}B_{16} - 2a^2A_{11}A_{17}B_2B_7B_{10}B_{16} - a^2A_{12}B_6B_{10}B_8B_{16},$$

$$E_{33} = A_{13}A_{17}B_6B_8B_{10}B_{16} + a^2A_{17}B_8B_7B_{10}B_{16} - a^2A_{12}B_6B_9B_{11}B_{16} + A_{13}A_{17}B_6B_9B_{11}B_{16} + a^2A_{17}B_9B_7B_{11}B_{16} - a^2A_{12}B_6B_{10}B_{12}B_{16},$$

$$E_{34} = a^2A_{13}A_{16}B_2B_{12}B_{16} + a^2A_{13}A_{17}B_6B_{12}B_{16} - 2a^2A_{12}A_{16}B_3B_6B_{12}B_{16},$$

$$E_{35} = -\, 2a^2A_{12}A_{16}B_2B_7B_{12}B_{16} - 2a^2A_{11}A_{17}B_2B_7B_{12}B_{16} - a^2A_{12}B_6B_8B_{12}B_{16} + A_{13}A_{17}B_6B_8B_{12}B_{16} - 2a^2A_{11}A_{17}B_3B_6B_{12}B_{16} - A_{11}A_{17}B_2B_7B_{10}B_{12}B_{16},$$

$$E_{36} = a^2A_{11}B_2B_{10}B_{12}B_{16} - 2a^2A_{12}A_{16}B_2B_7B_{10}B_{12} + 3a^2A_5A_6A_{12}A_{16}B_2B_7B_{16} - 2a^2A_{12}A_{16}B_3B_6B_{10}B_{16} - a^2A_{16}B_3B_{12}B_{13}B_{16} + A_5A_6A_{12}B_6B_8B_{14}B_{16},$$

$$E_{37} = A_{13}A_{16}B_2B_{10}B_{12}B_{16} - a^2A_{16}B_3B_{10}B_{12}B_{16} + A_{13}A_{17}B_6B_{10}B_{12}B_{16} - A_{11}A_{17}B_3B_6B_{10}B_{12}B_{16} + a^2A_{17}B_7B_{10}B_{12}B_{16} - A_{12}A_{16}B_2B_7B_{10}B_{12}B_{16},$$

$$E_{38} = -A_{12}B_6B_8B_{10}B_{12}B_{16} + A_{17}B_7B_8B_{10}B_{12}B_{16} - A_{12}B_6B_9B_{11}B_{12}B_{16},$$

$$E_{39} = -2a^2A_5A_6A_{17}B_7B_{13}B_{16} + a^2A_5A_6B_8B_{13}B_{16} + a^2A_{17}B_7B_8B_{13}B_{16},$$

$$E_{40} = a^2 A_{17} B_7 B_{10} B_{13} B_{16} + A_{17} B_7 B_8 B_{10} B_{13} B_{16} + A_{17} B_7 B_9 B_{11} B_{13} B_{16},$$

$$E_{41} = a^2 A_{17} B_8 B_{12} B_{13} B_{16} - A_{16} B_3 B_{10} B_{12} B_{13} B_{16} + A_{17} B_7 B_{12} B_{10} B_{13} B_{16} - B_8 B_{10} B_{12} B_{13} B_{16} - B_9 B_{11} B_{12} B_{13} B_{16} + A_{17} B_7 B_9 B_{11} B_{12} B_{16},$$

$$E_{42} = -2a^2 A_5 A_6 A_{12} B_6 B_{14} B_{16} + a^2 A_5 A_6 B_8 B_{14} B_{16} - a^2 A_{12} B_6 B_8 B_{14} B_{16},$$

$$E_{43} = -a^2 A_{12} B_6 B_{10} B_{14} B_{16} - A_{12} B_6 B_8 B_{10} B_{14} B_{16} - A_{12} B_6 B_9 B_{11} B_{14} B_{16} + a^2 A_{11} B_2 B_{12} B_{14} B_{16} - a^2 A_{12} B_6 B_{12} B_{14} B_{16} - A_5 A_6 A_{17} B_7 B_8 B_{13} B_{16},$$

$$E_{44} = -A_{12} B_6 B_8 B_{12} B_{14} B_{16} + A_{11} B_2 B_{10} B_{12} B_{14} B_{16} - A_{12} B_6 B_{10} B_{12} B_{14} B_{16} - B_8 B_{10} B_{12} B_{14} B_{16} - B_9 B_{11} B_{12} B_{14} B_{16},$$

$$E_{45} = a^2 A_5 A_6 B_{13} B_{14} B_{16} + A_5 A_6 B_{13} B_8 B_{14} B_{16} - B_8 B_{10} B_{13} B_{14} B_{16} - B_9 B_{11} B_{13} B_{14} B_{16} - B_8 B_{12} B_{13} B_{14} B_{16},$$

$$E_{46} = -B_{10} B_{12} B_{13} B_{14} B_{16} - 2a^2 A_5 A_6 A_{11} B_2 B_{15} B_{16} + a^2 A_{16} A_{13} B_2 B_{15} B_{16} - A_5 A_6 A_{13} A_{16} B_2 B_{15} B_{16} + a^2 A_{11} B_3 B_{10} B_{16} B_{17} - A_{16} B_3 B_{10} B_{12} B_{15} B_{16},$$

$$E_{47} = a^2 A_5 A_6 B_8 B_{15} B_{16} + a^2 A_{11} B_2 B_{10} B_{15} B_{16} + A_{16} A_{13} B_2 B_{10} B_{15} B_{16} - a^2 A_{16} B_3 B_{10} B_{15} B_{16} + a^2 A_{11} B_2 B_{12} B_{15} B_{16} - B_8 B_{10} B_{12} B_{15} B_{16},$$

$$E_{48} = A_{16} A_{13} B_2 B_{12} B_{15} B_{16} - a^2 A_{16} B_3 B_{12} B_{15} B_{16} + A_{11} B_2 B_{10} B_{12} B_{15} B_{16},$$

$$E_{49} = -B_9 B_{11} B_{12} B_{15} B_{16} + a^2 A_5 A_6 B_{13} B_{15} B_{16} - a^2 A_{16} B_3 B_{13} B_{15} B_{16} + A_5 A_6 A_{16} B_3 B_{13} B_{15} B_{16} + A_5 A_6 B_8 B_{13} B_{15} B_{16},$$

$$E_{50} = -A_{16} B_3 B_{10} B_{13} B_{15} B_{16} - B_8 B_{10} B_{13} B_{15} B_{16} - B_9 B_{11} B_{13} B_{15} B_{16} - A_{16} B_3 B_{13} B_{12} B_{15} B_{16} - B_8 B_{12} B_{13} B_{15} B_{16},$$

$$E_{51} = -B_{10} B_{12} B_{13} B_{15} B_{16} + a^2 A_5 A_6 B_{14} B_{15} B_{16} + a^2 A_{11} B_2 B_{14} B_{15} B_{16} - A_5 A_6 A_{11} B_2 B_{15} B_{14} B_{16} + A_5 A_6 A_8 B_{15} B_{14} B_{16},$$

$$E_{52} = A_{11} B_2 B_{10} B_{14} B_{15} B_{16} - B_8 B_{10} B_{14} B_{15} B_{16} - B_9 B_{11} B_{14} B_{15} B_{16} + A_{11} B_2 B_{12} B_{14} B_{15} B_{16} - B_8 B_{12} B_{14} B_{15} B_{16},$$

$$E_{53} = -B_{12} B_{10} B_{14} B_{15} B_{16} + A_5 A_6 B_{13} B_{14} B_{15} B_{16} - B_8 B_{13} B_{14} B_{15} B_{16} - B_{10} B_{13} B_{14} B_{15} B_{16} - B_{12} B_{13} B_{14} B_{15} B_{16} - A_{13} B_{10} B_{12} B_{16} B_{17},$$

$$E_{54} = -a^4 A_5 A_6 A_{11} B_3 B_{17} - a^4 A_5 A_6 A_{12} B_7 B_{17} + a^2 A_5 A_6 A_{13} B_8 B_{17} - 2a^2 A_5 A_6 A_{12} B_7 B_8 B_{17} + a^2 A_{17} B_7 B_{12} B_{13} B_{16} + A_{12} B_7 B_8 B_{12} B_{16} B_{17},$$

$$E_{55} = a^2 A_{12} B_7 B_9 B_{11} B_{17} + a^2 A_{12} B_7 B_8 B_{12} B_{17} + a^2 A_{11} B_3 B_{12} B_{10} B_{17} + a^2 A_{12} B_7 B_{12} B_{10} B_{17} - A_{13} B_8 B_{12} B_{10} B_{17},$$

$$E_{56} = A_{12} B_7 B_8 B_{12} B_{10} B_{17} - A_{13} B_9 B_{12} B_{11} B_{17} + A_{12} B_7 B_9 B_{12} B_{11} B_{17} + a^2 A_5 A_6 A_{13} B_{15} B_{17} - 2a^2 A_5 A_6 A_{11} B_3 B_{15} B_{17} - A_{13} B_9 B_{11} B_{16} B_{17},$$

$$E_{57} = A_5 A_6 A_{13} B_8 B_{15} B_{17} + a^2 A_{11} B_3 B_{10} B_{15} B_{17} - A_{13} B_8 B_{10} B_{15} B_{17} - A_{13} B_9 B_{11} B_{15} B_{17} + a^2 A_{11} B_3 B_{12} B_{15} B_{17} + A_{12} B_7 B_9 B_{11} B_{16} B_{17},$$

$$E_{58} = -A_{13}B_8B_{12}B_{15}B_{17} - A_{13}B_{12}B_{10}B_{15}B_{17} + A_{11}B_3B_{10}B_{12}B_{15}B_{17} + a^2A_5A_6A_{13}B_{16}B_{17} + a^2A_{12}B_7B_8B_{10}B_{17} - A_5A_6A_{12}B_7B_8B_{16}B_{17},$$

$$E_{59} = -2a^2A_5A_6A_{12}B_7B_{16}B_{17} + A_5A_6A_{13}B_8B_{16}B_{17} + a^2A_{12}B_7B_8B_{16}B_{17},$$

$$E_{60} = a^2A_{12}B_7B_{10}B_{16}B_{17} - A_{13}B_8B_{10}B_{16}B_{17} + A_{12}B_7B_8B_{10}B_{16}B_{17},$$

$$E_{61} = a^2A_{11}B_3B_{12}B_{16}B_{17} + a^2A_{12}B_7B_{12}B_{16}B_{17} - A_{13}B_8B_{12}B_{16}B_{17},$$

$$E_{62} = A_{11}B_3B_{10}B_{12}B_{16}B_{17} + A_{12}B_7B_{10}B_{12}B_{16}B_{17} + A_5A_6A_{13}B_{15}B_{16}B_{17},$$

$$E_{63} = -A_{13}B_8B_{15}B_{16}B_{17} - A_{13}B_{10}B_{15}B_{16}B_{17} + A_{11}B_3B_{10}B_{15}B_{16}B_{17} - A_{13}B_{12}B_{15}B_{16}B_{17} + A_{11}B_3B_{12}B_{15}B_{16}B_{17} + a^2A_{11}B_3B_{15}B_{16}B_{17},$$

$$E_{64} = a^4A_8A_{13}A_{16}B_2B_{18} + a^4A_8A_{13}A_{17}B_6B_{18} - 3a^4A_8A_{12}A_{16}B_3B_6B_{18},$$

$$E_{65} = -3a^4A_8A_{12}A_{16}B_2B_7B_{18} - 3a^4A_8A_{11}A_{17}B_2B_7B_{18} - a^4A_8A_{12}B_6B_8B_{18} + 2a^2A_8A_{13}A_{17}B_6B_8B_{18} - 3a^4A_8A_{11}A_{17}B_3B_6B_{18},$$

$$E_{66} = a^4A_8A_{11}B_2B_{10}B_{18} + 2a^2A_8A_{13}A_{16}B_2B_{10}B_{18} - a^4A_8A_{16}B_3B_{10}B_{18},$$

$$E_{67} = -3a^2A_8A_{12}A_{16}B_3B_6B_{10}B_{18} - 3a^2A_8A_{11}A_{17}B_3B_6B_{10}B_{18} + a^4A_8A_{17}B_7B_{10}B_{18} - a^2A_8B_{10}B_{13}B_{14}B_{18},$$

$$E_{68} = -3a^2A_8A_{11}A_{17}B_2B_7B_{10}B_{18} - 2a^2A_8A_{12}B_6B_8B_{10}B_{18} + A_8A_{13}A_{17}B_6B_8B_{10}B_{18} + 2a^2A_8A_{17}B_7B_8B_{10}B_{18},$$

$$E_{69} = -2a^2A_8A_{12}B_6B_9B_{11}B_{18} + A_8A_{13}A_{17}B_6B_9B_{11}B_{18} + 2a^2A_8A_{17}B_7B_9B_{11}B_{18} - a^4A_8A_{16}B_3B_{13}B_{18} - a^4A_8A_{12}B_6B_{10}B_{18} + 2a^2A_8A_{13}A_{16}B_2B_{15}B_{18},$$

$$E_{70} = 2a^2A_8A_{17}B_7B_8B_{13}B_{18} - 2a^2A_8A_{16}B_3B_{10}B_{13}B_{18} + 2a^2A_8A_{17}B_7B_{10}B_{13}B_{18} - a^2A_8B_8B_{10}B_{13}B_{18} - A_8A_{16}B_3B_{10}B_{13}B_{15}B_{18} - a^2A_8B_{10}B_{14}B_{15}B_{18},$$

$$E_{71} = A_8A_{17}B_7B_8B_{10}B_{13}B_{18} - a^2A_8B_9B_{11}B_{13}B_{18} + A_8A_{17}B_7B_9B_{11}B_{13}B_{18} + a^4A_8A_{11}B_2B_{14}B_{18} - 2a^2A_8A_{16}B_3B_{10}B_{15}B_{18},$$

$$E_{72} = -2a^2A_8A_{12}B_6B_8B_{14}B_{18} + 2a^2A_8A_{11}B_2B_{14}B_{10}B_{18} - a^2A_8B_8B_{10}B_{14}B_{18} - 2a^2A_8A_{12}B_6B_{10}B_{14}B_{18} - A_8B_8B_{13}B_{14}B_{15}B_{18},$$

$$E_{73} = -A_8A_{12}B_6B_8B_{10}B_{14}B_{18} - a^2A_8B_9B_{10}B_{14}B_{18} - A_8A_{12}B_6B_9B_{11}B_{14}B_{18} - a^2A_8B_8B_{13}B_{14}B_{18} + 2a^2A_8A_{12}B_7B_8B_{17}B_{18},$$

$$E_{74} = -A_8B_8B_{10}B_{13}B_{14}B_{18} - A_8B_9B_{11}B_{13}B_{14}B_{18} + a^4A_8A_{11}B_2B_{15}B_{18},$$

$$E_{75} = 2a^2A_8A_{11}B_2B_{10}B_{15}B_{18} + A_8A_{13}A_{16}B_2B_{10}B_{15}B_{18} - a^2A_8B_8B_{10}B_{15}B_{18},$$

$$E_{76} = -2a^2A_8A_{16}B_3B_{13}B_{15}B_{18} - a^2A_8B_8B_{13}B_{15}B_{18} - a^2A_8B_{13}B_{10}B_{15}B_{18},$$

$$E_{77} = -A_8B_9B_{11}B_{13}B_{15}B_{18} + 2a^2A_8A_{11}B_2B_{14}B_{15}B_{18} - a^2A_8B_8B_{14}B_{15}B_{18},$$

$$E_{78} = -A_8B_8B_{10}B_{14}B_{15}B_{18} - A_8B_9B_{11}B_{14}B_{15}B_{18} - a^2A_8B_{13}B_{14}B_{15}B_{18},$$

$$E_{79} = a^4A_8A_{11}B_3B_{17}B_{18} + a^4A_8A_{12}B_7B_{17}B_{18} - a^2A_8A_{13}B_8B_{17}B_{18},$$

$$E_{80} =2a^2A_8A_{11}B_3B_{10}B_{17}B_{18} + 2a^2A_8A_{12}B_7B_{10}B_{17}B_{18} - A_8A_{13}B_8B_{10}B_{17}B_{18}$$
$$+ A_8A_{12}B_7B_8B_{10}B_{17}B_{18}+2a^2A_8A_{11}B_3B_{15}B_{17}B_{18}-a^2A_8B_9B_{11}B_{15}B_{18},$$
$$E_{81} = -A_8A_{13}B_9B_{11}B_{17}B_{18} + A_8A_{12}B_7B_9B_{11}B_{17}B_{18} - a^2A_8A_{13}B_{15}B_{17}B_{18},$$
$$E_{82} = -A_8A_{13}B_{10}B_{15}B_{17}B_{18} + A_8A_{11}B_3B_{10}B_{15}B_{17}B_{18} - A_8A_{13}B_8B_{15}B_{17}B_{18},$$
$$E_{83} =3a^4A_5A_6A_{12}A_{16}B_2B_7 + A_{11}B_2B_{10}B_{12}B_{14}B_{15}$$
$$+ 3a^2A_5A_6A_{12}A_{16}B_3B_6B_{16} - A_{12}A_{16}B_3B_6B_{10}B_{12}B_{16}$$
$$+ 2a^2A_5A_6A_{16}B_3B_{15}B_{16} + 2a^2A_8A_{13}A_{17}B_6B_{10}B_{18}, ,$$
$$E_{84} = a^2A_{17}B_7B_8B_{12}B_{16} + 2a^2A_5A_6A_{16}B_3B_{13}B_{16} - a^2A_{16}B_3B_{10}B_{13}B_{16},$$
$$E_{85} = - a^4A_8A_{16}B_3B_{15}B_{18} - A_8B_8B_{10}B_{13}B_{15}B_{18} + A_8A_{11}B_2B_{10}B_{14}B_{15}B_{18}$$
$$- A_8B_{13}B_{10}B_{14}B_{15}B_{18} - 2a^2A_5A_6A_{11}B_3B_{16}B_{17},$$
$$E_{86} = -a^2A_8A_{13}B_{10}B_{17}B_{18} + a^4A_8A_{17}B_7B_8B_{18} + a^4A_8A_{17}B_7B_{13}B_{18},$$
$$E_{87} = -a^4A_8A_{12}B_6B_{14}B_{18}-A_5A_6A_{11}B_3B_{15}B_{16}B_{17} - 3a^2A_8A_{12}A_{16}B_2B_7B_{10}B_{18},$$
$$F_{11} = -a^6A_5A_6A_{12}A_{16}B_3B_6 - a^6A_5A_6A_{11}A_{17}B_3B_6 - a^6A_5A_6A_{12}A_{16}B_2B_7,$$
$$F_{12} =a^4A_5A_6A_{13}A_{17}B_6B_8 + a^4A_{12}A_{16}B_3B_6B_{10}B_{12} + a^4A_{11}A_{17}B_3B_6B_{10}B_{12}$$
$$+ a^4A_{12}A_{16}B_2B_7B_{10}B_{12} - a^6A_5A_6A_{11}A_{17}B_2B_7 + a^4A_5A_6A_{13}A_{17}B_6B_{16},$$
$$F_{13} =a^4A_{11}A_{17}B_2B_7B_{10}B_{12} - a^2A_{13}A_{17}B_8B_6B_{10}B_{12} - a^2A_{13}A_{17}B_6B_9B_{11}B_{12}$$
$$+ a^4A_5A_6A_{17}B_7B_8B_{13} - 3a^4A_5A_6A_{12}A_{16}B_2B_7B_{16},$$
$$F_{14} = - a^2A_{17}B_8B_7B_{10}B_{12}B_{13} - a^2A_{17}B_9B_7B_{11}B_{12}B_{13} - a^4A_5A_6A_{12}B_6B_8B_{14}$$
$$+ a^2A_{12}B_6B_8B_{10}B_{12}B_{14} + 2a^2A_5A_6A_{13}A_{17}B_6B_8B_{16},$$
$$F_{15} =a^2A_{12}B_6B_9B_{11}B_{12}B_{14} + a^4A_5A_6A_{13}A_{16}B_2B_{15} - a^2A_{13}A_{16}B_2B_{10}B_{12}B_{15}$$
$$- a^4A_5A_6A_{16}B_3B_{13}B_{15}+a^4A_{11}A_{17}B_2B_7B_{10}B_{16}+a^4A_{11}A_{17}B_3B_6B_{12}B_{16},$$
$$F_{16} =a^2A_{16}B_3B_{10}B_{12}B_{13}B_{15} + a^4A_5A_6A_{11}B_2B_{15}B_{14} - a^2A_{11}B_2B_{10}B_{12}B_{14}B_{15}$$
$$- a^2A_5A_6B_8B_{13}B_{14}B_{15} + 2a^2A_{11}A_{17}B_3B_6B_{10}B_{12}B_{16},$$
$$F_{17} = B_8B_{10}B_{12}B_{13}B_{14}B_{15} + B_9B_{11}B_{12}B_{13}B_{14}B_{15} + a^4A_5A_6A_{13}A_{16}B_2B_{16},$$
$$F_{18} = -3a^4A_5A_6A_{12}A_{16}B_3B_6B_{16} - 3a^4A_5A_6A_{11}A_{17}B_3B_6B_{16},$$
$$F_{19} = -3a^4A_5A_6A_{11}A_{17}B_2B_7B_{16} - a^4A_5A_6A_{12}B_6B_8B_{16} + a^4A_5A_6A_{17}B_7B_8B_{16},$$
$$F_{20} = a^4A_5A_{16}A_{12}B_3B_6B_{10}B_{16}+a^4A_{11}A_{17}B_3B_6B_{10}B_{16}+a^4A_{12}A_{16}B_2B_7B_{10}B_{16},$$
$$F_{21} = -a^2A_{13}A_{17}B_8B_6B_{10}B_{16} - a^2A_{13}A_{17}B_9B_6B_{11}B_{16} + a^4A_{12}A_{16}B_3B_6B_{12}B_{16},$$
$$F_{22} =a^4A_{12}A_{16}B_2B_7B_{12}B_{16} + a^4A_{11}A_{17}B_2B_7B_{12}B_{16} - a^2A_{13}A_{17}B_8B_6B_{12}B_{16}$$
$$- a^2A_{13}A_{16}B_2B_{10}B_{12}B_{16} + a^2A_{12}B_6B_{10}B_{12}B_8B_{16}, ,$$
$$F_{23} = -a^2A_{13}A_{17}B_{10}B_6B_{12}B_{16} + 2a^2A_{12}A_{16}B_3B_6B_{10}B_{12}B_{16},$$
$$F_{24} = 2a^2A_{12}A_{16}B_2B_7B_{10}B_{12}B_{16} + 2a^2A_{11}A_{17}B_2B_7B_{10}B_{12}B_{16},$$

$$F_{25} = - A_{13}A_{17}B_6B_{10}B_{12}B_8B_{16} - a^2A_{17}B_7B_{10}B_{12}B_8B_{16} + a^2A_{12}B_6B_9B_{11}B_{12}B_{16} - A_{13}A_{17}B_6B_9B_{11}B_{12}B_{16} - A_{17}B_7B_9B_{11}B_{12}B_{13}B_{16},$$

$$F_{26} = - a^2A_{17}B_7B_9B_{11}B_{12}B_{16} - a^4A_5A_6A_{16}B_3B_{13}B_{16} + a^4A_5A_6A_{17}B_7B_{13}B_{16} + 2a^2A_5A_6A_{17}B_7B_8B_{13}B_{16} + a^2A_{16}B_3B_{12}B_{10}B_{13}B_{16} - 2a^2A_5A_6A_{12}B_6B_8B_{14}B_{16},$$

$$F_{27} = -a^2A_{17}B_7B_8B_{10}B_{13}B_{16} - a^2A_{17}B_7B_9B_{11}B_{13}B_{16} - a^2A_{17}B_7B_8B_{12}B_{13}B_{16},$$

$$F_{28} = -a^2A_{17}B_7B_{12}B_{10}B_{13}B_{16} - A_{17}B_7B_8B_{10}B_{12}B_{13}B_{16} + a^4A_5A_6A_{11}B_2B_{14}B_{16},$$

$$F_{29} = -a^4A_5A_6A_{12}B_6B_{14}B_{16} + a^2A_{12}B_6B_8B_{10}B_{14}B_{16} + a^2A_{12}B_6B_9B_{11}B_{14}B_{16},$$

$$F_{30} = a^2A_{12}B_6B_8B_{12}B_{14}B_{16} - a^2A_{11}B_2B_{12}B_{10}B_{14}B_{16} + a^2A_{12}B_6B_{12}B_{10}B_{14}B_{16} + A_{12}B_6B_8B_{10}B_{12}B_{14}B_{16} - 2a^2A_5A_6A_{16}B_3B_{13}B_{15}B_{16},$$

$$F_{31} = A_{12}B_6B_9B_{11}B_{12}B_{14}B_{16} - a^2A_5A_6B_8B_{13}B_{14}B_{16} + B_8B_{10}B_{12}B_{13}B_{14}B_{16} + B_9B_{11}B_{12}B_{13}B_{14}B_{16} - A_{11}B_2B_{10}B_{12}B_{14}B_{15}B_{16} + 2a^2A_5A_6A_{11}B_2B_{14}B_{15}B_{16},$$

$$F_{32} = a^4A_5A_6A_{11}B_2B_{15}B_{16} + 2a^2A_5A_6A_{13}A_{16}B_2B_{15}B_{16} - a^4A_5A_6A_{16}B_3B_{15}B_{16} - a^2A_{13}A_{16}B_2B_{10}B_{15}B_{16} - A_5A_6B_8B_{13}B_{14}B_{15}B_{16} - a^2A_{12}B_7B_9B_{11}B_{12}B_{17},$$

$$F_{33} = a^2A_{13}A_{16}B_2B_{12}B_{15}B_{16} - a^2A_{11}B_2B_{10}B_{12}B_{15}B_{16} - A_{13}A_{16}B_2B_{10}B_{15}B_{16} + a^2A_{16}B_3B_{10}B_{12}B_{15}B_{16} - a^2A_5A_6A_{13}B_8B_{16}B_{17},$$

$$F_{34} = -a^2A_5A_6B_8B_{13}B_{15}B_{16} + a^2A_{16}B_3B_{10}B_{13}B_{15}B_{16} + a^2A_{16}B_3B_{12}B_{13}B_{15}B_{16},$$

$$F_{35} = A_{16}B_3B_{10}B_{12}B_{13}B_{15}B_{16} + B_8B_{10}B_{12}B_{13}B_{15}B_{16} + B_9B_{11}B_{12}B_{13}B_{15}B_{16},$$

$$F_{36} = -a^2A_5A_6B_8B_{14}B_{15}B_{16} - a^2A_{11}B_2B_{10}B_{14}B_{15}B_{16} - a^2A_{11}B_2B_{12}B_{14}B_{15}B_{16},$$

$$F_{37} = B_8B_{10}B_{12}B_{14}B_{15}B_{16} + B_9B_{11}B_{12}B_{14}B_{15}B_{16} - a^2A_5A_6B_{13}B_{14}B_{15}B_{16},$$

$$F_{38} = B_8B_{10}B_{13}B_{14}B_{15}B_{16} + B_9B_{11}B_{13}B_{14}B_{15}B_{16} + B_8B_{12}B_{13}B_{14}B_{15}B_{16},$$

$$F_{39} = B_8B_{12}B_{13}B_{14}B_{15}B_{16} + a^4A_5A_6A_{12}B_7B_8B_{17} - a^2A_{12}B_7B_8B_{10}B_{12}B_{17},$$

$$F_{40} = a^4A_5A_6A_{11}B_3B_{15}B_{17} - a^2A_5A_6A_{13}B_{15}B_8B_{17} - a^2A_{11}B_3B_{10}B_{12}B_{15}B_{17} + A_{13}B_8B_{10}B_{12}B_{15}B_{17} - a^2A_{12}B_7B_8B_{12}B_{16}B_{17} - A_{12}B_7B_8B_{10}B_{12}B_{16}B_{17},$$

$$F_{41} = A_{13}B_9B_{11}B_{12}B_{15}B_{17} + a^4A_5A_6A_{11}B_3B_{16}B_{17} + a^4A_5A_6A_{12}B_7B_{16}B_{17},$$

$$F_{42} = 2a^2A_5A_6A_{12}B_7B_8B_{16}B_{17} - a^2A_{12}B_7B_8B_{10}B_{16}B_{17} - a^2A_{12}B_7B_9B_{11}B_{16}B_{17},$$

$$F_{43} = -a^2A_{11}B_3B_{10}B_{12}B_{16}B_{17} - a^2A_{12}B_7B_{10}B_{12}B_{16}B_{17} + A_{13}B_8B_{10}B_{12}B_{16}B_{17},$$

$$F_{44} = A_{13}B_9B_{11}B_{12}B_{16}B_{17} - A_{12}B_7B_9B_{11}B_{12}B_{16}B_{17} - a^2A_5A_6A_{13}B_{15}B_{16}B_{17} + 2a^2A_5A_6A_{11}B_3B_{15}B_{16}B_{17} + A_{13}B_9B_{11}B_{15}B_{16}B_{17} + a^6A_8A_{11}A_{17}B_2B_7B_{18},$$

$$F_{45} = -A_5A_6A_{13}B_8B_{15}B_{16}B_{17} - a^2A_{11}B_3B_{10}B_{15}B_{16}B_{17} + A_{13}B_8B_{10}B_{15}B_{16}B_{17},$$

$$F_{46} = -a^2A_{11}B_3B_{12}B_{15}B_{16}B_{17} + A_{13}B_8B_{12}B_{15}B_{16}B_{17} + A_{13}B_{10}B_{12}B_{15}B_{16}B_{17} - A_{11}B_3B_{10}B_{12}B_{15}B_{16}B_{17} + 3a^4A_8A_{11}A_{17}B_2B_7B_{10}B_{18},$$

$$F_{47} = a^6A_8A_{12}A_{16}B_3B_6B_{18} + a^6A_8A_{11}A_{17}B_3B_6B_{18} + a^6A_8A_{12}A_{16}B_2B_7B_{18},$$

$$F_{48} = -a^4A_8A_{13}A_{17}B_8B_6B_{18} - a^4A_8A_{13}A_{16}B_2B_{10}B_{18} - a^4A_8A_{13}A_{17}B_{10}B_6B_{18} + 3a^4A_8A_{12}A_{16}B_3B_6B_{10}B_{18} - 2a^2A_8A_{13}A_{17}B_6B_9B_{11}B_{18},$$

$$F_{49} = 3a^4A_8A_{11}A_{17}B_3B_6B_{10}B_{18} + 3a^4A_8A_{12}A_{16}B_2B_7B_{10}B_{18},$$

$$F_{50} = -2a^2A_8A_{13}A_{17}B_6B_8B_{10}B_{18} - a^4A_8A_{17}B_7B_8B_{10}B_{18} + a^4A_8A_{12}B_6B_9B_{11}B_{18},$$

$$F_{51} = -a^4A_8A_{17}B_7B_9B_{11}B_{18} - a^4A_8A_{17}B_7B_8B_{13}B_{18} + a^4A_8A_{16}B_3B_{13}B_{10}B_{18} - a^4A_8A_{17}B_7B_{13}B_{10}B_{18} - a^4A_8A_{11}B_2B_{10}B_{14}B_{18} + 2a^2A_8A_{12}B_6B_9B_{11}B_{14}B_{18},$$

$$F_{52} = -2a^2A_8A_{17}B_7B_8B_{10}B_{13}B_{18} - 2a^2A_8A_{17}B_7B_9B_{11}B_{13}B_{18},$$

$$F_{53} = a^4A_8A_{12}B_6B_{10}B_{14}B_{18} + 2a^2A_8A_{12}B_6B_8B_{10}B_{14}B_{18} + a^2A_8B_8B_{10}B_{13}B_{14}B_{18},$$

$$F_{54} = a^2A_8B_9B_{11}B_{13}B_{14}B_{18} - a^4A_8A_{13}A_{16}B_2B_{15}B_{18} - a^4A_8A_{11}B_2B_{10}B_{15}B_{18} - 2a^2A_8A_{13}A_{16}B_2B_{10}B_{15}B_{18} + 2a^2A_8A_{16}B_3B_{10}B_{13}B_{15}B_{18},$$

$$F_{55} = a^4A_8A_{16}B_3B_{10}B_{15}B_{18} + a^4A_8A_{16}B_3B_{13}B_{15}B_{18} + a^2A_8B_8B_{10}B_{13}B_{15}B_{18},$$

$$F_{56} = a^2A_8B_9B_{11}B_{13}B_{15}B_{18} - a^4A_8A_{11}B_2B_{14}B_{15}B_{18} + a^2A_8B_8B_{10}B_{14}B_{15}B_{18},$$

$$F_{57} = a^2A_8B_9B_{11}B_{14}B_{15}B_{18} + a^2A_8B_8B_{13}B_{14}B_{15}B_{18} + a^2A_8B_{13}B_{10}B_{14}B_{15}B_{18} + A_8B_8B_{10}B_{13}B_{14}B_{15}B_{18} - 2a^2A_8A_{11}B_2B_{10}B_{14}B_{15}B_{18},$$

$$F_{58} = A_8B_9B_{11}B_{13}B_{14}B_{15}B_{18} - a^4A_8A_{12}B_7B_8B_{17}B_{18} - a^4A_8A_{11}B_3B_{10}B_{17}B_{18} - a^4A_8A_{12}B_7B_{10}B_{17}B_{18} + a^4A_8A_{12}B_6B_8B_{14}B_{18},$$

$$F_{59} = -a^4A_8A_{13}B_{10}B_8B_{17}B_{18} - 2a^2A_8A_{12}B_7B_8B_{10}B_{17}B_{18} + a^2A_8A_{13}B_9B_{11}B_{17}B_{18},$$

$$F_{60} = -a^4A_8A_{11}B_3B_{15}B_{17}B_{18} + a^2A_8A_{13}B_8B_{15}B_{17}B_{18} + a^2A_8A_{13}B_{10}B_{15}B_{17}B_{18} - 2a^2A_8A_{11}B_3B_{10}B_{15}B_{17}B_{18} - 2a^2A_8A_{12}B_7B_9B_{11}B_{17}B_{18},$$

$$F_{61} = A_8A_{13}B_8B_{10}B_{15}B_{17}B_{18} + A_8A_{13}B_9B_{11}B_{15}B_{17}B_{18}a^4A_8A_{12}B_6B_8B_{10}B_{18},$$

$$G_{11} = a^6A_5A_6A_{12}A_{16}B_3B_6B_{16} + a^6A_5A_6A_{11}A_{17}B_3B_6B_{16} + a^6A_5A_6A_{12}A_{16}B_2B_7B_{16} + a^6A_5A_6A_{11}A_{17}B_2B_7B_{16},$$

$$
\begin{aligned}
G_{12} =& - a^4 A_5 A_6 A_{13} A_{17} B_6 B_8 B_{16} - a^4 A_{12} A_{16} B_3 B_6 B_{10} B_{12} B_{16} \\
& - a^4 A_{11} A_{17} B_3 B_6 B_{10} B_{12} B_{16} - a^4 A_{12} A_{16} B_2 B_7 B_{10} B_{12} B_{16}, \\
G_{13} =& - a^4 A_{11} A_{17} B_2 B_7 B_{10} B_{12} B_{16} + a^2 A_{13} A_{17} B_6 B_8 B_{10} B_{12} B_{16} \\
& + a^2 A_{13} A_{17} B_6 B_9 B_{11} B_{12} B_{16} - a^4 A_5 A_6 A_{17} B_7 B_8 B_{13} B_{16}, \\
G_{14} =& a^2 A_{17} B_7 B_8 B_{10} B_{12} B_{13} B_{16} + a^2 A_{17} B_7 B_9 B_{11} B_{12} B_{13} B_{16} \\
& + a^4 A_5 A_6 A_{12} B_6 B_8 B_{14} B_{16} - a^2 A_{12} B_6 B_8 B_{10} B_{12} B_{14} B_{16}, \\
G_{15} =& - a^2 A_{12} B_6 B_9 B_{11} B_{12} B_{14} B_{16} - a^4 A_5 A_6 A_{13} A_{16} B_2 B_{15} B_{16} \\
& + a^2 A_{13} A_{16} B_2 B_{10} B_{12} B_{15} B_{16} + a^4 A_5 A_6 A_{16} B_3 B_{13} B_{15} B_{16}, \\
G_{16} =& - a^2 A_{16} B_3 B_{10} B_{12} B_{13} B_{15} B_{16} - a^4 A_5 A_6 A_{11} B_2 B_{14} B_{15} B_{16} \\
& + a^2 A_{11} B_2 B_{10} B_{12} B_{14} B_{15} B_{16} + a^2 A_5 A_6 B_8 B_{13} B_{14} B_{15} B_{16}, \\
G_{17} =& - B_8 B_{10} B_{12} B_{13} B_{14} B_{15} B_{16} - B_9 B_{11} B_{12} B_{13} B_{14} B_{15} B_{16} \\
& - a^4 A_5 A_6 A_{12} B_7 B_8 B_{16} B_{17} + a^2 A_{12} B_7 B_8 B_{10} B_{12} B_{16} B_{17}, \\
G_{18} =& a^2 A_{12} B_7 B_9 B_{11} B_{12} B_{16} B_{17} - a^4 A_5 A_6 A_{11} B_3 B_{15} B_{16} B_{17} \\
& + a^2 A_5 A_6 A_{13} B_8 B_{15} B_{16} B_{17} + a^2 A_{11} B_3 B_{10} B_{12} B_{15} B_{16} B_{17}, \\
G_{19} =& - A_{13} B_8 B_{10} B_{12} B_{15} B_{16} B_{17} - A_{13} B_9 B_{11} B_{12} B_{15} B_{16} B_{17} \\
& - a^6 A_8 A_{12} A_{16} B_3 B_6 B_{10} B_{18} - a^6 A_8 A_{11} A_{17} B_3 B_6 B_{10} B_{18}, \\
G_{20} =& - a^6 A_8 A_{12} A_{16} B_2 B_7 B_{10} B_{18} - a^6 A_8 A_{11} A_{17} B_2 B_7 B_{10} B_{18} \\
& + a^4 A_8 A_{13} A_{17} B_6 B_8 B_{10} B_{18} + a^4 A_8 A_{13} A_{17} B_6 B_9 B_{11} B_{18}, \\
G_{21} =& a^4 A_8 A_{17} B_7 B_8 B_{10} B_{13} B_{18} + a^4 A_8 A_{17} B_7 B_9 B_{11} B_{13} B_{18} \\
& - a^4 A_8 A_{12} B_6 B_8 B_{10} B_{14} B_{18} - a^4 A_8 A_{12} B_6 B_9 B_{11} B_{14} B_{18}, \\
G_{22} =& a^4 A_8 A_{13} A_{16} B_2 B_{10} B_{15} B_{18} - a^4 A_8 A_{16} B_3 B_{10} B_{13} B_{15} B_{18} \\
& + a^4 A_8 A_{11} B_2 B_{10} B_{14} B_{15} B_{18} - a^2 A_8 B_8 B_{10} B_{13} B_{14} B_{15} B_{18}, \\
G_{23} =& - a^2 A_8 B_9 B_{11} B_{13} B_{14} B_{15} B_{18} + a^4 A_8 A_{12} B_7 B_8 B_{10} B_{17} B_{18} \\
& + a^4 A_8 A_{12} B_7 B_9 B_{11} B_{17} B_{18} + a^4 A_8 A_{11} B_3 B_{10} B_{15} B_{17} B_{18}, \\
G_{24} =& -a^2 A_8 A_{13} B_8 B_{10} B_{15} B_{17} B_{18} - a^2 A_8 A_{13} B_9 B_{11} B_{15} B_{17} B_{18}.
\end{aligned}
$$

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ПРОБЛЕМ ДЕФОРМАЦИЈА РАВНИ У РОТИРАЈУЋЕМ МИКРОИСТЕГЉИВОМ ТЕРМОЕЛАСТИЧНОМ ТЕЛУ СА МИКРОТЕМПЕРАТУРАМА

Резиме. Проучаван је дводимензиони проблем бесконачног микроистегљивог термоеластичног тела са микротемпературама под дејством механичких утицаја. Средина ротира равномерном угаоном брзином $\vec{\Omega}$. Коришћена је анализа нормалних модова ради добијања тачних израза за компоненте нормалног померања, микротемпературе, нормалне силе напона, тензора микронапона, расподеле температуре, топлотног флукса и тензора тангенцијалног напона. Ефекти микроротације и дефермације на разматрене величине су приказани графички.

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