Figures 1 (g), (h) and (i) illustrate the effects of the fractional-order parameter on the strain. Unlike the effect of β on the stresses, a direct proportion between the absolute value of the amplitude of the strains and the variations of β can be noticed in Fig. 1 (d) and (e).

Figure 2 presents the effects of variations of the pulse intensity Ω on the behavior of the physical quantities φ, σ and e. Figures 2(a), (d) and (g) show that the value of the pulse intensity Ω is directly proportional to the absolute value of the amplitude of the physical quantities φ, σ and e. Figures 2(c), (f) and (i) show significant changes in the amplitude of the field functions φ, σ and e respectively with the two types of heat conduction.

We also noticed a significant change in the absolute value of the amplitude of the field functions φ, σ and e in the two types of heat conduction.

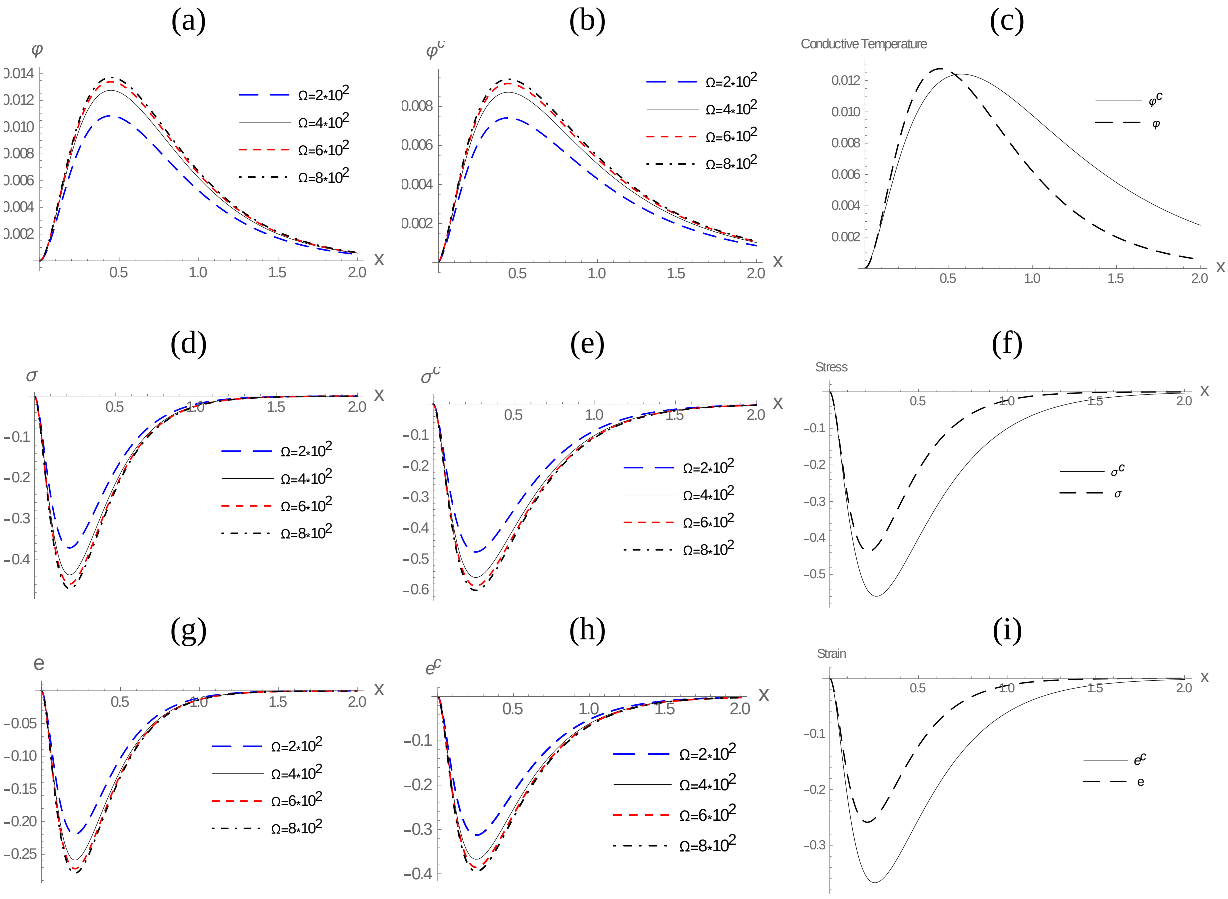

Fig. 2. Effect of pulse parameter Ω on φ, σ and e for $\beta = 0.5$, $t = 0.2$, $\tau_o = 0.02$:
(a) hyperbolic conductive temperature; (b) parabolic conductive temperature;
(c) the hyperbolic and parabolic conductive temperature at $\Omega = 4\times10^2$;
(d) stress in the hyperbolic case;
(e) stress in parabolic case; (f) hyperbolic and parabolic stress at $\Omega = 4\times10^2$;
(g) strain in hyperbolic case; (h) strain in the parabolic case;
(i) hyperbolic and parabolic strain at $\Omega = 4\times10^2$

Figure 3 represent the variations of the field function under the changes of time t. We noticed that the field functions changes significantly with the variation of time t. All the field functions are in direct proportion with the variation of t. Figure 3 (a) and (b) shows that the peaks of the temperatures occur at different points and move away from the near end $x = 0$.

Figures 3 (g), (h) show that the strain resembles the behavior of the stress. Figures 3 (c), (f) and (i) show that the φ, σ and e attain their equilibrium before φ^c, σ^c and e^c, respectively.

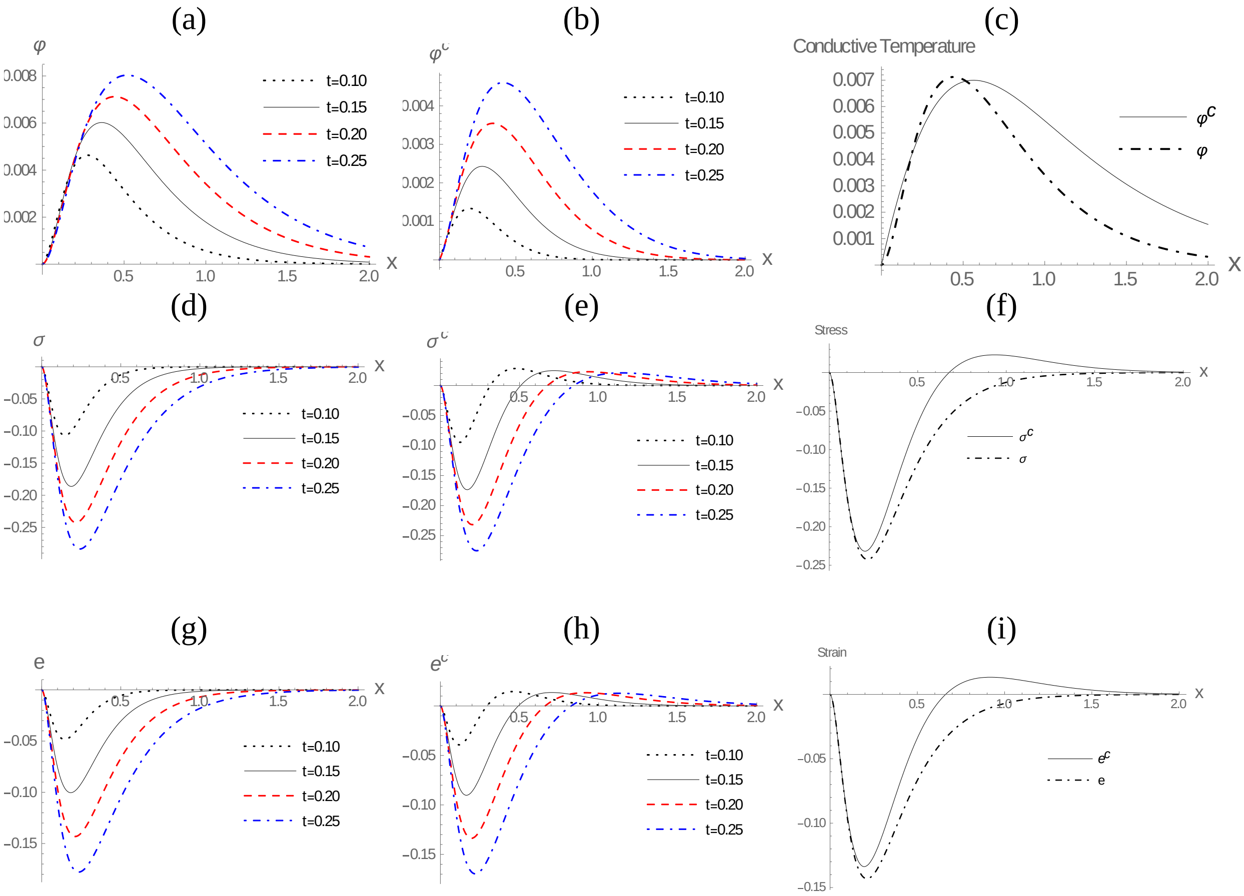

Fig. 3. Effect of time t on φ, σ and e for $\Omega = 10^2$, $\beta = 0.5$, $\tau_o = 0.02$: (a) hyperbolic conductive temperature; (b) parabolic conductive temperature; (c) the hyperbolic and parabolic conductive temperature at $t = 0.2$; (d) stress in the hyperbolic case; (e) stress in parabolic case; (f) hyperbolic and parabolic stress at $t = 0.2$; (g) strain in hyperbolic case; (h) strain in the parabolic case; (i) hyperbolic and parabolic strain $t = 0.2$

Conclusions

In summary, it is found that the field functions φ, σ and e have asymptotic stability in the hyperbolic case (i.e., in contrast to the classical two-temperature model, where they have local stability). Increasing the strength of the laser pulse leads to an increase in the absolute values of all the field functions magnitudes. The strain resembles the same behavior of the stress with any parameter. Stress and strain tend to equilibrium state rapidly than temperatures. The effect of time on the field functions is more significant than the effects of the other parameters. Increasing the time and the strength of the pulse, pumping more energy into the system, leads to an increase of the absolute values of the amplitude of field functions. Increasing fractional-order parameter, which Increases dissipation, results in decreasing the absolute values of the amplitude of φ, σ and e.

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