The optimum linear and nonlinear novel passive base isolators and tuned mass dampers are introduced in this thesis to mitigate the dynamic responses of the dynamic systems, such as single degree of freedom, multi degree of freedom systems and also to overcome the drawbacks of traditional passive base isolators and tuned mass dampers. Newton's second law applies to derive the governing equations of motion for the controlled structures. In addition, Lagrange's method applies to derive the nonlinear governing equations of motion of the nonlinear controlled structures. Taylor series expansion applies to generalize the nonlinear equations of motion of the controlled structures. The stochastic linearization method applies to linearize each nonlinear element of the governing equations of motion of the controlled structures. H_2 and $H\infty$ optimization methods are applied to derive the exact closed-form expressions for optimal design parameters of each novel passive vibration control device. The transfer function formation and harmonic balance methods are applied to derive the frequency domain responses of the controlled structures subjected to harmonic, random-white noise excitations analytically. Therefore, using these dynamic responses, the dynamic response reduction capacity of each novel passive vibration control device obtains in the frequency domain. In addition, a numerical study is performed, considering the Newmark-Beta method, to further determine the dynamic response reduction capacities, such as displacement and acceleration reduction capacities in the time domain. For this numerical study, the near-field with pulse and far-field earthquake records are applied as base excitations. The dynamic response reduction capacity of introduced passive vibration isolation systems is significantly at least 30 % superior to the traditional ones. An analytical solver is introduced to derive the non-dimensional response spectra of the impact oscillator. The impact between the floors of the two adjacent building structures or the impact between adjacent decks and abutments is modelled by an impact oscillator subjected to closed-form mathematical formulations of near-fault earthquake motions as pulse-type excitations. The momentum-based stereo-mechanical method is used as a contact force-based model to perform the impact analysis. The non-dimensional relative displacement between the impact oscillator and the barrier is determined as $\tilde{\delta} < 3$ for each successive impact.