

**Table S1.** Summary of ANOVA Results and Model Adequacy for the Five Quadratic Models

Critical Quality Attribute (Response)	Model p-value	R <sup>2</sup>	Adjusted R <sup>2</sup>	Predicted R <sup>2</sup>	Adequate Precision
Particle Size (Y <sub>1</sub> )	< 0.0001	0.998	0.995	0.986	75.2
Zeta Potential (Y <sub>2</sub> )	< 0.0001	0.994	0.987	0.962	52.4
EE% Gentamicin (Y <sub>3</sub> )	< 0.0001	0.991	0.981	0.941	41.8
EE% Ciprofloxacin (Y <sub>4</sub> )	< 0.0001	0.997	0.994	0.981	68.9
EE% Lysozyme (Y <sub>5</sub> )	< 0.0001	0.989	0.977	0.928	38.5

**Table S2. Physicochemical Properties of the Optimized Chitosan-MIL-53(Fe) Nanoformulation**

Critical Quality Attribute (CQA)	Result (Mean ± SD, n=3)
Particle Size (nm)	248 ± 11
Polydispersity Index (PDI)	0.21 ± 0.02
Zeta Potential (mV)	+33.8 ± 1.7
Encapsulation Efficiency, Gentamicin (%)	68.5 ± 2.4
Encapsulation Efficiency, Ciprofloxacin (%)	85.1 ± 1.9
Encapsulation Efficiency, Lysozyme (%)	39.7 ± 2.1