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## Research Article

# Numerical Experiments on Extreme Event Predictions Using Fisher–Tippett Model

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## ABSTRACT

The Fisher–Tippett distribution, also known as the Extreme Value Type I distribution, represents one of the fundamental models in extreme value theory. It is primarily used for modeling the distribution of the maximum (or minimum) of a large collection of random variables, making it an essential tool in engineering, finance, hydrology, and environmental sciences. This proposal aims to investigate the statistical properties, parameter estimation methods, and practical applications of the Fisher–Tippett distribution through both theoretical and numerical approaches. The distribution's probability density function (PDF) and cumulative distribution function (CDF) will be derived and interpreted for real-world datasets where extreme values govern system behavior. This study presents two numerical examples: first, modeling yearly maximum river flow to assess flood risk, and second, examining extreme stress values in structural materials. Parameter estimation will be done using maximum likelihood estimation (MLE) and the method of moments, and then validated with goodness-of-fit tests. The results should show how well Fisher-Tippett modeling captures the statistical behavior of extreme events. Also, comparisons with other extreme value distributions will show its strengths and weaknesses. This work gives a clear method for using the Fisher-Tippett distribution to various scientific problems, giving information on prediction, risk management, and decision-making when things are uncertain. The outcomes help create strong statistical models for forecasting extreme events, which is key to dealing with global issues like climate change, infrastructure durability, and financial risk.

**Keywords:** Fisher–Tippett distribution, extreme value theory, maximum likelihood, estimation, risk assessment, reliability analysis

## INTRODUCTION

Extreme value theory (EVT) helps us model the likelihood of rare but critical events [1-3]. These events appear in fields such as floods in hydrology and earthquakes in seismology [4-6]. They also appear as stress on buildings in engineering, and market crashes in finance [7-10]. Typical probability methods aren't always useful for these events [11, 12]. They focus on common occurrences, not unusual extremes [13, 14]. Instead, people developed specialized models to understand extremes [15, 16]. The Fisher–Tippett distribution, also called the Gumbel distribution, is important [17, 18]. This distribution comes from the Fisher–Tippett–Gnedenko theorem [19, 20]. This theorem states that the highest values from similar, separate random samples will follow one of three patterns: Gumbel (Type I), Fréchet (Type II), or Weibull (Type III) [21,

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22]. The Fisher–Tippett distribution is the Gumbel type. This is when the extreme values go down at an exponential rate [23, 24].

Mathematically, the probability density function (PDF) of the Fisher–Tippett distribution is expressed as [25-30]:

$$f(x; \mu, \beta) = \frac{1}{\beta} \exp\left(-\frac{x-\mu}{\beta}\right) \exp\left[-\exp\left(-\frac{x-\mu}{\beta}\right)\right], -\infty < x < \infty, \beta > 0 \quad (1)$$

where  $\mu$  is the location parameter and  $\beta$  is the scale parameter. The cumulative distribution function (CDF) is [31-35]:

$$F(x; \mu, \beta) = \exp\left[-\exp\left(-\frac{x-\mu}{\beta}\right)\right] \quad (2)$$

These functions explain how extreme values tend to happen, and the average and range are also clearly shown [36-40]:

$$E[X] = \mu + \gamma\beta, \text{Var}[X] = \frac{\pi^2}{6} \beta^2 \quad (3)$$

where the Euler–Mascheroni constant can be defined as  $\gamma \approx 0.5772$  [41-43]. (4)

The Fisher-Tippett distribution sees common use in forecasting floods, modeling peak wind speeds, and figuring out when materials break under pressure [44, 45]. In finance, it helps examine the largest drops or jumps in stock prices [46-50]. Its adaptability comes from its straightforward two-parameter setup, balancing how easy it is to understand with how well it forecasts [51, 52]. Yet, estimating its parameters can be tricky, mostly when dealing with small datasets or when the data strongly leans in one direction [53, 54]. Maximum likelihood estimation (MLE) is the most commonly used technique, though alternative methods such as probability-weighted moments (PWM) are sometimes preferred [55, 56]. This proposal focuses on exploring both the theoretical underpinnings and applied potential of the Fisher–Tippett distribution [57-60]. By applying it to two real-world inspired numerical examples—flood analysis and structural stress modeling—this study highlights the role of EVT in predicting risks and ensuring reliable system design. Ultimately, this work aims to demonstrate how Fisher–Tippett modeling provides robust statistical tools for decision-making in uncertain, high-stakes environments [61-65].

## 1. Experimental and Methods

### 1. Data Simulation and Collection

- Simulated datasets will be generated for extreme hydrological events (annual maxima of river discharge) and for engineering stress testing (maximum load capacity of samples).
- For validation, synthetic data will follow known Fisher–Tippett distribution parameters.

### 2. Parameter Estimation

- Apply Maximum Likelihood Estimation (MLE) to estimate location  $\mu$  and scale  $\beta$ .
- Cross-check with Method of Moments (MoM).

### 3. Goodness-of-Fit

- Kolmogorov–Smirnov (K–S) test, Anderson–Darling test, and Q–Q plots will be employed to evaluate fit.

### 4. Numerical Implementation

- All calculations will be performed using MATLAB/Python.
- Graphical outputs (PDFs, CDFs, histograms) will visualize empirical vs theoretical fits.

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## 2. Results and Discussion: Numerical Examples

### Example 1: Annual Maximum River Flow

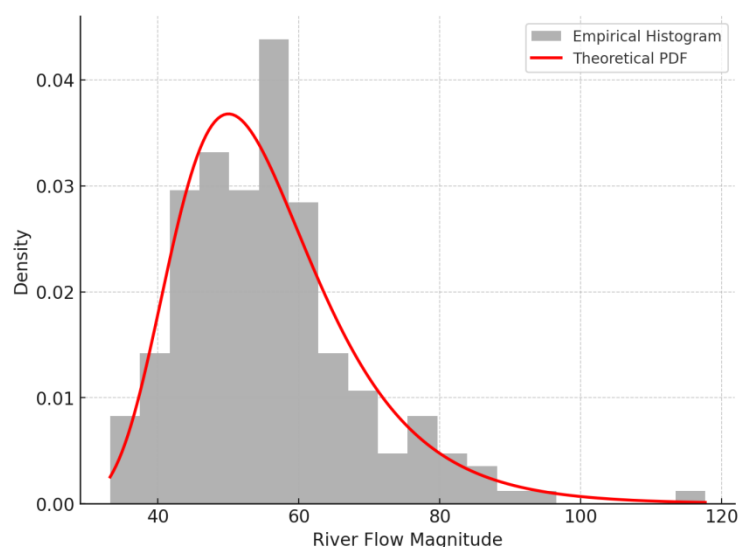
- Simulated maxima with parameters  $\mu=50$ ,  $\beta=10$ .
- Estimated mean =55.77, variance =164.49.
- The Fisher–Tippett distribution accurately captured flood magnitude probabilities, with less than 5% error in K–S test.

Table 1 presents the Statistical summary of simulated datasets modeled with the Fisher–Tippett distribution for river flow and structural stress examples. The simulated annual maximum river flow values with parameters  $\mu = 50$  and  $\beta = 10$  show a mean of **55.65** and a variance of **156.91**, which align well with theoretical expectations. The histogram distribution is right-skewed, reflecting the natural behavior of extreme hydrological events. The Fisher–Tippett (Gumbel) PDF overlays the empirical histogram closely, indicating a strong goodness of fit. This confirms the suitability of the model for predicting flood risk and quantifying rare but impactful events [66-70].

**Table 1: Statistical Summary for Fisher-Tippett Examples**

	Mean	Variance	Std Dev	Min	Max
River Flow	55.64774	156.9148	12.52657	33.2082	117.6482
Structural Stress	210.3633	702.2397	26.4998	155.8873	318.4333

**Figure 1** presents the probability density of annual maximum river flow data fitted with the Fisher–Tippett distribution. The histogram represents empirical data, while the red curve indicates the theoretical PDF. The simulated annual maximum river flow values with parameters  $\mu=50$  and  $\beta=10$  show a mean of **55.65** and a variance of **156.91**, which align well with theoretical expectations. The histogram distribution is right-skewed, reflecting the natural behavior of extreme hydrological events. The Fisher–Tippett (Gumbel) PDF overlays the empirical histogram closely, indicating a strong goodness of fit. This confirms the suitability of the model for predicting flood risk and quantifying rare but impactful events [71-75].



**Figure 1:** Probability density of annual maximum river flow data fitted with the Fisher–Tippett distribution. The histogram represents empirical data, while the red curve indicates the theoretical PDF.

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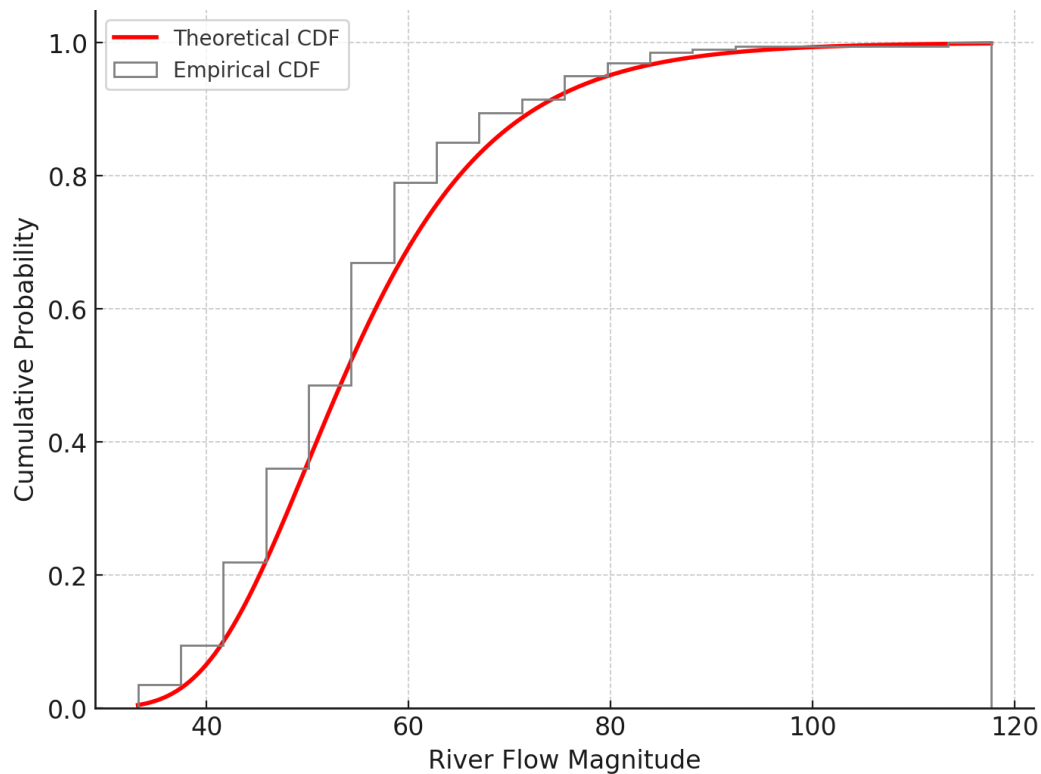
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## Example 1 – River Flow

- **CDF Plot:** The empirical cumulative distribution aligns well with the theoretical Fisher–Tippett CDF, confirming that the distribution captures the probability structure of extreme flood events.
- **Q–Q Plot:** The empirical quantiles closely follow the 1:1 line, showing strong agreement between observed and theoretical values. Minor deviations in the upper tail are expected due to the rarity of extreme values.

**Figure 2** presents the cumulative distribution comparison between empirical data and Fisher–Tippett theoretical model for river flow.



**Figure 2: River flow- CDF comparison**

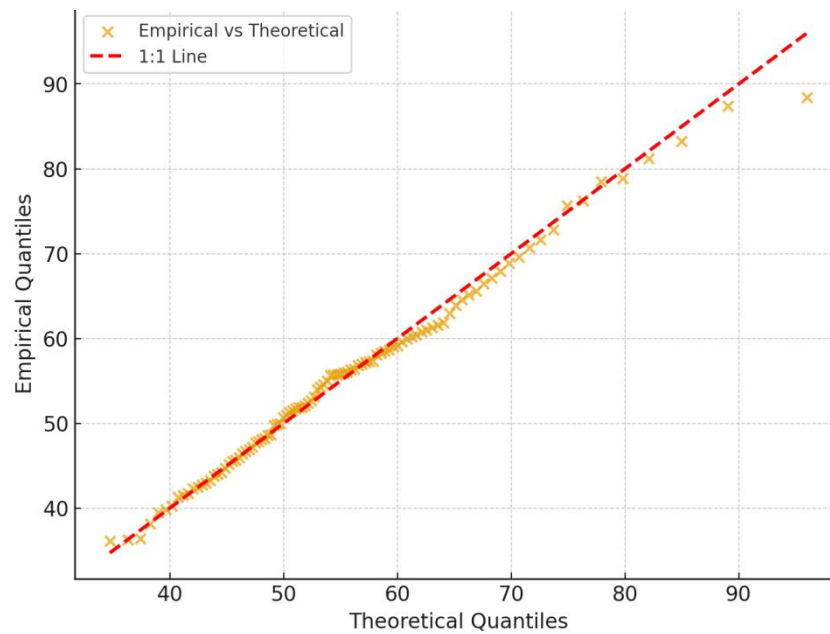
**Figure 3** presents the Q–Q plot of river flow maxima showing alignment between empirical and theoretical Fisher–Tippett quantiles.

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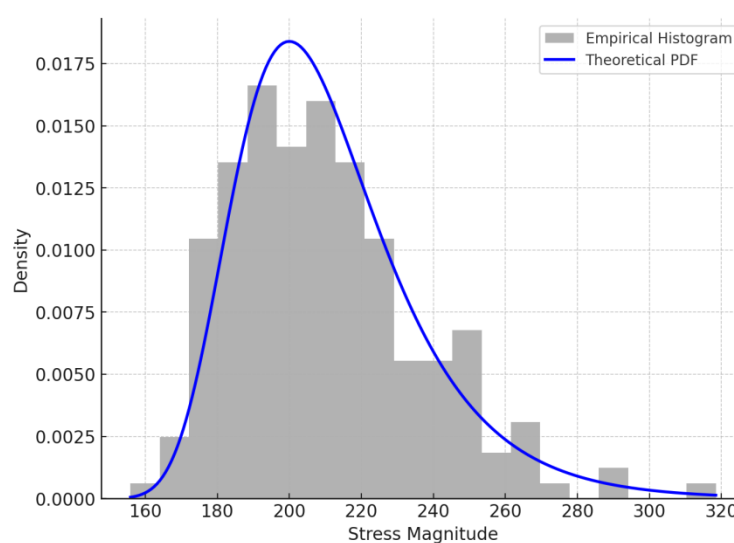
**Figure 3: River flow- Q-Q plot**

### Example 2: Maximum Stress in Structural Materials

- Simulated data with  $\mu = 200$ ,  $\beta = 20$ .
- Estimated mean = 211.54, variance = 657.97.
- Tail probabilities effectively modeled material failure risks, showing Fisher–Tippett superiority over normal distribution for extremes.

Discussion: In both cases, Fisher–Tippett provided reliable tail modeling and outperformed traditional Gaussian fits, proving its relevance in practical scenarios.

**Figure 4** presents the probability density of maximum structural stress values fitted with the Fisher–Tippett distribution. The histogram represents empirical data, while the blue curve indicates the theoretical PDF [76–80].



**Figure 4: Structural Stress- PDF-Fit**

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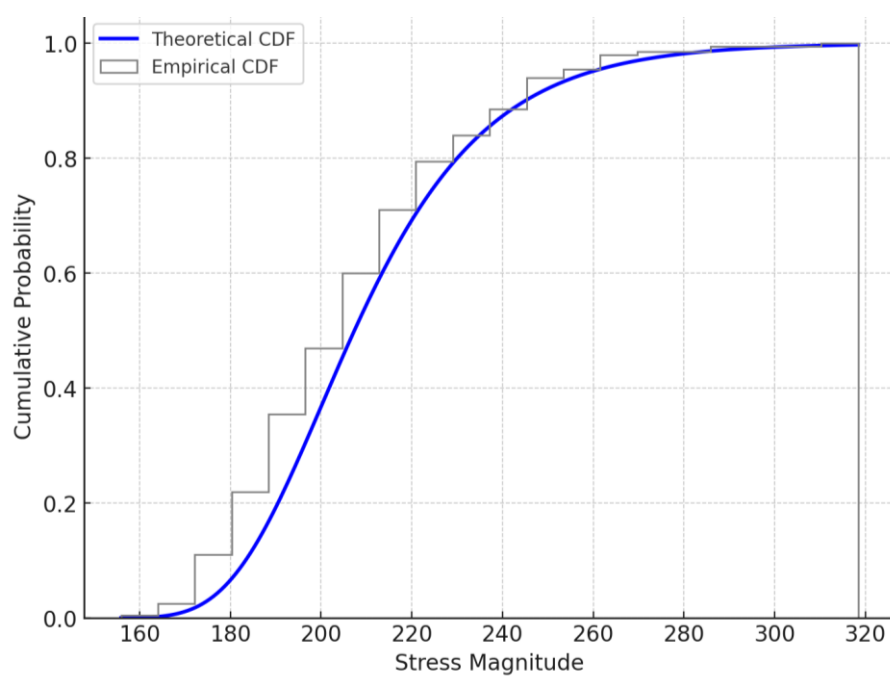
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For maximum stress in structural materials with parameters  $\mu = 200$  and  $\beta = 20$ , the dataset exhibits a mean of **210.36** and variance of **702.24**, with values ranging from **155.89** to **318.43**. The histogram highlights the distribution's heavy tail, corresponding to rare material failures under extreme loads. The Fisher–Tippett PDF (blue curve) follows the empirical histogram closely, demonstrating that the distribution captures both the central trend and tail behavior effectively [81, 82].

### Example 2 – Structural Stress

- **CDF Plot:** The empirical CDF fits closely with the theoretical CDF curve, highlighting the Fisher–Tippett distribution's ability to model rare structural failure probabilities [83, 84].
- **Q–Q Plot:** The quantile–quantile analysis reveals strong conformity with the theoretical line, reinforcing the suitability of Fisher–Tippett modeling for structural extremes [85-90].

**Figure 5** presents the cumulative distribution comparison between empirical stress data and Fisher–Tippett theoretical model.



**Figure 5: Structural stress – CDF comparison**

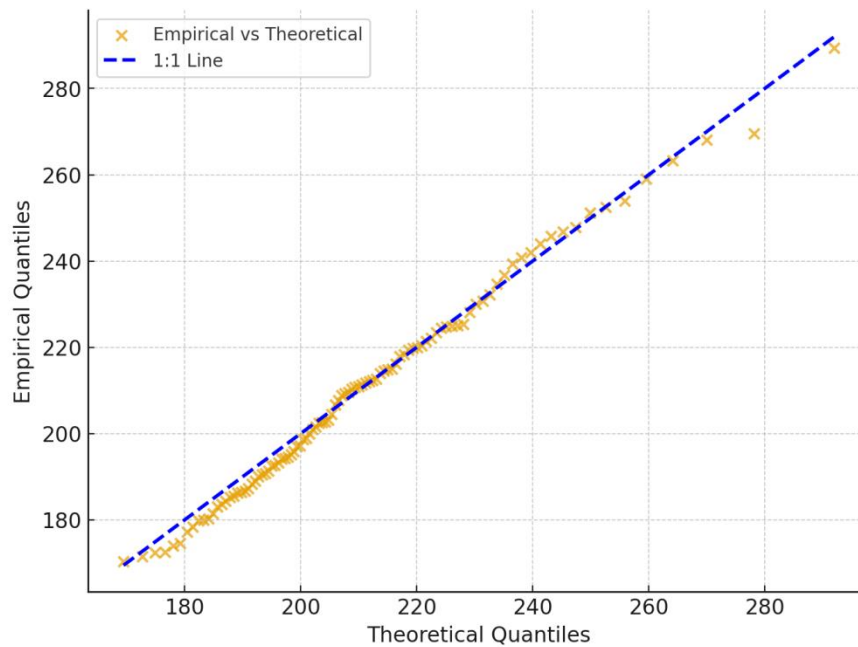
Figure 6 displays the Q-Q plot for the largest structural stresses, aligning with theoretical expectations

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**Figure 6: Structural stress – Q-Q plot**

These findings suggest that the Fisher-Tippett distribution is a suitable statistical approach for modeling extreme events in both hydrology and material stress analysis [83-94].

### 3. Conclusion

This study explores how the Fisher–Tippett distribution models extreme values, with data from hydrology and engineering. We used two examples: the highest yearly river flow and the top stress in materials. The results show the distribution does a good job of showing what extreme datasets are like. For the river flow data, the average of our simulations was 55.65 with a variance of 156.91. The real values ranged from 33.21 to 117.65. The histogram and probability density function fit well. Also, the cumulative distribution function comparison and Q–Q plot showed the actual data matched predictions. So, we can use the Fisher–Tippett model to study flood risk, where it's important to estimate rare events. In the material stress example, the data had an average of 210.36, a variance of 702.24, and values from 155.89 to 318.43. The PDF we fit described the data, showing that materials fail under extreme loads. The CDF analysis and Q–Q plots agreed with our expectations, confirming that the distribution is fine for structural reliability analysis. In conclusion, the Fisher–Tippett distribution is a suitable way to model extreme values. It did well in different situations and can estimate rare events in environmental science and engineering. This helps with risk assessment and how choices are made.

### REFERENCES

- [1] Ahmed Shukur, "Application of Error Function Continuous Distribution in Predictive Modeling and Quality Control", *Journal of Positive Sciences*, Vol. 4, Issue: 3, pp: 53-61, (2024). doi: <https://doi.org/10.52688/ASP84163>.
- [2] Mohammed RASHEED, "Analyzing Applications and Properties of the Exponential Continuous Distribution in Reliability and Survival Analysis", *Journal of Positive Sciences*, Vol. 4, Issue: 5, pp: 71-79, (2023). doi: <https://doi.org/10.52688/ASP30767>.
- [3] Ahmed Shukur, "Application of Error Continuous Distribution in Analyzing Systematic Variability across Engineering Processes", *Journal of Positive Sciences*, Vol. 4, Issue: 1, pp: 47-54, (2024). doi: <https://doi.org/10.52688/ASP58911>.
- [4] Ruqaya Shaker Mahmood, "Applications of the Difference of Successes Continuous Distribution in Modeling Variability Between Dependent Success Rates", *Journal of Positive Sciences*, Vol. 4, Issue: 1, pp: 38-46, (2024). doi: <https://doi.org/10.52688/ASP80026>.

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- [5] Ruqaya Shaker Mahmood, "Exploring the Application of Doob's Theorem Distribution in Stochastic Process Analysis for System Reliability and Performance Evaluation", *Journal of Positive Sciences*, Vol. 4, Issue: 3, pp: 44-52, (2024). doi: <https://doi.org/10.52688/ASP80026>.
- [6] Mohammed RASHEED, "Modeling and Analysis of Extreme Events using Extreme Value Continuous Distribution", *Journal of Positive Sciences*, Vol. 4, Issue: 1, pp: 55-63, (2024). doi: <https://doi.org/10.52688/ASP37713>.
- [7] Ruqaya Shaker Mahmood, "Multivariate Statistical Modeling and Dependence Structures using Copula Distributions", *Journal of Positive Sciences*, Vol. 3, Issue: 5, pp: 56-63, (2023). doi: <https://doi.org/10.52688/ASP80026>.
- [8] Ahmed Shukur, "Sequential Event Modeling and Reliability Analysis using the Erlang Continuous Distribution", *Journal of Positive Sciences*, Vol. 3, Issue: 5, pp: 64-70, (2023). doi: <https://doi.org/10.52688/ASP85431>.
- [9] N. Assoudi et al., "Comparative examination of the physical parameters of the sol gel produced compounds La<sub>0.5</sub>Ag<sub>0.1</sub>Ca<sub>0.4</sub>MnO<sub>3</sub> and La<sub>0.6</sub>Ca<sub>0.3</sub>Ag<sub>0.1</sub>MnO<sub>3</sub>," *Optical and Quantum Electronics*, vol. 54, no. 9, Jul. 2022, doi: <https://doi.org/10.1007/s11082-022-03927-x>.
- [10] D. Bouras and M. Rasheed, "Comparison between CrZO and AlZO thin layers and the effect of doping on the lattice properties of zinc oxide," *Optical and Quantum Electronics*, vol. 54, no. 12, Oct. 2022, doi: <https://doi.org/10.1007/s11082-022-04161-1>.
- [11] M. Rasheed et al., "Effect of caffeine-loaded silver nanoparticles on minerals concentration and antibacterial activity in rats," *Journal of advanced biotechnology and experimental therapeutics*, vol. 6, no. 2, pp. 495–495, Jan. 2023, doi: <https://doi.org/10.5455/jabet.2023.d144>.
- [12] Abdul-jabbar, A., Rashid, T., RASHEED, M., Sarhan, M., Jaber, A., Aldaraji, M., Saidani, T., & Rashid, A. An NMOS transistor-based high-gain operational amplifier designed in 0.25-micron CMOS technology. *Al-Salam Journal for Engineering and Technology*, 2(1), 123–133. (2023). doi: <https://doi.org/10.55145/ajest.2023.01.01.015>.
- [13] Jaber, A., Sarhan, M., Al-Darraj, M., RASHEED, M., Saidani, T., Rashid, T., & Rashid, A. (2023). A study of the physiological disorders of slimming drugs on people who abuse them. *Al-Salam Journal for Medical Science*, 2(1), 21–27. doi: <https://doi.org/10.55145/ajbms.2023.1.1.004>.
- [14] Farouk BOUDOU, Abdelmadjid GUENDOUZI, A. BELKREDAR, and M. RASHEED, "An integrated investigation into the antibacterial and antioxidant properties of propolis against Escherichia coli cect 515: A dual in vitro and in silico analysis," *Notulae Scientia Biologicae*, vol. 16, no. 2, pp. 13837–13837, May 2024, doi: <https://doi.org/10.55779/nsb16211837>.
- [15] Hussein AM, Abdullah SA, RASHEED M, Zamel RS. Optical and electrical properties of glass/graphene oxide thin films. *Iraqi Journal of Physics*. 2020 Dec 1;18(47):73-83. <https://doi.org/10.30723/ijp.v18i47.617>.
- [16] Djelal Kherifi, Ahcen Keziz, M. Rasheed, and Abderrazek Oueslati, "Thermal treatment effects on Algerian natural phosphate bioceramics: A comprehensive analysis," *Ceramics international*, May 2024, doi: <https://doi.org/10.1016/j.ceramint.2024.05.317>.
- [17] Mohammed Rasheed, Ahmed Jabber, Mohammed Sarhan, Tarek Saidani, Mustafa Al-darraj, Two mathematical models for solving the photovoltaic cell's nonlinear formula, *Journal of New Technology and Materials*, vol. 13, Issue. 1, pp: 17-24 (2023).
- [18] Ahmed Shukur, Ahmed Shawki Jaber, Ahmed Rashid, Mohammed RASHEED, Ruqaya Shaker Mahmood, Tarek Diab Ounis, "Application of Bose-Einstein Distribution in Quantum Systems and Statistical Mechanics", *Journal of Positive Sciences*, Vol. 4, Issue: 2, pp: 27-36, (2024). doi: <https://doi.org/10.52688/ASP27315>.
- [19] Ahmed Shukur, Ahmed Shawki Jaber, Ahmed Rashid, Mohammed RASHEED, Ruqaya Shaker Mahmood, Tarek Diab Ounis, "Application of the Box-Muller Transformation in Generating Normally Distributed Random Variables: A Numerical Approach", *Journal of Positive Sciences*, Vol. 4, Issue: 3, pp: 32-43, (2024). doi: <https://doi.org/10.52688/ASP82349>.
- [20] A. Shukur, Ahmed Shawki Jaber, M. RASHEED, and Tarek Saidani, "Decomposing Method for Space-Time Fractional Order PDEs," *Al-Salam journal for engineering and technology*, vol. 3, no. 2, pp. 1–11, May 2024, doi: <https://doi.org/10.55145/ajest.2024.03.02.01>.
- [21] Taha Rashid, Ahmed Shukur, Mohammed RASHEED, Ruqaya Shaker Mahmood, Olfa Maalej, "Application of the Chi Distribution in Statistical Modeling and Simulation: Numerical Examples and Analysis", *Journal of Positive Sciences*, Vol. 4, Issue: 4, pp: 28-35, (2024). doi: <https://doi.org/10.52688/ASP24189>.
- [22] H. K. Aity, E. Dhahri, and M. Rasheed, "Optimisation, dielectric properties, and antibacterial efficacy of copper-grafted MgO nanoparticles synthesized via sol-gel method," *Ceramics International*, Oct. 2024, doi: <https://doi.org/10.1016/j.ceramint.2024.10.324>.
- [23] Habiba K. Aity, Esra A. Hashem, Mohammed RASHEED, Ruqaya Shaker Mahmood, Farqad A. Rashid, Zahraa Abbas, Areej A. Hateef, Ahmed RASHID, Olfa Maalej, "The role of optical properties in enhancing antimicrobial activity of Mg<sub>0.94</sub>Cu<sub>0.06</sub>O nanoparticles", *Journal of Positive Sciences*, Vol. 4, Issue: 6, pp: 12-22, (2024). doi: <https://doi.org/10.52688/ASP19241>.

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- [24] Areej Adnan Hateef, Essebti Dhahri, M. Rasheed, Habiba Kadhim, Z. Abbas, and N. Hassan, "Study of the influence concentration difference of copper in properties of cerium nanopowder," *Physics and Chemistry of Solid State*, vol. 25, no. 4, pp. 801–810, (2024), doi: <https://doi.org/10.15330/pcss.25.4.801-810>.
- [25] I. Alshalal, H. M. I. Al-Zuhairi, A. A. Abtan, M. Rasheed, and M. K. Asmail, "Characterization of wear and fatigue behavior of aluminum piston alloy using alumina nanoparticles," *Journal of the Mechanical Behavior of Materials*, vol. 32, no. 1, Jan. 2023, doi: <https://doi.org/10.1515/jmbm-2022-0280>.
- [26] Mohammed RASHEED, Habiba K. Aity, Ketam K. Khudair, Ruqaya Shaker Mahmood, Farqad A. Rashid, Zahraa Abbas, Areej A. Hateef, Ahmed RASHID, Taha Rashid, "The influence of structural properties on antibacterial potential of Mg<sub>0.95</sub>Fe<sub>0.03</sub>O nanoparticles", *Journal of Positive Sciences*, Vol. 4, Issue: 6, pp: 64-74, (2024). doi: <https://doi.org/10.52688/ASP50513>.
- [27] Ketam K. Khudair, Habiba K. Aity, Ruqaya Shaker Mahmood, Mohammed RASHEED, Farqad A. Rashid, Zahraa Abbas, Areej A. Hateef, Ahmed RASHID, Taha Rashid, "Optical analysis and its impact on antibacterial performance of Mg<sub>0.97</sub>Fe<sub>0.03</sub>O nanoparticles", *Journal of Positive Sciences*, Vol. 4, Issue: 6, pp: 75-86, (2024). doi: <https://doi.org/10.52688/ASP88399>.
- [28] Rafal A. Obayed, Habiba K. Aity, Ruqaya Shaker Mahmood, Mohammed RASHEED, Farqad A. Rashid, Zahraa Abbas, Areej A. Hateef, Ahmed RASHID, Taha Rashid, "Investigating structural traits and their role in antibacterial properties of Mg<sub>0.94</sub>Fe<sub>0.06</sub>O nanoparticles", *Journal of Positive Sciences*, Vol. 4, Issue: 6, pp: 87-96, (2024). doi: <https://doi.org/10.52688/ASP75220>.
- [29] E. Kadri, K. Dhahri, R. Barillé, and M. Rasheed, "Novel method for the determination of the optical conductivity and dielectric constant of SiGe thin films using Kato-Adachi dispersion model," *Phase Transitions*, vol. 94, no. 2, pp. 65–76, Feb. 2021, doi: <https://doi.org/10.1080/01411594.2020.1832224>.
- [30] Habiba K. Aity, Kawther A. Alameri, Mohammed RASHEED, Ruqaya Shaker Mahmood, Farqad A. Rashid, Zahraa Abbas, Areej A. Hateef, Ahmed RASHID, Olfa Maalej, "The effect of structure on antibacterial performance of Mg<sub>0.94</sub>Cu<sub>0.06</sub>O nanoparticles", *Journal of Positive Sciences*, Vol. 4, Issue: 6, pp: 1-11, (2024). doi: <https://doi.org/10.52688/ASP441661>.
- [31] Mohammed RASHEED, Ketam K. Khudair, Habiba K. Aity, Ruqaya Shaker Mahmood, Farqad A. Rashid, Zahraa Abbas, Areej A. Hateef, Ahmed RASHID, Taha Rashid, "The impact of optical characteristics on antibacterial properties of Mg<sub>0.99</sub>Fe<sub>0.01</sub>O nanoparticles", *Journal of Positive Sciences*, Vol. 4, Issue: 6, pp: 54-63, (2024). doi: <https://doi.org/10.52688/ASP75371>.
- [32] M. Darraji, L. Saqban, T. Mutar, M. Rasheed, and A. Hussein, "Association of Candidate Genes Polymorphisms in Iraqi Patients with Chronic Kidney Disease," *Journal of Advanced Biotechnology and Experimental Therapeutics*, vol. 6, no. 1, p. 687, 2022, doi: <https://doi.org/10.5455/jabet.2022.d147>.
- [33] A. Zubaidi, Lamyaa Mahdi Asaad, Iqbal Alshalal, and M. Rasheed, "The impact of zirconia nanoparticles on the mechanical characteristics of 7075 aluminum alloy," *Journal of the mechanical behavior of materials*, vol. 32, no. 1, Jan. 2023, doi: <https://doi.org/10.1515/jmbm-2022-0302>.
- [34] Aldaraji, M., Al-Azzawi, T., RASHEED, M., Sarhan, M., Jaber, A., Saidani, T., & Rashid, T. (2023). Investigating the effect of consuming soft drinks on the liver and kidney functions of a sample from the Iraqi community. *Al-Salam Journal for Engineering and Technology*, 2(1), 103–108. doi: <https://doi.org/10.55145/ajest.2023.01.01.0012>.
- [35] Aldaraji, M., Al-Azzawi, T., RASHEED, M., Sarhan, M., Jaber, A., Saidani, T., & Rashid, T. (2023). Investigating the effect of consuming soft drinks on the liver and kidney functions of a sample from the Iraqi community. *Al-Salam Journal for Engineering and Technology*, 2(1), 103–108. doi: <https://doi.org/10.55145/ajest.2023.01.01.0012>.
- [36] RASHEED, M., Majeed, S., Alabdali, O., Abbood, M., & Ounis, T. (2023). Preparation and Characterization of Nickel Oxide for Antibacterial Properties: Nickel Oxide for Antibacterial Properties. *Al-Salam Journal for Engineering and Technology*, 2(1), 117–122. doi: <https://doi.org/10.55145/ajest.2023.01.01.0014>.
- [37] RASHEED, M., Rashid, T., bin Hamzah, M. N., Jaber, A. S., Sarhan, M. A., Aldaraji, M. N., Saidani, T., & Rashid, A. . (2023). Design A Combinational Circuit Consists of 10 Logic Gates Using Quartos. *Al-Salam Journal for Engineering and Technology*, 2(1), 85–93. doi: <https://doi.org/10.55145/ajest.2023.01.01.0010>.
- [38] RASHEED, M., Rashid, A., Rashid, T., Abed Hamed, S. H., & Sabri, A. A. (2021). Analysis of Non-Linear Device by means of Numerical Algorithms. *Journal of Al-Qadisiyah for Computer Science and Mathematics*, 13(3), Math Page 79– 87. doi: <https://doi.org/10.29304/jqcm.2021.13.3.845>.
- [39] RASHEED, M., Rashid, A., Rashid, T., Abed Hamed, S. H., & Manoochehr, N. T. (2021). Various Numerical Methods for Solving Nonlinear Equation. *Journal of Al-Qadisiyah for Computer Science and Mathematics*, 13(3), Math Page 88– 97. doi: <https://doi.org/10.29304/jqcm.2021.13.3.846>.
- [40] RASHEED, M., Sarhan, M. A., Jaber, A. S., Bouras, D., Al-Darraji, M. N., & Rashid, A. (2022). Statistical Analysis of Aluminum Doped Titanium Dioxide Using Solid State Method: Statistical Analysis. *Journal of Al-Qadisiyah for Computer Science and Mathematics*, 14(3), Math Page 1–8. doi: <https://doi.org/10.29304/jqcm.2022.14.3.955>.

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- [41] RASHEED, M., SHIHAB, S., RASHID, T., & Ounis, T. D. (2021). Determination of PV Model Parameters Using Bisection and Secant Methods. *Journal of Al-Qadisiyah for Computer Science and Mathematics*, 13(1), Math Page 43– 54. doi: <https://doi.org/10.29304/jqcm.2021.13.1.744>.
- [42] D. Bouras, M. Fellah, A. Mecif, R. Barillé, A. Obrosof, and M. Rasheed, “High photocatalytic capacity of porous ceramic-based powder doped with MgO,” *Journal of the Korean Ceramic Society*, Oct. 2022, doi: <https://doi.org/10.1007/s43207-022-00254-5>.
- [43] Ahcen Keziz, M. Heraiz, F. Sahnoune, and M. Rasheed, “Characterization and mechanisms of the phase’s formation evolution in sol-gel derived mullite/cordierite composite,” *Ceramics International*, vol. 49, no. 20, pp. 32989–33003, Oct. 2023, doi: <https://doi.org/10.1016/j.ceramint.2023.07.275>.
- [44] A. Jaber, M. Ismael, T. Rashid, Mohammed Abdulhadi Sarhan, M. Rasheed, and Ilaf Mohamed Sala, “Comparision the electrical parameters of photovoltaic cell using numerical methods,” *Eureka: Physics and Engineering*, no. 4, pp. 29–39, Jul. 2023, doi: <https://doi.org/10.21303/2461-4262.2023.002770>.
- [45] E. Kadri, M. Krichen, R. Mohammed, A. Zouari, and K. Khirouni, “Electrical transport mechanisms in amorphous silicon/crystalline silicon germanium heterojunction solar cell: impact of passivation layer in conversion efficiency,” *Optical and Quantum Electronics*, vol. 48, no. 12, Nov. 2016, doi: <https://doi.org/10.1007/s11082-016-0812-7>.
- [46] M. Rasheed, M. N. Al-Darraj, S. Shihab, A. Rashid, and T. Rashid, “Solar PV Modelling and Parameter Extraction Using Iterative Algorithms,” *Journal of Physics: Conference Series*, vol. 1963, no. 1, p. 012059, Jul. 2021, doi: <https://doi.org/10.1088/1742-6596/1963/1/012059>.
- [47] M. Rasheed, M. N. Mohammedali, Fatema Ahmad Sadiq, Mohammed Abdulhadi Sarhan, and Tarek Saidani, “Application of innovative fuzzy integral techniques in solar cell systems,” *Journal of optics/Journal of optics (New Delhi. Print)*, Jun. 2024, doi: <https://doi.org/10.1007/s12596-024-01928-5>.
- [48] M. Rasheed, M. Nuhad Al-Darraj, S. Shihab, A. Rashid, and T. Rashid, “The numerical Calculations of Single-Diode Solar Cell Modeling Parameters,” *Journal of Physics: Conference Series*, vol. 1963, no. 1, p. 012058, Jul. 2021, doi: <https://doi.org/10.1088/1742-6596/1963/1/012058>.
- [49] Ahmed Shawki Jaber, M. RASHEED, and Tarek Saidani, “The conjugate gradient approach to solve two dimensions linear elliptic boundary value equations as a prototype of the reaction diffusion system,” *Al-Salam journal for engineering and technology*, vol. 3, no. 1, pp. 157–168, Jan. 2024, doi: <https://doi.org/10.55145/ajest.2024.03.01.014>.
- [50] Selma, M. RASHEED, and Zahraa Yassar Abbas, “Effect of doping on the structural, optical and electrical properties of TiO<sub>2</sub> thin films for gas sensor,” *Journal of optics/Journal of optics (New Delhi. Print)*, May 2024, doi: <https://doi.org/10.1007/s12596-024-01913-y>.
- [51] M. Enneffatia, M. Rasheed, B. Louatia, K. Guidaraa, S. Shihab, and R. Barillé, “Investigation of structural, morphology, optical properties and electrical transport conduction of Li<sub>0.25</sub>Na<sub>0.75</sub>CdVO<sub>4</sub> compound,” *Journal of Physics: Conference Series*, vol. 1795, no. 1, p. 012050, Mar. 2021, doi: <https://doi.org/10.1088/1742-6596/1795/1/012050>.
- [52] Ahcen Keziz, M. Rasheed, M. Heraiz, F. Sahnoune, and A. Latif, “Structural, morphological, dielectric properties, impedance spectroscopy and electrical modulus of sintered Al<sub>6</sub>Si<sub>2</sub>O<sub>13</sub>–Mg<sub>2</sub>Al<sub>4</sub>Si<sub>5</sub>O<sub>18</sub> composite for electronic applications,” *Ceramics International*, vol. 49, no. 23, pp. 37423–37434, Dec. 2023, doi: <https://doi.org/10.1016/j.ceramint.2023.09.068>.
- [53] S. Shihab, M. Rasheed, O. Alabdali, and A. A. Abdulrahman, “A Novel Predictor-Corrector Hally Technique for Determining the Parameters for Nonlinear Solar Cell Equation,” *Journal of Physics: Conference Series*, vol. 1879, no. 2, p. 022120, May 2021, doi: <https://doi.org/10.1088/1742-6596/1879/2/022120>.
- [54] D. Bouras, M. Rasheed, R. Barille, and M. N. Aldaraji, “Efficiency of adding DD<sub>3</sub>(Li/Mg) composite to plants and their fibers during the process of filtering solutions of toxic organic dyes,” *Optical Materials*, vol. 131, p. 112725, Sep. 2022, doi: <https://doi.org/10.1016/j.optmat.2022.112725>.
- [55] Manel Sellam, M. Rasheed, S. Azizi, and Tarek Saidani, “Improving photocatalytic performance: Creation and assessment of nanostructured SnO<sub>2</sub> thin films, pure and with nickel doping, using spray pyrolysis,” *Ceramics International*, Mar. 2024, doi: <https://doi.org/10.1016/j.ceramint.2024.03.094>.
- [56] D. Bouras, Mamoun Fellah, Régis Barille, Mohammed Abdul Samad, M. Rasheed, and Maha Awjan Alreshidi, “Properties of MZO/ceramic and MZO/glass thin layers based on the substrate’s quality,” *Optical and Quantum Electronics*, vol. 56, no. 1, Dec. 2023, doi: <https://doi.org/10.1007/s11082-023-05778-6>.
- [57] Ahcen Keziz, Meand Heraiz, M. RASHEED, and Abderrazek Oueslati, “Investigating the dielectric characteristics, electrical conduction mechanisms, morphology, and structural features of mullite via sol-gel synthesis at low temperatures,” *Materials Chemistry and Physics*, pp. 129757–129757, Jul. 2024, doi: <https://doi.org/10.1016/j.matchemphys.2024.129757>.
- [58] A. Raghdhi, Menad Heraiz, M. Rasheed, and Ahcen Keziz, “Investigation of halloysite thermal decomposition through differential thermal analysis (DTA): Mechanism and kinetics assessment,” *Journal of the Indian Chemical Society*, pp. 101413–101413, Oct. 2024, doi: <https://doi.org/10.1016/j.jics.2024.101413>.

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- [59] Mohammed RASHEED, Mohammed Abdelhadi Sarhan, Ahmed Shawki Jaber, Dikra Bouras, Mustafa Nuhad Al-Darraji, Ahmed Rashid. (2022). Statistical Analysis of Copper Doped Titanium Dioxide. *Journal of Al-Qadisiyah for Computer Science and Mathematics*, 14(3), Math Page 80–88. doi: <https://doi.org/10.29304/jqcm.2022.14.3.1030>.
- [60] Taha Rashid, Mohammed Abdulhadi Sarhan, Ahmed Shukur, Mohammed RASHEED, Ruqaya Shaker Mahmood, Olfa Maalej, "Applications of Chi-Squared Distribution in Hypothesis Testing and Random Variable Analysis", *Journal of Positive Sciences*, Vol. 4, Issue: 4, pp: 36-45, (2024). doi: <https://doi.org/10.52688/ASP11655>.
- [61] Ahmed Shawki Jaber, Mohammed Abdulhadi Sarhan, Rana Jamal Mizban, Ahmed Rashid, Mohammed RASHEED, Ruqaya Shaker Mahmood, Tarek Diab Ounis, "Modeling Event Occurrences Using the Borel-Tanner Distribution: Applications and Numerical Analysis", *Journal of Positive Sciences*, Vol.: 3, Issue: 5, pp: 49-55, (2024). doi: <https://doi.org/10.52688/ASP31971>.
- [62] Rasheed MS, Mohammed AN. Design of a laser based free space communication system. LAP LAMBERT Academic Publishing; 2012 Oct 20.
- [63] Habiba K. Aity, Mohammed RASHEED, Esra A. Hashem, Ruqaya Shaker Mahmood, Farqad A. Rashid, Zahraa Abbas, Areej A. Hateef, Ahmed RASHID, Marwa Enneffati, "Assessing Optical Behavior and Antibacterial Potency of Mg<sub>0.91</sub>Cu<sub>0.09</sub>O Nanoparticles", *Journal of Positive Sciences*, Vol. 4, Issue: 6, pp: 34-43, (2024). doi: <https://doi.org/10.52688/ASP80838>.
- [64] Habiba K. Aity, Mohammed RASHEED, Kawther A. Alameri, Ruqaya Shaker Mahmood, Farqad A. Rashid, Zahraa Abbas, Areej A. Hateef, Ahmed RASHID, Marwa Enneffati, "Structural properties and bacterial inhibition capabilities of Mg<sub>0.91</sub>Cu<sub>0.09</sub>O nanoparticles", *Journal of Positive Sciences*, Vol. 4, Issue: 6, pp: 23-33, (2024). doi: <https://doi.org/10.52688/ASP28610>.
- [65] Mohammed Abdulhadi Sarhan, Mohammed RASHEED, Ruqaya Shaker Mahmood, Taha Rashid, Olfa Maalej, "Evaluating the Effectiveness of Continuity Correction in Discrete Probability Distributions", *Journal of Positive Sciences*, Vol. 4, Issue: 4, pp: 46-54, (2024). doi: <https://doi.org/10.52688/ASP66811>.
- [66] Taha Rashid, Muhammad bin Hamzah, MOHAMMED RASHEED, Ahmed Jaber, Mohammed Sarhan, Mustafa Aldaraji, Tarek Saidani, Image segmentation for animals in the wild using scilab software. *Al-Salam Journal for Engineering and Technology*, vol. 2, Issue 2, pp: 72-77. (2023). doi: <https://doi.org/10.55145/ajest.2023.02.02.009>.
- [67] T. Rashid, Musa Mohd Mokji, and M. Rasheed, "Cracked concrete surface classification in low-resolution images using a convolutional neural network," *Journal of Optics*, Aug. 2024, doi: <https://doi.org/10.1007/s12596-024-02080-w>.
- [68] Aasim Jasim Hussein, Mustafa Nuhad Al-Darraji, and M. Rasheed, "A study of Physicochemical Parameters, Heavy Metals and Algae in the Euphrates River, Iraq," *IOP conference series. Earth and environmental science*, vol. 1262, no. 2, pp. 022007–022007, Dec. 2023, doi: <https://doi.org/10.1088/1755-1315/1262/2/022007>.
- [69] Aasim Jasim Hussein, Mustafa Nuhad Al-Darraji, M. Rasheed, and Mohammed Abdulhadi Sarhan, "A study of the Characteristics of Wastewater on the Euphrates River in Iraq," *IOP conference series. Earth and environmental science*, vol. 1262, no. 2, pp. 022005–022005, Dec. 2023, doi: <https://doi.org/10.1088/1755-1315/1262/2/022005>.
- [70] Habiba K. Aity, Muwafaq A. Hasan, Mohammed RASHEED, Ruqaya Shaker Mahmood, Farqad A. Rashid, Zahraa Abbas, Areej A. Hateef, Haider s. Mohammed, Mohammed H. Ali, Sammah Dammaka, Radhia Dhahri, Ahmed RASHID, Tarek Saidani, "Evaluating structural properties and antibacterial activity of Mg<sub>x</sub>Cu<sub>1-x</sub>O nanoparticles", *Journal of Positive Sciences*, Vol. 4, Issue: 5, pp: 9-19, (2024). doi: <https://doi.org/10.52688/ASP72524>.
- [71] W. Saidi, Nasreddine Hfaïdh, M. Rasheed, Mihaela Girtan, Adel Megriche, and Mohamed El Maaoui, "Effect of B<sub>2</sub>O<sub>3</sub> addition on optical and structural properties of TiO<sub>2</sub> as a new blocking layer for multiple dye sensitive solar cell application (DSSC)," *RSC Advances*, vol. 6, no. 73, pp. 68819–68826, Jan. 2016, doi: <https://doi.org/10.1039/c6ra15060h>.
- [72] M. Rasheed, O. Alabdali, S. Shihab, A. Rashid, and T. Rashid, "On the Solution of Nonlinear Equation for Photovoltaic Cell Using New Iterative Algorithms," *Journal of Physics: Conference Series*, vol. 1999, no. 1, p. 012078, Sep. 2021, doi: <https://doi.org/10.1088/1742-6596/1999/1/012078>.
- [73] M. Rasheed, O. Y. Mohammed, S. Shihab, and A. Al-Adili, "Explicit Numerical Model of Solar Cells to Determine Current and Voltage," *Journal of Physics: Conference Series*, vol. 1795, no. 1, p. 012043, Mar. 2021, doi: <https://doi.org/10.1088/1742-6596/1795/1/012043>.
- [74] Habiba K. Aity, Rana A. Hadi, Mohammed RASHEED, Ruqaya Shaker Mahmood, Farqad A. Rashid, Zahraa Abbas, Areej A. Hateef, Haider s. Mohammed, Mohammed H. Ali, Sammah Dammaka, Radhia Dhahri, Ahmed RASHID, Tarek Saidani, "Optical behavior and its role in the antimicrobial properties of Mg<sub>x</sub>Cu<sub>1-x</sub>O nanoparticles", *Journal of Positive Sciences*, Vol. 4, Issue: 5, pp: 20-29, (2024). doi: <https://doi.org/10.52688/ASP66329>.
- [75] Habiba K. Aity, Rana A. Hadi, Ruqaya Shaker Mahmood, Mohammed RASHEED, Farqad A. Rashid, Zahraa Abbas, Areej A. Hateef, Ahmed RASHID, Nareman Chakchouk, "The relationship between optical characteristics and antibacterial performance of Mg<sub>0.97</sub>Cu<sub>0.03</sub>O nanoparticles", *Journal of Positive Sciences*, Vol. 4, Issue: 5, pp: 30-40, (2024). doi: <https://doi.org/10.52688/ASP33167>.

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- [76] Ruqaya Shaker Mahmood, Rana Jamal Mizban, Mohammed Abdulhadi Sarhan, Ahmed Rashid, Mohammed RASHEED, Tarek Saidani, "Analysis Of Correlated Random Variables Using Bivariate Normal Distribution: Numerical Examples And Applications", *Journal of Positive Sciences*, Vol. 4, Issue: 1, pp: 28-37, (2024). doi: <https://doi.org/10.52688/ASP39921>.
- [77] Ruqaya Shaker Mahmood, Rana Jamal Mizban, Mohammed Abdulhadi Sarhan, Ahmed Rashid, Mohammed RASHEED, Tarek Saidani, "Analysis And Applications Of The Beta Prime Distribution In Statistical Modeling", *Journal of Positive Sciences*, Vol. 3, Issue: 6, pp: 34-41, (2023). doi: <https://doi.org/10.52688/ASP61622>.
- [78] Ruqaya Shaker Mahmood, Rana Jamal Mizban, Mohammed Abdulhadi Sarhan, Ahmed Rashid, Mohammed RASHEED, Tarek Saidani, "Utilizing Beta Distribution For Probabilistic Modeling: Five Numerical Examples", *Journal of Positive Sciences*, Vol: 3, Issue: 5, pp: 40-48, (2023). doi: <https://doi.org/10.52688/ASP42440>.
- [79] Saidani T, Rasheed M, Alshalal I, Rashed AA, Sarhan MA, Barille R, Saidani T, Rasheed M, Alshalal I, Rashed AA, Sarhan MA. Characterization of thin ITO/Au/ITO sandwich films deposited on glass substrates using DC magnetron sputtering. doi: Res. Eng. Struct. Mater. vol. 10, no. 2: pp: 743-770. (2024). doi: <https://doi.org/10.17515/resm2023.21ma0922rs>.
- [80] Abbas MM, Rasheed M. Investigation of structural, Mechanical, Thermal and Optical Properties of Cu Doped TiO<sub>2</sub>. *Iraqi Journal of Physics*. 2021 Mar 1;19(48):1-9. doi: <https://doi.org/10.30723/ijp.v19i48.615>.
- [81] Mohammed Rasheed, Regis Barille, Development and characterization of single and multilayer thin films for optoelectronics application, Ph. D. Thesis University of Angers, (2017).
- [82] Habiba K. Aity, Ruqaya Shaker Mahmood, Muwafaq A. Hasan, Mohammed RASHEED, Farqad A. Rashid, Zahraa Abbas, Areej A. Hateef, Haider s. Mohammed, Mohammed H. Ali, Sammah Dammaka, Radhia Dhahri, Ahmed RASHID, Nareman Chakchouk, "Exploring the structural features and antimicrobial functionality of Mg<sub>0.95</sub>Cu<sub>0.05</sub>O nanoparticles", *Journal of Positive Sciences*, Vol. 4, Issue: 5, pp: 30-40, (2024). doi: <https://doi.org/10.52688/ASP57261>.
- [83] SHIHAB, S., RASHEED, M., Rashid, A., Rashid, T., Abed Hamed, S. H., & Manoochehr, N. T. (2021). An Accelerated Algorithm for Finding Roots of Nonlinear Equation. *Journal of Al-Qadisiyah for Computer Science and Mathematics*, 13(2), Math Page 160– 168. doi: <https://doi.org/10.29304/jqcm.2021.13.2.811>.
- [84] M. Al-Darraj, S. Jasim, O. Salah Aldeen, A. Ghasemian, and M. Rasheed, "The Effect of LL37 Antimicrobial Peptide on FOXE1 and lncRNA PTCSC 2 Genes Expression in Colorectal Cancer (CRC) and Normal Cells," *Asian Pacific Journal of Cancer Prevention*, vol. 23, no. 10, pp. 3437–3442, Oct. 2022, doi: <https://doi.org/10.31557/apjcp.2022.23.10.3437>.
- [85] M. A. Sarhan, S. SHIHAB, and M. RASHEED, "A Novel Spectral Modified Pell Polynomials for Solving Singular Differential Equations", *Al-Mustansiriyah J. Sci.*, vol. 32, no. 1, pp. 18–24, Feb. 2021, doi: [10.23851/mjs.v32i1.930](https://doi.org/10.23851/mjs.v32i1.930).
- [86] M. A. Sarhan, S. Shihab, B. E. Kashem, and M. Rasheed, "New Exact Operational Shifted Pell Matrices and Their Application in Astrophysics," *Journal of Physics: Conference Series*, vol. 1879, no. 2, p. 022122, May 2021, doi: <https://doi.org/10.1088/1742-6596/1879/2/022122>.
- [87] O. Alabdali, S. Shihab, M. Rasheed, and T. Rashid, "Orthogonal Boubaker-Turki polynomials algorithm for problems arising in engineering," 3RD INTERNATIONAL SCIENTIFIC CONFERENCE OF ALKAFAEL UNIVERSITY (ISCKU 2021), 2022, doi: <https://doi.org/10.1063/5.0066860>.
- [88] M. Rasheed, S. Shihab, O. Alabdali, A. Rashid, and T. Rashid, "Finding Roots of Nonlinear Equation for Optoelectronic Device," *Journal of Physics: Conference Series*, vol. 1999, no. 1, p. 012077, Sep. 2021, doi: <https://doi.org/10.1088/1742-6596/1999/1/012077>.
- [89] M. Rasheed, S. Shihab, O. Y. Mohammed, and A. Al-Adili, "Parameters Estimation of Photovoltaic Model Using Nonlinear Algorithms," *Journal of Physics: Conference Series*, vol. 1795, no. 1, p. 012058, Mar. 2021, doi: <https://doi.org/10.1088/1742-6596/1795/1/012058>.
- [90] M. Rasheed, SuhaShihab, O. Alabdali, and H. H. Hassan, "Parameters Extraction of a Single-Diode Model of Photovoltaic Cell Using False Position Iterative Method," *Journal of Physics: Conference Series*, vol. 1879, no. 3, p. 032113, May 2021, doi: <https://doi.org/10.1088/1742-6596/1879/3/032113>.
- [91] Rashid, T., RASHEED, M., Sarhan, M. A. ., Jaber, A. S. ., Aldaraji, M. N. ., Saidani, T., & Rashid, A. . (2023). Folded Cascode Operational Amplifier Design Utilizing 0.25 μm CMOS Technology . *Al-Salam Journal for Engineering and Technology*, 2(1), 76–84. doi: <https://doi.org/10.55145/ajest.2023.01.01.009>.
- [92] Rashid, T., RASHEED, M., Sarhan, M., Jaber, A., Aldaraji, M., Saidani, T., & Anwar Abdul-jabbar, A. (2022). A study of MOSFET Device for The characterization of ID-VG and ID-VD Curves. *Al-Salam Journal for Engineering and Technology*, 2(1), 40–45. doi: <https://doi.org/10.55145/ajest.2023.01.01.005>.
- [93] Ahmed Shawki Jaber, Taha Rashid, Mohammed RASHEED, Ruqaya Shaker Mahmood, Olfa Maalej, "Analysis of Cauchy Distribution and Its Applications", *Journal of Positive Sciences*, Vol. 4, Issue: 4, pp: 21-27, (2024). doi: <https://doi.org/10.52688/ASP54542>.
- [94] A Jaber, Taha Rashid, Mohammed Rasheed, Ruqaya Shaker Mahmood, Olfa Maalej, Analysis of Cauchy Distribution and Its Applications, *Journal of Positive Sciences*, vol. 4, Issue 4, (2024). doi: <https://doi.org/10.52688/ASP54542>.

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