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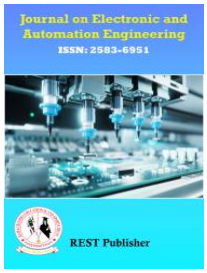

Innovations in Electronics and Communications Organisation Lab using the SPSS Method

***Vimala Saravanan, M. Ramachandran, Libiya Saravanan, Sathishkumar Mani**

REST Labs, Kaveripattinam, Krishnagiri, Tamil Nadu, India

*Corresponding Author Email: vimalarsri@gmail.com

Abstract: *The Electronics and Communication Engineering Laboratory plays a vital role in imparting practical knowledge and professional training to the students in this specialized field. As a fundamental component of the learning process, the laboratory bridges the gap between theory and practice by providing extensive hands-on exposure. It is carefully designed to support various areas of Electronics and Communication Engineering with modern equipment and a wide range of experimental resources. The system encourages experimentation, analysis and innovation among the students. The main emphasis of the laboratory is on analog electronics, where learners study electronic components that handle continuous signals. Through extensive experimentation, students gain insights into component behaviour, applications and circuit design. The laboratory focuses on developing conceptual understanding and practical skills, especially in analysing and implementing key functional analog components within larger systems. The facility is equipped with essential instruments such as cathode ray oscilloscopes, function generators, regulated power supplies, ammeters, voltmeters and digital millimetres. In addition, digital IC training kits, test-based IC kits and supporting tools are available to conduct experiments as prescribed by the VTU syllabus, thereby reinforcing the theoretical concepts. Experienced faculty members supervise the lab sessions and provide expert guidance. The lab also supports learning in microprocessor and microcontrollers, thus helping students understand the internal architecture of processors like Intel 8085, 8086 and 8051, as well as programming and development board usage. Furthermore, dedicated labs including Analog Electronics Circuits, Microprocessor and Microcontroller, Communication, Digital Signal Processing, Power Electronics, VLSI and HDL labs contribute to comprehensive training. Reliability analysis using Cornbrash's alpha gave a value of 0.763, indicating acceptable model reliability for the analysis.*

Keywords: *Analog Electronics Circuits Lab, Microprocessor & Microcontroller Lab, Communication Lab, Digital Signal Processing Lab, VLSI Lab, HDL Lab.*

1. INTRODUCTION

The Electronics and Communications Organization Lab stands as the cornerstone of practical learning for students pursuing studies in this field. This state-of-the-art facility is meticulously designed to provide hands-on experience Electronics and of Communication Engineering in various aspects. With an array of cutting-edge equipment and resources, the lab offers an immersive environment for students to explore, experiment, and innovate. One of the key focal points of the lab is Analog Electronics. Here, students delve into the nuances of electronic components and their behavior in continuous signal applications [1]. They work with components like diodes, transistors, and operational amplifiers to design and analyze circuits that amplify, filter, and process analog signals. Through a series of meticulously crafted experiments, students gain insights into the practical applications of theoretical concepts. The Microprocessor & Microcontroller section is another crucial segment of the lab. In this dynamic space, students immerse themselves in the world of embedded systems and digital processing units. They work with microprocessors and microcontrollers to develop applications that range from simple interfacing tasks to more complex control systems [2]. The lab equips students with the ability to write and debug assembly and C programs, preparing them for real-world applications in fields such as automation, robotics, and control systems. Communication Lab serves as a hub for refining students' skills in signal transmission and reception. Here, they explore both analog and digital communication techniques. Through experiments and projects, students gain hands-on experience in modulating and demodulating signals, and they delve into the principles of data transmission. This lab not only hones their technical skills but also emphasizes effective communication, a vital aspect for professionals in the electronics and telecommunications industry [3]. The Digital Signal Processing Lab

is a critical space for students to dive into the realm of processing digital information. In this lab, students work with DSP processors and software tools to implement algorithms that manipulate digital signals. Through a series of experiments, they gain proficiency in techniques like filtering, spectral analysis, and noise reduction. This lab equips students with the skills needed to design and optimize digital processing systems, which find applications in areas like audio and image processing [4]. The Power Electronics Lab is dedicated to the study of electrical power conversion and control. Here, students work with power electronic devices and circuits to design systems for applications such as motor drives, power supplies, and converters. Through hands-on experiments, students gain practical knowledge in power switching devices, control techniques, and energy conversion. This lab prepares students to address challenges in the efficient utilization of electrical power, a critical aspect in today's energy-conscious world [5]. The VLSI Lab is the domain of Very Large-Scale Integrated circuits. It provides students with the tools and resources to explore the entire VLSI design flow, from conceptualization to fabrication. Through projects, students gain hands-on experience in designing digital systems, testing logic functions, and optimizing circuit performance. This lab prepares students to contribute to the advancement of integrated circuit technology, a field that underpins the modern electronics industry [6]. Finally, the HDL Lab focuses on Hardware Description Languages, which are pivotal in digital design and simulation. Here, students gain proficiency in coding and simulating digital circuits using languages like Verilog or VHDL. Through projects and exercises, they become adept at modeling and synthesizing digital systems. This lab equips students with the skills to efficiently design and validate complex digital circuits, a fundamental skill in the modern era of digital electronics. In conclusion, the Electronics and Communications Organization Lab is a hub of hands-on learning and innovation [7]. It provides students with the practical skills and knowledge needed to excel in the dynamic field of electronics and communications engineering. Through a combination of state-of-the-art equipment, meticulously designed experiments, and expert guidance, this lab empowers students to become proficient and innovative engineers in the rapidly evolving world of electronics and communications. The Communications Organization Lab is a cornerstone of practical education for students pursuing studies in the field of electronics and communications engineering [8]. This cutting-edge facility is meticulously designed to provide hands-on experience in various aspects of modern communication systems. With an array of advanced equipment and resources, the lab offers an immersive environment for students to explore, experiment, and innovate. One of the key focal points of the lab is Analog and Digital Modulation Techniques. In this segment, students delve into the intricacies of signal modulation and demodulation [9]. They work with various modulation schemes like Amplitude Modulation (AM), Frequency Modulation (FM), and Phase Modulation (PM). Through a series of meticulously crafted experiments, students gain insights into how information is encoded onto carrier waves for efficient transmission. They also explore digital modulation techniques like Phase Shift Keying (PSK) and Quadrature Amplitude Modulation (QAM), which are vital in modern digital communication systems. The lab also encompasses the study of Antennas and Wave Propagation. Here, students get hands-on experience with different types of antennas and their characteristics [10]. They learn how antennas radiate and receive electromagnetic waves, a fundamental aspect of wireless communication. Through experiments and projects, students gain practical knowledge in antenna design, pattern analysis, and propagation phenomena. This knowledge is crucial in the design of efficient and reliable wireless communication systems, including those used in cellular networks, satellite communications, and radar systems. The lab also emphasizes the study of Communication Networks [11]. Students explore the architecture and protocols of various networks, Wired and wireless local Area Networks (LANs), Wide Area Networks (WANs) and including the Internet. They gain hands-on experience in configuring and testing network devices such as routers and switches. This practical exposure equips students with the skills needed to design, implement, and troubleshoot modern communication networks, which are the backbone of global information exchange [12]. One of the critical areas of focus in the lab is Digital Signal Processing for Communications. In this segment, students work with specialized hardware and software tools to process digital signals for communication applications. They learn about techniques such as filtering, equalization, and modulation/demodulation in the digital domain. Through a series of experiments, students gain proficiency in optimizing the quality and efficiency of digital communication systems. This knowledge is crucial for designing robust and reliable communication systems in today's digital age [13]. The lab also provides hands-on experience in Satellite Communication Systems. Students explore the principles of satellite communication, including the design and operation of geostationary and non-geostationary satellites. They learn about link budgets, frequency bands, and the challenges of satellite-based communication. Through experiments and projects, students gain practical knowledge in designing satellite links, which have a wide range of applications including television broadcasting, global positioning systems (GPS), and remote sensing [14]. Furthermore, the lab encompasses the study of Optical Communication Systems. Students delve into the world of fiber optics, understanding the principles of light propagation through optical fibers. They work with optical transmitters, receivers, and modulators to gain hands-on experience in transmitting and receiving information using light signals. This knowledge is crucial in the design of high-speed and high-bandwidth communication systems, including those used in internet backbone networks and long-haul communication links [15]. The lab also offers insights into the world of Wireless Communication Systems. Students explore various wireless technologies including cellular

communication, Bluetooth, and Wi-Fi. They gain practical experience in configuring and testing wireless communication devices and networks. This knowledge is essential for the design and deployment of wireless communication systems, which have become integral to our daily lives [16]. In conclusion, the Communications Organization Lab is a hub of hands-on learning and innovation in the field of electronics and communications engineering. It provides students with the practical skills and knowledge needed to excel in the dynamic world of modern communication systems [17]. Through a combination of state-of-the-art equipment, meticulously designed experiments, and expert guidance, this lab empowers students to become proficient and innovative engineers in the rapidly evolving field of electronics and communications. Despite our prior investigations that have highlighted the challenges of group projects, such as the presence of "free riding" students who do not contribute proportionally, we have identified the irregularity in student paper notebook submissions as another obstacle. This irregularity may stem from the pre-university phase, where certain students may not have received formal training in note-taking [18]. Considering the generation of "Digital Natives" and their adeptness with digital technology, our research pivoted towards embracing this trend. We sought to motivate students to use Electronic Laboratory Notebooks (ELNs) as an alternative to the traditional paper-based format. ELNs, unlike their paper counterparts, enable the inclusion of text, data, images, and even recorded audio, facilitating seamless exchange and synchronization of generated content [19]. In this context, our work aims to transcend existing research boundaries in the field. We seek to demonstrate how students can leverage ELNs not only to enhance their collaborative learning experience but also to showcase their individuality and unique contributions within the group projects of the Electronic Engineering Bachelor Degree Program [20].

2. MATERIAL AND METHOD

Analog Electronics Circuits Lab: The Analog Electronics Circuits Lab is a crucial space where students delve into the intricacies of electronic components and their behavior in continuous signal applications. This hands-on environment provides a platform for exploring fundamental concepts like amplification, filtering, and signal processing. Through various experiments, students gain practical experience in designing and analyzing analog circuits. This lab fosters skills in troubleshooting, measurement techniques, and encourages a deeper understanding of electronic systems.

Microprocessor & Microcontroller Lab: In the Microprocessor & Microcontroller Lab, students step into the world of embedded systems and digital processing units. They engage with microprocessors and microcontrollers to develop applications that range from simple interfacing tasks to more complex control systems. This lab equips students with the ability to write and debug assembly and C programs. Through a series of experiments, they gain proficiency in interfacing peripheral devices and sensors, providing a strong foundation in embedded system design.

Communication Lab: The Communication Lab serves as a hub for honing the communication skills of students. Here, they delve into various aspects of analog and digital communication techniques. Through experiments and projects, students gain hands-on experience in modulating and demodulating signals, as well as understanding the principles of data transmission. Additionally, the lab provides opportunities for students to enhance their presentation and reporting abilities, critical for effective communication in the field of electronics and telecommunications.

Digital Signal Processing Lab: The Digital Signal Processing Lab focuses on processing digital information for various applications, from audio and image processing to telecommunications. Students work with DSP processors and software tools to implement algorithms that manipulate digital signals. Through experiments, they gain proficiency in techniques like filtering, spectral analysis, and noise reduction. This lab equips students with the skills to design and optimize digital processing systems.

Power Electronics Lab: The Power Electronics Lab serves as the arena for students to explore the conversion and control of electrical power. Here, they work with power electronic devices and circuits to design systems for applications like motor drives, power supplies, and converters. Through hands-on experiments, students gain practical knowledge in power switching devices, control techniques, and energy conversion. This lab equips them with the skills needed to address challenges in the efficient utilization of electrical power.

VLSI Lab: The VLSI Lab is dedicated to the design and implementation of Very Large-Scale Integrated circuits. It provides students with the tools and resources to explore the entire VLSI design flow, from conceptualization to fabrication. Through projects, students gain hands-on experience in designing digital systems, testing logic functions, and optimizing circuit performance. This lab prepares students to contribute to the advancement of integrated circuit technology.

HDL LAB: The HDL Lab is a critical space for students to dive into Hardware Description Languages, which are pivotal in digital design and simulation. Here, students gain proficiency in coding and simulating digital circuits

using languages like Verilog or VHDL. Through projects and exercises, they become adept at modeling and synthesizing digital systems. This lab equips students with the skills to efficiently design and validate complex digital circuits.

Method: SPSS (Statistical Package for the Social Sciences) is a popular software used for statistical analysis and data management. It is commonly used in various fields, including social sciences, psychology, business, and healthcare. The SPSS method typically involves the following steps: Data Entry: The first step is to enter the data into SPSS. This can be done manually, importing data from external sources (e.g., Excel), or using data collection tools integrated with SPSS. outliers, and data errors. You may also need to recode variables, transform data, or create new variables as required. such as mean, median, standard deviation, minimum, and maximum. SPSS can generate descriptive statistics for individual variables or groups of variables. Data Analysis: SPSS offers a wide range of statistical analysis options, t-tests, ANOVA, regression, Correlation, factor analysis and arm-square Tests etc. Chosen Specific analysis Methodological research question and will be analyzed Depends on the data type. Interpretation of Results: After conducting the statistical analysis, you need to interpret the results. SPSS outputs tables and graphs that present the results of the analysis. It's important to carefully interpret the findings in the context of the research question and the data. Reporting and Visualization: SPSS allows you to generate tables and charts to visualize the results of the analysis. These visual representations can be included in research reports, presentations, or academic papers. Data Export: Once the analysis is complete, you may need to export the results to other formats (e.g., Excel, Word, PDF) for further reporting or sharing with others.

3. RESULT AND DISCUSSION

TABLE 1. Descriptive Statistics

	N	Range	Minimum	Maximum	Sum	Mean		Std. Deviation
Analog Electronics Circuits Lab	135	4	1	5	452	3.35	.089	1.039
Microprocessor & Microcontroller Lab	135	4	1	5	425	3.15	.116	1.347
Communication Lab	135	4	1	5	484	3.59	.104	1.206
Digital Signal Processing Lab	135	4	1	5	469	3.47	.103	1.202
Power Electronics Lab	135	4	1	5	484	3.59	.134	1.557
VLSI Lab	135	4	1	5	503	3.73	.117	1.363
HDL LAB	135	4	1	5	448	3.32	.107	1.244
Valid N (listwise)	135							

Table 1 Shows the Descriptive Statistics provides a comprehensive statistical overview of the performance evaluations in various laboratory courses. Each lab has been assessed based on a scale ranging from 1 to 5, with 1 denoting the minimum and 5 indicating the maximum rating. The data encompasses 135 evaluations for each lab, ensuring a substantial sample size for robust analysis. Across all labs, the mean ratings are consistently positive, ranging from 3.15 to 3.73, reflecting a generally favourable perception of the lab experiences. The Standard Deviation, which measures the extent of variation or dispersion in the ratings, ranges from .089 to .134. This indicates a moderate level of agreement among the evaluations. The labs with the highest mean ratings are VLSI Lab and Power Electronics Lab, both scoring above 3.5. On the other hand, the Microprocessor & Microcontroller Lab and Analog Electronics Circuits Lab received slightly lower mean ratings, though still maintaining a positive sentiment overall. It is noteworthy that all labs have a relatively similar range and distribution of ratings, indicating a consistent level of performance across the board. The total sum of ratings for each lab ranges from 425 to 503, further illustrating the overall positive reception of the lab experiences.

TABLE 2. Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.755	.763	7

Table 2 shows the Cronbach's Alpha Reliability Statistics result. The overall Cronbach's Alpha value for the model is .763 which indicates 76% reliability. From the literature review, the above 50% Cronbach's Alpha value model can be considered for analysis.

TABLE 3. Frequency Statistics

		Analog Electronics Circuits Lab	Microprocessor & Microcontroller Lab	Communication Lab	Digital Signal Processing Lab	Power Electronics Lab	VLSI Lab	HDL LAB
N	Valid	135	135	135	135	135	135	135
	Missing	0	0	0	0	0	0	0
Mean		3.35	3.15	3.59	3.47	3.59	3.73	3.32
Std. Error of Mean		.089	.116	.104	.103	.134	.117	.107
Median		3.00	3.00	3.00	3.00	4.00	4.00	3.00
Mode		3	3	3	3	5	5	3
Std. Deviation		1.039	1.347	1.206	1.202	1.557	1.363	1.244
Variance		1.079	1.814	1.454	1.445	2.424	1.857	1.547
Skewness		-.296	.265	-.268	-.383	-.498	-.514	-.250
Std. Error of Skewness		.209	.209	.209	.209	.209	.209	.209
Kurtosis		.192	-1.229	-.785	-.503	-1.324	-1.073	-.778
Std. Error of Kurtosis		.414	.414	.414	.414	.414	.414	.414
Range		4	4	4	4	4	4	4
Minimum		1	1	1	1	1	1	1
Maximum		5	5	5	5	5	5	5
Sum		452	425	484	469	484	503	448
Percentiles	10	2.00	2.00	2.00	2.00	1.00	2.00	1.00
	20	3.00	2.00	3.00	3.00	2.00	2.20	2.00
	25	3.00	2.00	3.00	3.00	2.00	3.00	3.00
	75	4.00	5.00	5.00	5.00	5.00	5.00	4.00
	80	4.00	5.00	5.00	5.00	5.00	5.00	5.00
	90	5.00	5.00	5.00	5.00	5.00	5.00	5.00

Table 3 Show the Frequency Statistics in Analog Electronics Circuits Lab, Microprocessor & Microcontroller Lab, Communication Lab Digital Signal Processing Lab, Power Electronics Lab, VLSI Lab and HDL LAB curve values are given.

TABLE 4. Reliability Statistic individual parameter

	Cronbach's Alpha if Item Deleted
Analog Electronics Circuits Lab	.709
Microprocessor & Microcontroller Lab	.788
Communication Lab	.727
Digital Signal Processing Lab	.726
Power Electronics Lab	.707
VLSI Lab	.727
HDL LAB	.677

Table 4 Shows the Reliability Statistic individual parameter Cronbach's Alpha Reliability results. The Cronbach's Alpha value for Analog Electronics Circuits Lab .709, Microprocessor & Microcontroller Lab .788, Communication Lab .727, Digital Signal Processing Lab .726, Power Electronics Lab .707, VLSI Lab .727, HDL LAB .677 this indicates all the parameter can be considered for analysis.

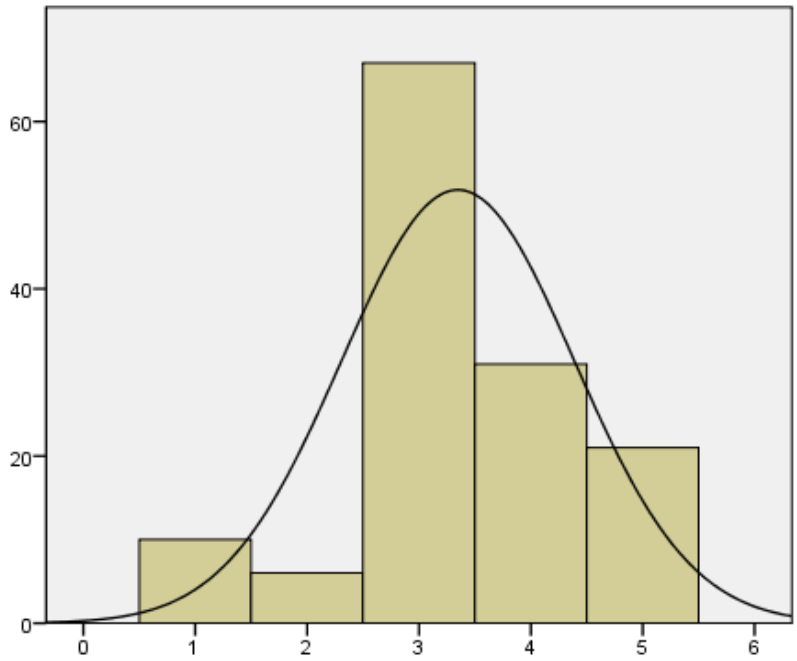

FIGURE 1. Analog Electronics Circuits Lab

Figure 1 shows the histogram plot for Analog Electronics Circuits Lab from the figure it is clearly seen that the data are slightly Left skewed due to more respondent chosen 3 for Analog Electronics Circuits Lab except the 2 value all other values are under the normal curve shows model is significantly following normal distribution.

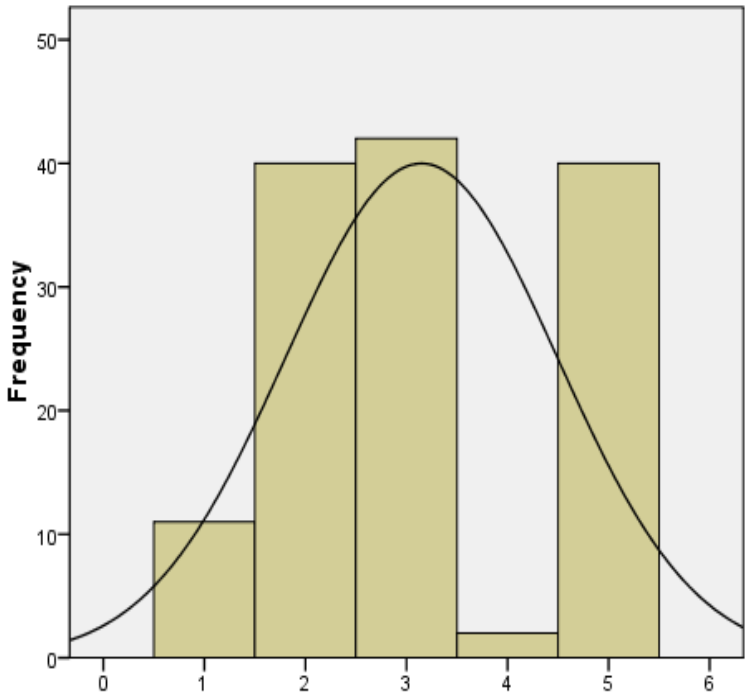

FIGURE 2. Microprocessor & Microcontroller Lab

Figure 2 shows the histogram plot for Microprocessor & Microcontroller Lab from the figure it is clearly seen that the data are slightly Left skewed due to more respondent chosen 3 for Microprocessor & Microcontroller Lab except the 2 value all other values are under the normal curve shows model is significantly following normal distribution.

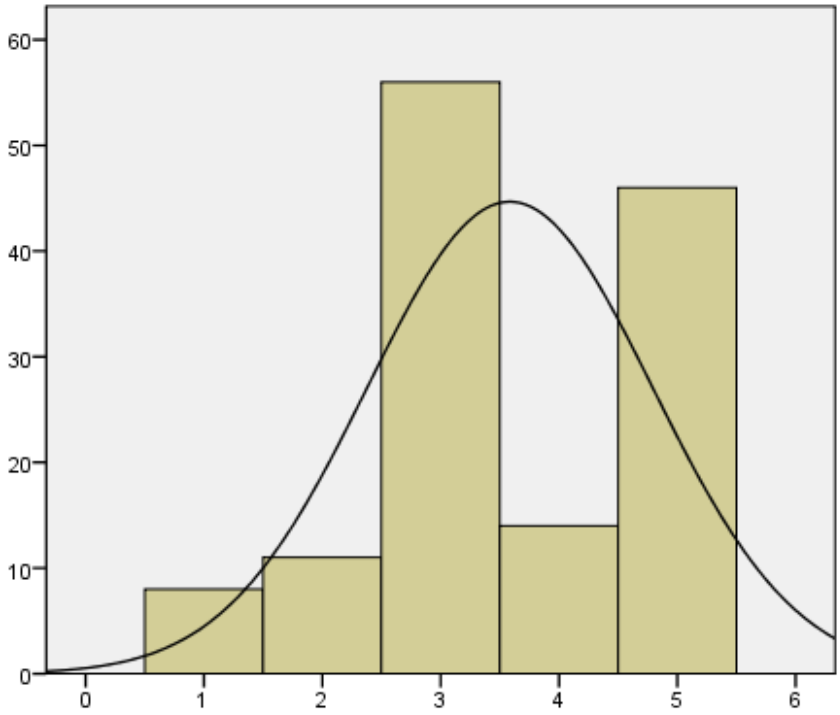

FIGURE 3. Communication Lab

Figure 3 shows the histogram plot for Communication Lab from the figure it is clearly seen that the data are slightly Left skewed due to more respondent chosen 3 for Communication Lab except the 2 value all other values are under the normal curve shows model is significantly following normal distribution.

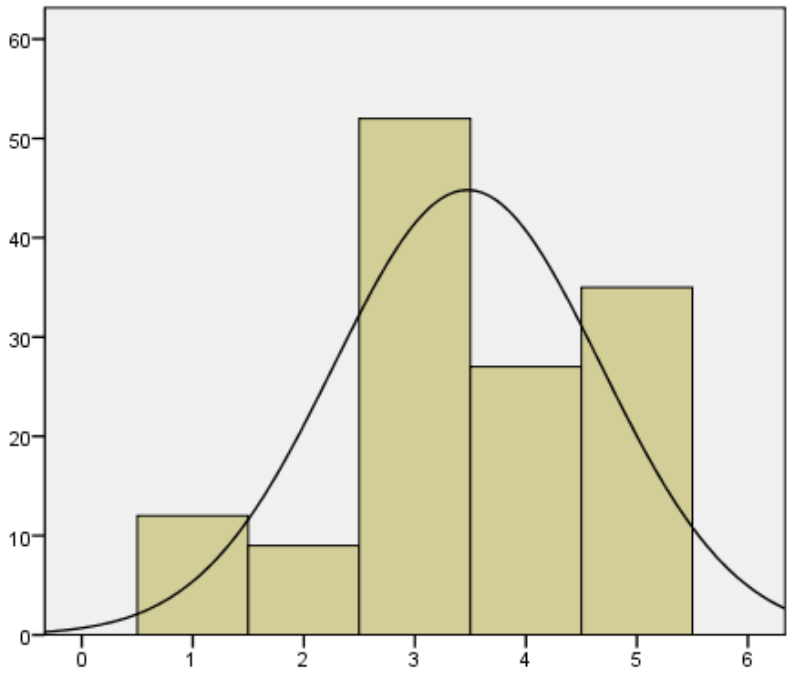

FIGURE 4. Digital Signal Processing Lab

Figure 4 shows the histogram plot for Digital Signal Processing Lab from the figure it is clearly seen that the data are slightly Left skewed due to more respondent chosen 3 for Digital Signal Processing Lab except the 2 value all other values are under the normal curve shows model is significantly following normal distribution.

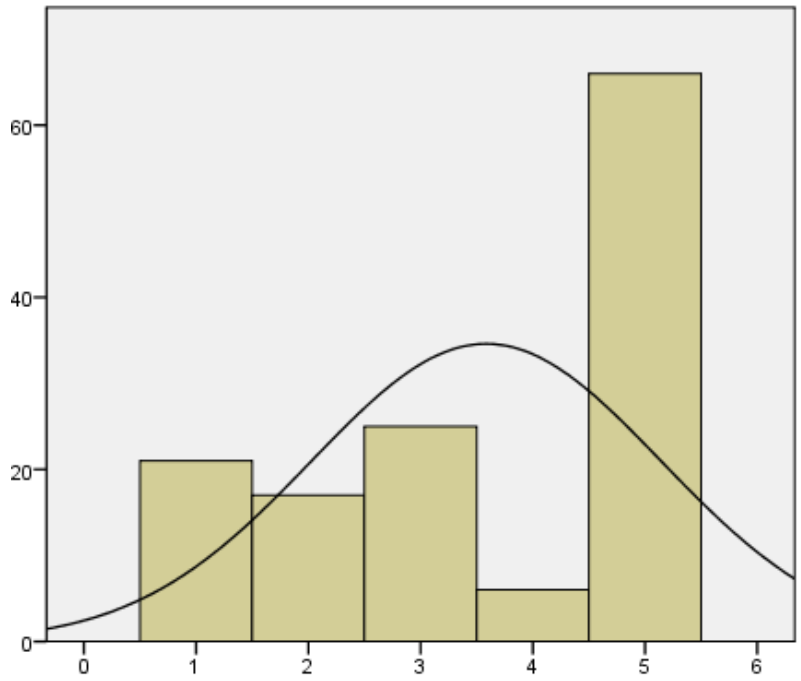

FIGURE 5. Power Electronics Lab

Figure 5 shows the histogram plot for Power Electronics Lab from the figure it is clearly seen that the data are slightly Right skewed due to more respondent chosen 5 for Power Electronics Lab except the 2 value all other values are under the normal curve shows model is significantly following normal distribution.

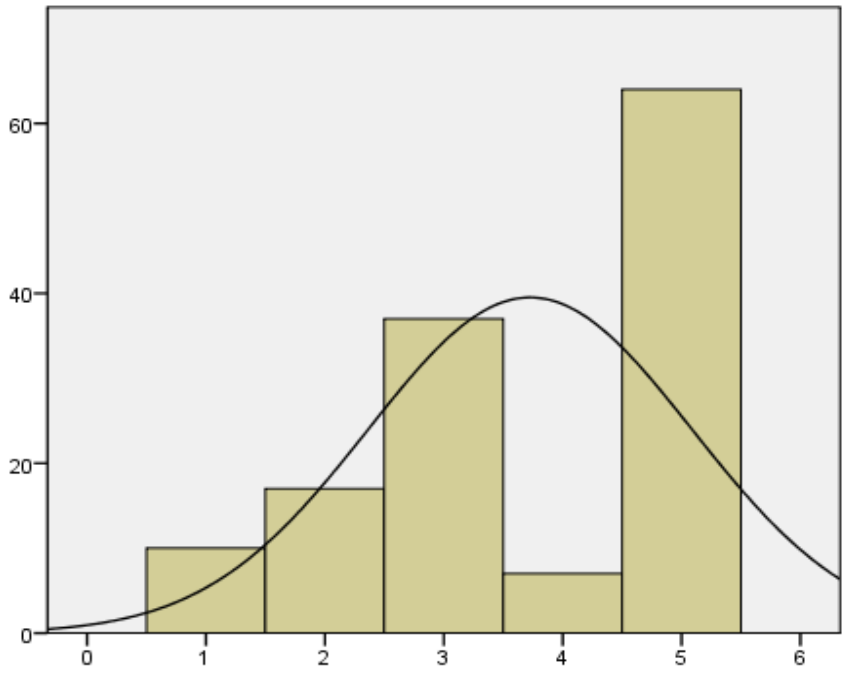

FIGURE 6. VLSI Lab

Figure 6 shows the histogram plot for VLSI Lab from the figure it is clearly seen that the data are slightly Right skewed due to more respondent chosen 5 for VLSI Lab except the 2 value all other values are under the normal curve shows model is significantly following normal distribution.

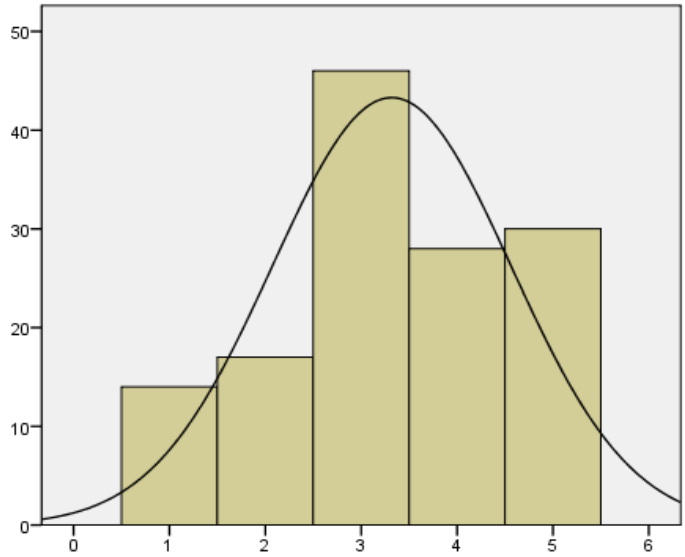

FIGURE 7. HDL LAB

Figure 7 shows the histogram plot for HDL LAB from the figure it is clearly seen that the data are Slightly Left skewed due to more respondent chosen 3 for HDL LAB except the 2 value all other values are under the normal curve shows model is significantly following normal distribution.

TABLE 5. Correlation

	Analog Electronics Circuits Lab	Microprocessor & Microcontroller Lab	Communication Lab	Digital Signal Processing Lab	Power Electronics Lab	VLSI Lab	HDL LAB
Analog Electronics Circuits Lab	1	.064	.480**	.536**	.307**	.358**	.520**
Microprocessor & Microcontroller Lab	.064	1	.084	.118	.300**	-.047	.177*
Communication Lab	.480**	.084	1	.595**	.190*	.189*	.377**
Digital Signal Processing Lab	.536**	.118	.595**	1	.166	.157	.372**
Power Electronics Lab	.307**	.300**	.190*	.166	1	.558**	.554**
VLSI Lab	.358**	-.047	.189*	.157	.558**	1	.571**
HDL LAB	.520**	.177*	.377**	.372**	.554**	.571**	1
**. Correlation is significant at the 0.01 level (2-tailed).							

Table 5 shows the correlation between motivation parameters for Analog Electronics Circuits Lab for Digital Signal Processing Lab is having highest correlation with Microprocessor & Microcontroller Lab and having lowest correlation. Next the correlation between motivation parameters for Microprocessor & Microcontroller Lab. For Power Electronics Lab is having highest correlation with Analog Electronics Circuits Lab and having lowest correlation. Next the correlation between motivation parameters for Communication Lab for Digital Signal Processing Lab is having highest correlation with Microprocessor & Microcontroller Lab and having lowest correlation. Next the correlation between motivation parameters for Digital Signal Processing Lab for Communication Lab is having highest correlation with Microprocessor & Microcontroller Lab and having lowest correlation. Next the correlation between motivation parameters for Power Electronics Lab for VLSI Lab is having highest correlation with Digital Signal Processing Lab and having lowest correlation. Next the correlation between motivation parameters for VLSI Lab For HDL LAB is having highest correlation with Digital Signal Processing Lab and having lowest correlation. Next the correlation between motivation parameters for HDL LAB For VLSI Lab is having highest correlation with Microprocessor & Microcontroller Lab and having lowest correlation.

4. CONCLUSION

The Electronics and Communications Organization Lab is pivotal in the education and training of students in this specialized field. Serving as a cornerstone of their learning journey, this lab offers hands-on practice and experience that is crucial for their understanding. Catering to various aspects of engineering related to Electronics and Communication, this lab is meticulously designed with state-of-the-art equipment and an extensive array of resources. It provides students with an environment conducive to exploration, testing, and rapid innovation. Among the lab's primary focuses, one area of significance is analog electronics. In this segment, students delve into the intricate details of electronic components, particularly those involved in processing continuous signals. Their behaviour and applications are closely examined, providing a comprehensive understanding of this critical aspect of electronics. Fundamental knowledge and practical skills necessary for the application and design of analog electronic circuits. Special emphasis is placed on analysing key functional components. Students will gain an understanding of the operational principles of common analog components and how to integrate them into larger circuits or networks. The lab is equipped with essential instruments such as cathode ray oscilloscopes (CROs), function generators, regulated power supplies, ammeters, voltmeters, and digital multimeters. Within this lab, there is a provision of digital IC training equipment along with a substantial collection of test-based IC sets and test apparatus. These resources enable students to conduct the prescribed tests in accordance with the VTU syllabus, reinforcing the theoretical concepts. The Electronics and Communications Organization Lab stands as the cornerstone of practical learning for students pursuing studies in this field. This state-of-the-art facility is meticulously designed to provide hands-on experience Electronics and of Communication Engineering in various aspects. With an array of cutting-edge equipment and resources, the lab offers an immersive environment for students to explore, experiment, and innovate. One of the key focal points of the lab is Analog Electronics. Here, students delve into the nuances of electronic components and their behaviour in continuous signal applications. The Cronbach's Alpha Reliability Statistics result. The overall Cronbach's Alpha value for the model is .763 which indicates 76% reliability. From the literature review, the above 50% Cronbach's Alpha value model can be considered for analysis.

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