MECHATRONIC SYSTEMS

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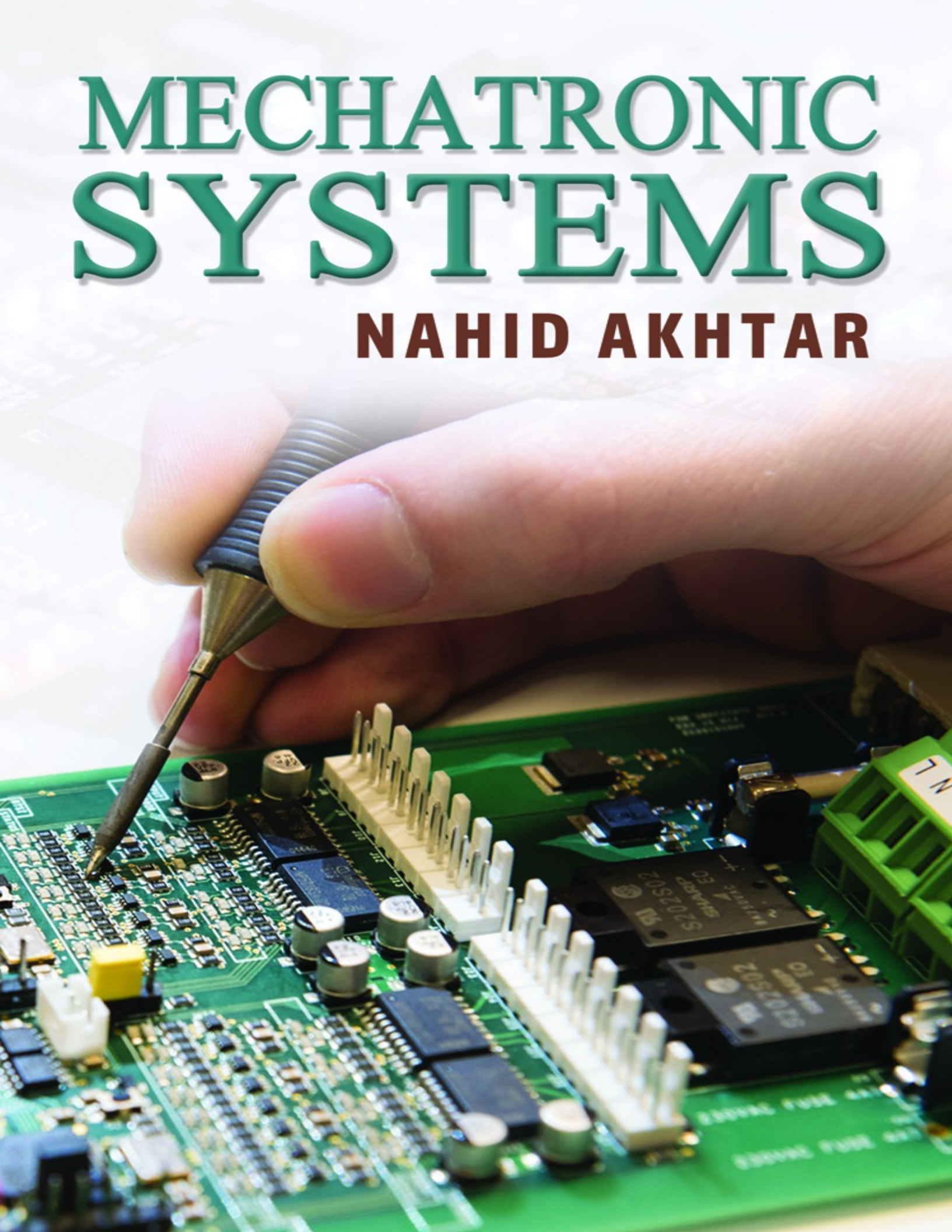

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INTRODUCTION

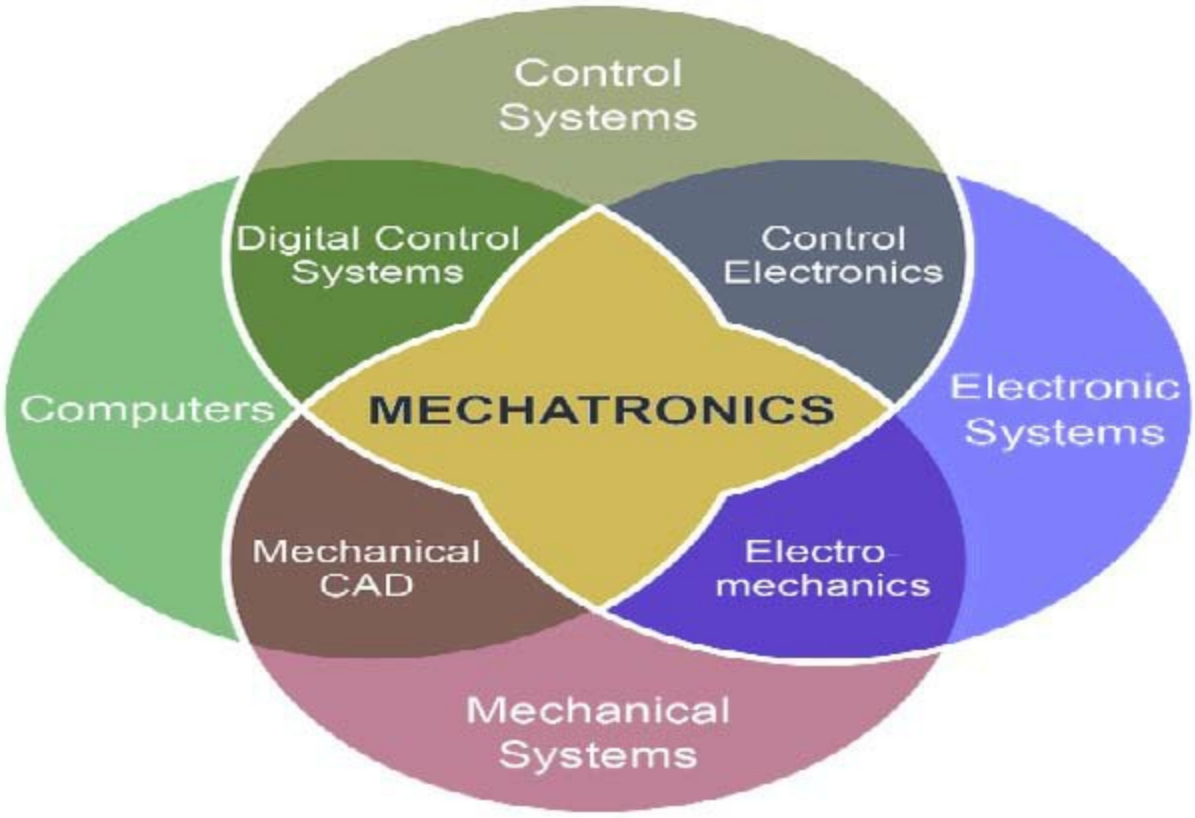
OVERVIEW OF MECHATRONICS:

Mechatronics, which is also called mechatronic engineering, is a multidisciplinary branch of engineering that focuses on the engineering of both electrical and mechanical systems, and also includes a combination of robotics, electronics, computer, telecommunications, systems, control, and product engineering. As technology advances over time, various subfields of engineering have succeeded in both adapting and multiplying. The intention of mechatronics is to produce a design solution that unifies each of these various subfields. Originally, the field of mechatronics was intended to be nothing more than a combination of mechanics and electronics, hence the name being a portmanteau of mechanics and electronics; however, as the complexity of technical systems continued to evolve, the definition had been broadened to include more technical areas.

HISTORICAL PERSPECTIVE OF MECHATRONICS:

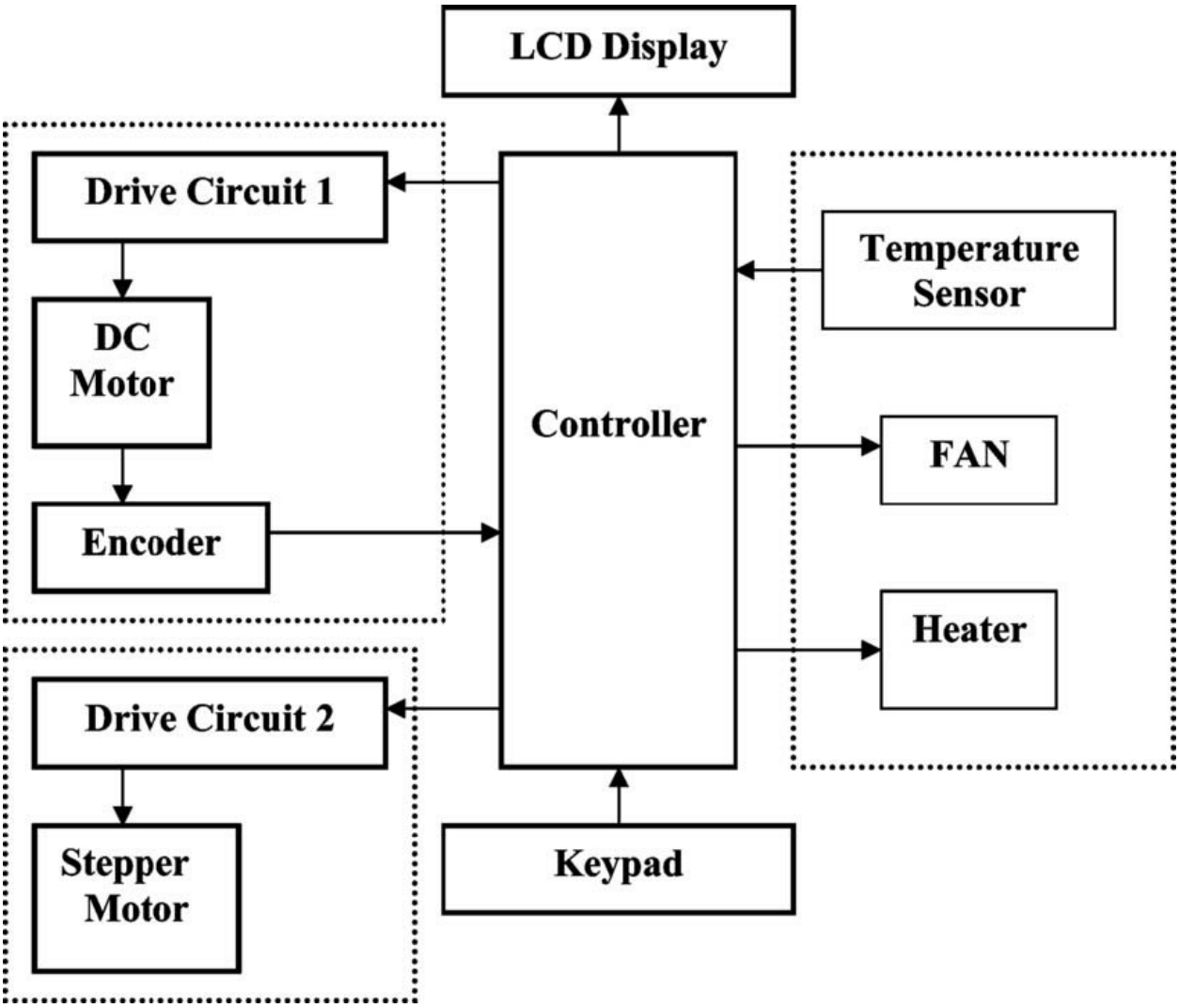
The word mechatronics first coined by Japanese industry “Yaskawa electric corporation” in 1969. The company was granted the trademark rights on the word in 1971. Mechatronics became popular in Europe. This period mostly the servo technology is used in mechatronics 1970-1980 period. Information technology was introduced. Micro processers were embedded in mechanical system in 1981-90. Communication technology was added. Remote operation and Robotics were developed courses and conferences related to mechatronics were offered by various institutions and industries in 1991-2000. After 2000 mechatronics application finds in aerospace, defense engineering, bio-mechanics, automobile electronics, banking ATM etc.

DEFINITION OF MECHATRONICS:



Mechatronics is the synergistic integration of mechanical engineering, electronics, computer technology and information technology to produce or enhance products and system. In simple words mechatronics is a technology combining electronics and mechanical engineering.

Block diagram of mechatronics system



FUNCTIONS OF MECHATRONICS SYSTEM:

- ➢ Develop PLC logic circuits in Ladder Programming and export its wire diagram to Panel as well as to PLC.
- ➢ Calculate the force, torque, power, stress, strain of its mechanical components.
- ➢ Get a proficiency in Solid Works Electrical and Solid Works Design.
- ➢ Design HMI for giving commands to machines.
- ➢ Programming, Debug Errors, Assemble, Sleep, Repeat.
- ➢ The main function of mechatronic system is to do a process without or minimal human intervention in complex situation.

ADVANTAGES OF MECHATRONICS:

- ➢ High level of integration.
- ➢ Increased functionality and better design.
- ➢ More use of electronics and software.
- ➢ Use of artificial intelligence and intelligent process control.
- ➢ Assume responsibility for a process an operation with little interference of operation.
- ➢ Multisensory and programs environments.
- ➢ The product produced are cost effective and very good quality.
- ➢ High rate of flexibility.
- ➢ Greater extent of machine utilization.
- ➢ Greater productivity.
- ➢ High life expected by proper maintenance.
- ➢ The integration of sensor and control system in complex system reduces capital expenses.

DISADVANTAGES OF MECHATRONICS:

- ➢ The initial cost is very high.
- ➢ The complicated design and system.
- ➢ The repair and maintenance are complex.
- ➢ The replacement is difficult that it is difficult to change old system to new system.
- ➢ Imperative to have knowledge of different engineering fields for design and implementation.
- ➢ Specific problem of various system will have to be addressed separately and properly.

BENEFITS OF MECHATRONICS IN MANUFACTURING

1. Lower cost and better function: Each component must have a positive impact on the financial bottom line. Less wiring and connectors, fewer components and sensors, less labor invested, reduced time spent in setup and maintenance and maximized operational uptime all substantially reduce the overall cost of ownership and operation.

2. Less space: By building the driver, controller and amplifier into a smart motor, less panel space is needed, which saves material, time, labor and overall cost.

3. Simplified wiring: Combining the driver, controller and amplifier means fewer sensors are needed, especially when an encoder is used, fewer I/O connections, and a less complicated wiring schemes.

4. Reduced troubleshooting: With fewer components and less wire connections, the job of tracing down problems that may arise is greatly reduced.

5. Streamlined commissioning: Machine installation and start up is made easier with pre-programmed homing routines and with the ability to make changes at an individual axis without working through the PLC. This distributed control model frees the installation team to work on multiple axes simultaneously, and report progress through Internet connectivity. It also allows an operator to make in-process adjustments at an individual axis without affecting the PLC or entire production line.

6. Modular integration: Standardized smart robot modules make integration into multiple axes or multiple machines a natural and easy process.

7. Automated adjustment: Switching a packaging or assembly line to a different size or part can become automated and “recipe driven,” increasing manufacturing flexibility and speed. Such adjustments eliminate time consuming manual changes.

8. Maximized uptime: Real-time monitoring of temperatures, friction, motor torque and other performance related data can be routed to a mobile device allowing operators, maintenance or engineers to proactively handle issues related to maximizing machine uptime.

9.Preventative maintenance: Established time frames for periodic maintenance based on cycles, number of pieces run or other dynamic conditions can easily be monitored and reported to any IoT connected device, such as a work station, tablet or mobile phone, allowing teams to proactively keep equipment running at peak efficiency.

10. Increased output: All of these things are working together in an IoT connected motion system, driving greater flexibility, less downtime, increased performance and greater bottom line output for manufacturers, assembly lines, packaging equipment and production equipment.

MECHATRONICS SYSTEM ENGINEERING:

Students in the Master of Science in mechatronic systems engineering program study, research and practice across the fields of electrical, mechanical and computer engineering. This cross-disciplinary major is customizable with specialization areas and thematic course sequences to align with your specific areas of interest and career goals. From developing service robots to aid children with special needs, to inventing unmanned vehicle systems to monitor traffic congestion, there are numerous ways for mechatronic systems engineers to apply their knowledge in the public and private sectors.

DIFFERENCE BETWEEN VERIFICATION AND VALIDATION:

Verification	Validation
1. Verification is a static practice of verifying documents, design, code and program.	1. Validation is a dynamic mechanism of validating and testing the actual product.
2. It does not Involve executing the code.	2. It always involves executing the code.
3. It is human based checking of documents and files.	3. It is computer based execution of program.
4. Verification uses methods like inspections, reviews, walkthroughs, and Desk-checking etc.	4. Validation uses methods like black box (functional) testing, gray box testing, and white box (structural) testing etc.

5. Verification is to check whether the software conforms to specifications.	5. Validation is to check whether software meets the customer expectations and requirements.
6. It can catch errors that validation cannot catch. It is low level exercise.	6. It can catch errors that verification cannot catch. It is High Level Exercise.
7. Target is requirements specification, application and software architecture, high level, complete design, and database design etc.	7. Target is actual product-a unit, a module, a bent of integrated modules, and effective final product.
8. Verification is done by QA team to ensure that the software is as per the specifications in the SRS document.	8. validation is carried out with the involvement of testing team.
9. It generally comes first-done before validation.	9. It generally follows after verification.