Module 1 - Intro to modeling and simulation

1.1:- Model characterization,
Model development

1.2:- Simulation studies
Programming languages

1.3:- Organization & terminology

1.4:- Simulation examples
Single server queue
Simple inventory system.

* Modelling

⇒ It is the process of creating a simplified representation of a system or a process to understand, analyze and make predictions according to its behavior.

* Simulation

⇒ Simulation of a system is the operation of a model which helps analyze performance of existing or a proposed system.
It is an act of using a model for simulation.

* Advantages of modeling and simulation

⇒ allows to understand how a system operates w/o working it realtime.
⇒ easy to make changes compared to realtime system
⇒ allows to determine the system requirements by applying diff. configurations

* Disadvantages

⇒ It requires domain knowledge, training and experience
⇒ Process is expensive
⇒ Requires manpower and is a time-consuming process.

* Model Characterization

⇒ Model " refers to the process of understanding, describing and evaluating the properties of a model. It involves identifying key features, assumptions, parameters within model.

⇒ Key aspects:
> Identification of components including variables, equations.
> Understang the assumptions and simplifications.
> Validation & verification of processes to assess reliability.
> defining performance evalution metrics.

⇒ Eg: Imagine you want to build a toy car. So you need to identify and understand all the essential features like how it moves & turns, limitations, maximum speed etc. You also need to know all the materials required to make the toy

* Model development

⇒ It refers to the process of creating a representation of a system process or model physically or virtually.

⇒ key aspects:
> It begins with conceptualizing the system to be modeled.
> next step is to formulate the model using eqn, and algos
> next it is implemented using appropriate software tools

⇒ Eg: In the toy car example, model development will include assembling of all the components of the car like chasis, wheel etc.
It will also involve building computer simulation of car using appropriate software.

* Programming Languages

⇒ Numerous programming languages used in modeling & simulation:

> Python
- widely used for its simplicity. It uses libraries like Numpy, Pandas & Matplotlib.

> R
- offers a rich ecosystem of packages for statistical modeling & simulation

> MATLAB
- commonly used in research for numerical computing, data analysis and simulation.

> CPP
- Provides ~~high value~~ fast execution speed making it suitable for large scall simulations

> Simulink
- Graphical programming env within MATLAB for modeling.

> Java
- Used due to its platform independence