DEPARTMENT OF <u>PRODUCTION ENGINEERING</u>

NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI

COURSE PLAN – PART I			
Name of the programme and specialization	**B.Tech. (Production Engineering)**		
Course Title	**MANUFACTURING SYSTEM SIMULATION (Theory & Lab)**		
Course Code	PRPC29	**No. of Credits**	4
Course Code of Pre-requisite subject(s)	**MAIR47**		
Session	**August 2021**	**Section (if, applicable)**	**A and B**
Name of Faculty	**Dr. S. PrasannaVenkatesan**	**Department**	**Production Engg.**
Email	**prasanna@nitt.edu**	**Telephone No.**	**2503514**
Name of Course Coordinator(s) (if, applicable)	**---**		
E-mail	**--**	**Telephone No.**	**---**
Course Type	√ **Core course**	☐ **Elective course**	

Syllabus (approved in BoS)	

Introduction to simulation - Components of a system, Types of models, Monte Carlo Simulation, Steps in simulation, applications -Discrete Event Simulation – components of DES -Time advance mechanism.

Introduction – probability mass function, probability density function, Statistical models – Discrete distributions – Bernoulli, Binomial, Poisson, Geometric- Continuous distributions – Normal, Uniform, Exponential Gamma, Triangular Empirical Distributions

Properties of random numbers- Random number generation techniques – mid square, mid product Constant multiplier, linear, additive congruential. Test for random numbers- uniformity, independence- Kolmogorov Smirnov test, chi squareRuns test, Gap test, poker test, autocorrelation test Random variate generation-Inverse transform Acceptance rejection, convolution method

Input Analysis Methods-Examples-Verification of simulation models- Validation of simulation models-Measure of performance and their estimation- Output Analysis Methods-Transient and steady-state behaviour – Evaluation of alternate system design – Simulation-Based Optimization (SBO).

Simulation packages spreadsheet, witness, Arena, etc., simulation of queuing models, inventory models, Material handling, assembly systems, logistics and supply chains.

COURSE OBJECTIVES

To acquire knowledge of the design/evaluation of different manufacturing systems using simulation modelling.

COURSE OUTCOMES (CO)	
Course Outcomes	**Aligned Programme Outcomes (PO)**
1. Understand the role of simulation in decision making	**1,2,5,6,78,11,12**
2. Develop and analyze simulation models for manufacturing system	**1,4,5,7,9,11**
3. Understand the applications of probability in simulation	**1,2,4,5,7,11**
4. Understand the methods for random number and variate generation	**1,2,4,5,7,11**
5. Understand the statistical methods used for input and output modelling in simulation	**1,2,4,5,7,11**

COURSE PLAN – PART II

COURSE OVERVIEW

The course will cover modelling techniques, random number generators, discrete-event simulation approaches, input and output modelling and state-of-the-art simulation software. In the simulation laboratory, the students will get exposure on how to build and analyze simulation models using the simulation packages such as Simquick, Flexsim, Witness, Arena.

This course will enable students to analyze and develop simulation models of given problems.

COURSE TEACHING AND LEARNING ACTIVITIES

S.No.	Week/Contact Hours		Topic	Mode of Delivery [Online MS teams]
1	1	1	Introduction to Simulation	MS One note/stylus
		2	Models, Types of models,	MS One note/stylus
		3	Components of a system, types of simulation, Steps in simulation Advantages, limitations and applications	PPT
		4	Introduction to lab software simquick	Lab- Tutorial Model1
2	**2**	5	Monte Carlo Simulation,	MS One note/stylus
		6	Discrete Event Simulation – Examples,	PPT
		7	Components of DES, Time advance mechanism, model	PPT
		8	Lab-Simquick	Lab- Tutorial Model2
3	**3**	9	Introduction – pmf, pdf, cdf	MS One note/stylus
		10	Statistical models –Examples	MS One note/stylus
		11	Discrete distributions – Bernoulli, Binomial, Poisson, Geometric	MS One note/stylus
		12	Lab-Flexsim	Lab- Tutorial Model3

		13	Continuous distributions –Normal, Uniform, Exponential	MS One note/stylus
4	**4**	14	Gamma, Triangular	MS One note/stylus
		15	Empirical Distributions Problems	MS One note/stylus
		16	Lab-Flexsim/Flexsim HC	Lab- Tutorial Model4
		17	Properties of random numbers	MS One note/stylus
5	**5**	18	Random number generation techniques – midsquare, mid product	MS One note/stylus
		19	Constant multiplier, linear, additive congruential, test for random numbers- uniformity, independence	MS One note/stylus
		20	Lab-Arena	Lab- Tutorial Model5
		21	Kolmogorov simronov test, chi square	MS One note/stylus
6	**6**	22	Runs test, Gap test, poker test,	MS One note/stylus
		23	Autocorrelation test, Random variate generation-Inverse transform	MS One note/stylus
		24	Lab-Arena	Lab- Tutorial Model6
		25	Acceptance rejection, convolution method	MS One note/stylus
7	**7**	26	Input Analysis Methods	PPT
		27	Examples, Verification of simulation models	PPT
		28	Lab-Arena	Lab- Tutorial Model7
		29	Validation of simulation models	MS One note/stylus, PPT
8	**8**	30	Measure of performance and their estimation	MS One note/stylus,PPT
		31	Output Analysis Methods, Examples	MS One note/stylus,PPT
		32	Lab-Arena	Lab- Tutorial Model8
		33	Transient and steady-state behaviour	PPT
9	**9**	34	Simulation packages	PPT
		35	Simulation of queuing models-case study	PPT
		36	Lab-Witness	Lab-revision/demo
		37	Simulation of inventory models	PPT
10	**10**	38	Simulation of supply chain	PPT
		39	Simulation of material handling systems	PPT
		40	Lab-case examples, VR, AR, Emulation	Lab-revision/demo

COURSE ASSESSMENT METHODS (shall range from 4 to 6)				
S.No.	Mode of Assessment	Week/Date	Duration	% Weightage
1	Cycle test 1-MS teams#	6	1 hour	20
2	Cycle test 2- MS teams#	12	1 hour	20
3	Objective type test (Theory)- MS teams	14	0.45 hour	20
4	Objective type test (Lab)- MS teams	15	0.30 hour	10
CPA	Compensation Assessment*- MS teams#	15	1hour	20
5	Final Assessment *- (Theory) Through Institute portal	*As per institute schedule and guidelines.*	2 hour	30

*mandatory; refer to guidelines on page 4.
 # Extra 15 min. will be provided for uploading the answer sheet.

COURSE EXIT SURVEY (mention the ways in which the feedback about the course shall be assessed)

Course Exit survey will be collected at the end of the semester before the start of final assessment examination through online. Students can log in their MIS account to give feedback. Mid-semester anonymous feedback shall be collected to improve the teaching-learning process. Apart from this, students can share feedback during class committee meetings.

COURSE POLICY (preferred mode of correspondence with students, compensation assessment policy to be specified)

MODE OF CORRESPONDENCE (email/ phone etc)

The course faculty is available for consultation based on prior appointment to his email at - prasanna@nitt.edu

COMPENSATION ASSESSMENT POLICY

- o Attending online classes regularly and continuously is required for the students to understand the concepts. The recorded lectures of online teaching are made available for a limited period in MS teams to download.

- o Meaningful engagement with the faculty member and participation in the discussions is encouraged during remote learning.

- o If any student is not able to attend any of the continuous assessments (1 and 2) due to **genuine reason**, the student is permitted to attend a compensation assessment with 20% weightage. A candidate may appear for a compensation assessment only once.

- o Attending the objective type test (Theory and Lab) and final assessment (theory) is a must. Final assessment (Theory) will be on the entire syllabus.

ATTENDANCE POLICY (A uniform attendance policy as specified below shall be followed)

- ➢ Attendance for students will be considered as per institute policy.

ACADEMIC DISHONESTY & PLAGIARISM

- ➢ Copying the content directly from the online source and submitting it as a part of assessment.

ADDITIONAL INFORMATION, IF ANY

FOR APPROVAL

Course Faculty _____ 09-08-21   **CC- Chairperson** _____   **HOD** _____

V.Satheeshkumar