National Institute of Technology Hamirpur
Computer Science and Engineering
End-Semester Examination – December, 2020

Degree Program: B.Tech
Course Title: Modelling & Simulation
Date of Examination: 08.12.2020 (Morning)
Faculty's name: Dr. D. P. Mahato

Semester: 5^{th}
Time duration: 2 hours (10:00 to 12:00)
Total Marks: 50
Course Code: CSD-311

Note: All the questions are compulsory.

Q.1) $\mathbf{2+2+2+2+2=10}$ marks

(i) Which simulation technique can we use to estimate the ranges of key parameters relevant to the COVID 19 disease: When will things return to a new norm? and What is the best way to monitor the rapidly changing situation at regional levels?

(ii) Given a $N * N$ board with the Knight placed on the first block of an empty board. Moving according to the rules of chess knight must visit each square exactly once. Print the order of each the cell in which they are visited. Which simulation technique can we use here in this problem?

(iii) Although this is called a test for normality, it actually doesnt tell you whether a particular sample likely came from a normal population. Instead, it will tell you when it is unlikely that you have a normal distribution. One advantage to this test is that it doesnt make any assumptions about the distribution of data. A sample can be compared to a distribution using a this test. The test is usually recommended for large samples over 2000. What is that test?

(iv) Suppose we want to model the queuing model for a shop. What will be distribution of customer arrival and what will be the equation for the rate of job arrival? How will the jobs be served and what will be the equation of service rate of the job?

(v) Tsunami generated by submarine slides are arguably an under-considered risk in comparison to earthquake-generated tsunami. We want to model and simulate the Tsunami. What should be the steps to model this problem? Which simulation technique is good in this problem?

Q.2) **10** marks

One dentist schedules all his patients for 30 *minutes* appointments. Patients take more or less than 30 *minutes* depending on the type of dental work. The following table shows the various category of work, their probabilities and the time actually needed to complete the work.

Category	Time Required	No. of Patients	Probability (%)
Filling	45 *minutes*	40	0.40
Crown	60 *minutes*	15	0.15
Cleaning	15 *minutes*	15	0.15
Extracting	45 *minutes*	10	0.10
Check-up	15 *minutes*	20	0.20

Simulate the dentist's clinic for four hours and find out the average waiting time for the patients as well as the idleness of the doctor. Use the following random numbers for handling the above problem by using **Monte Carlo Simulation Method**. Random Numbers are as: $40, 82, 11, 34, 25, 66, 17, 79$. Assume that all the paitients show up at the clinic at exactly their scheduled arrival starting time at $8:00$ AM.

Q.3) **10** marks

Suppose or consider the sequence of 5 numbers as: $0.15, 0.94, 0.05, 0.51$, and 0.29. Given that $\alpha = 0.05$ and $D_\alpha = 0.565$. Null Hypothesis: Whether the hypothesis of uniformity can be rejected. (Solve using **Kolmogorov-Smirnov Test**). Given that $D = max_{1 \leq Y \leq N} \left[F(Y_i) - \frac{i-1}{N}, \frac{i}{N} - F(Y_i)\right]$

Q.4) **10** marks

The production volume of units assembled by three different operators (1, 2 and 3) during 9 shifts are summarized in the given table. Check whether there is significant difference between the production volumes of units assembled by three operators using **Kruskal-Wallis Test** at a significance level of 0.05. Suppose N=n_1+n_2+n_3 and H $\sim$ chi-square distribution with $(K-1)$ degree of freedom, where K is the total number of samples. (Given $H = \frac{12}{N(N+1)}\Sigma_{j=1}^{3}\frac{{R_j}^2}{n_j} - 3(N+1)$ and the table chi-square value with 2 degree of freedom at the given significance level of 0.05 is 5.991).

Shift No.	**Operator 1**	**Operator 2**	**Operator 3**
1	29	30	26
2	34	21	36
3	34	23	41
4	20	25	48
5	32	44	27
6	45	37	39
7	42	34	28
8	24	19	46
9	35	38	15

Q.5) **10** marks

In a computer company, the performance indices of a randomly selected sample of programmers of each of its two branches located in different cities are summarized in the given table. Check using **Mann-Whitney** U **Test** whether the two samples are drawn from identical populations against the alternate hypothesis that the first population is stochastically larger than the second population at a significance level of 0.05. Given that the standard normal value for the given significance level of $\alpha = 0.05$ placed at right tail is 1.64.

Branch 1.	**Branch 2**	**Branch 1**	**Branch 2**
87	78	91	83
76	55	68	97
57	92	73	53
50	71	79	89
43	25	59	74
73	62	50	30
40	45	35	54
90	77	82	32
75	34	73	–
85	50	66	–