SHIV NADAR
INSTITUTION OF EMINENCE DEEMED TO BE UNIVERSITY
DELHI NCR

Office of The Dean of Academics

Course Description Form
Monsoon 2025

Instructions:

Who should fill this form?

- The form is to be filled out by the instructors teaching a course offered to the undergraduate students in the Monsoon 2025 semester. In case multiple instructors are teaching a course, the form needs to be filled out just once.

Filling up the form:

- Please fill in all the sections.
- The fillable space is marked as: Fill Me
- Double click and use the backspace key on the greyed-out region to remove the default text. Use the tab key to move to the next fillable field.
- Hover your mouse over the **text in this colour** in the form to get details about the fillable field, wherever highlighted.
- In case of multiple instructors teaching a course, details about all the faculty are to be filled in the same box in section C. Please check the details by hovering your mouse over the highlighted text. Details on Teaching Assistants / Lab Assistants can be provided under Section L.
- Please note this form does NOT accept Rich Text Format

Usability of the form:

- A subset of the form data will be used to populate the course catalogue in the ERP, the SNU web page and for accreditation requirements, as applicable.
- This form can be used as a course handout or a course outline as well.

Using the form **(IMPORTANT):**

- Before opening the file, right click the file >> Click Properties >> Check 'Unblock' under the General Tab >> Click Apply >> Click OK.
- After opening the file, click 'Enable Content' to edit the editable portions of the file.

Saving the form:

- Before submitting the form, please name the file as <course-code>-25MO.pdf e.g. Esc101 code should be saved as esc101-25MO.pdf (all small letters, no blanks and no special characters). CCC courses as <course-code>-25MO1.pdf for session1 and <course-code>-25MO2.pdf for session 2.
- Please retain the Word file for future reference. The office of the Dean of Academics may request it in the future.
- While saving the PDF format, please exclude the first instruction page and the reference included at the end.

Form submission date:

Last date to submit the form is .....

Section A:								
Course Code	MAT 4XX							
Course Title	Simulation And Computation							
Course Credits	4	**No. of Contact Hours/week**	**L:**	3	**T:**	1	**P:**	0
School	Natural Sciences							
Offered By	Mathematics							
Method of Instruction:	In Person	**Offered in:**	Monsoon Semeste	Full Semster				
Check each box, when applicable, if the course covers one or more of the below listed attributes								
☒	**REALS**	☐	**VELS**	☒	**DISE**			
Prerequisites	Mat101 Or Similar Calculus Course And Mat285 Probability And Distributions Or A Similar Probability Course							
List The Courses Which May Be Like This Course. So, If A Student Has Already Done A Course From This List, They Should NOT Register For This Course, I.E. It's A Negative List								
Fill this, if applicable: A Similar Course Was Offered With Code ..... In Year								

NOTE:

Section B:This course is offered as (use checkbox) for which Programs			
☐	Major Core for:		Instructor's Approval
☒	Major Elective for:	B.Sc. Mathematics	Not required
☒	UWE for:	All	Not required
☐	Project /UG Thesis / Internship	Any Other Information	Instructor's Approval
☐	CCC for:	Choose a Category	Instructor's Approval
☒	Specialization (If applicable)	Data Science	Not required
☒	Minor (If applicable)	Mathematics	Not required
Estimated No. of Seats:	50	Estimated Number of Sections	1

Section C: State the Program Learning Goals of the Major Degree Program mapped to the Core Course (Applicable to Major Core courses only)
PLG1
PLG3
PLG4

Section D: State the Course Objectives / Aim (Specific details of what the course intends to achieve in terms of student knowledge and ability. Items should begin with phrases such as "To provide students with …", "To enable students to …", "To develop students' skills in …" and so on.)
• To introduce students to the fundamental concepts of statistical simulation and computational methods. • To develop the ability to simulate data from known probability distributions using various techniques. • To familiarize students with Monte Carlo methods for integration, estimation, and hypothesis testing. • To enable understanding and implementation of Markov Chain Monte Carlo (MCMC) algorithms including Metropolis-Hastings and Gibbs Sampling. • To equip students with resampling techniques such as bootstrapping and jackknife for statistical inference. • To apply computational tools for parameter estimation, model fitting, and optimization.

Section E: State the Learning Outcomes (A list of what students will know or be able to do as a result of successfully completing the course. Should be expressed as knowledge, skills, or attitudes.)
On successful completion of the course, students will be able to:
• Generate Pseudo-Random Numbers And Simulate Data From Standard Distributions. • Apply Monte Carlo Techniques For Integration, Estimation, And Simulation-Based Hypothesis Testing. • Implement Mcmc Algorithms (Metropolis-Hastings And Gibbs Sampling) For Complex Probabilistic Models. • Use Resampling Techniques Like Bootstrapping And Jackknife For Inference. • Evaluate The Goodness-Of-Fit And Compare Statistical Models Using Empirical Tools. • Perform Optimization And Parameter Estimation Using Computational Techniques.

Section F: State if course contributes to any skill development
Inferential Analysis Data Science

Section G: Module-wise Curriculum Content (Syllabus, Lab work, Project, Term paper, Group work, etc.)

Module 1: Simulation Techniques (6 hours)
•Pseudo-random number generation
•Generation of random variables from standard distributions
•Inverse transformation method
•Acceptance-Rejection method
Module 2: Monte Carlo Methods (6 hours)
•Monte Carlo integration
•Monte Carlo estimation
•Monte Carlo methods for hypothesis testing
•Importance sampling
Module 3: Markov Chain Monte Carlo (MCMC) (6 hours)
•Introduction to MCMC
•Markov chains and stationary distributions
•Metropolis-Hastings algorithm
•Gibbs Sampling
Module 4: Resampling Techniques (6 hours)
•Bootstrap method: principles and applications
•Jackknife resampling
•Cross-validation techniques
•Estimation of bias and standard error using resampling
Module 5: Statistical Model Fitting and Diagnostics (7 hours)
•Histogram, empirical density, and empirical CDF
•Goodness-of-fit tests: Kolmogorov-Smirnov, Chi-square test
•Graphical diagnostics for model checking
Module 6: Computational Statistics and Optimization (8 hours)
•Maximum Likelihood Estimation via numerical methods
•Newton-Raphson method
•Expectation-Maximization (EM) algorithm
•Linear and nonlinear regression (overview and implementation)
Experiments / Case Studies
•Simulating random samples from Normal, Exponential, and Gamma distributions
•Monte Carlo estimation of π and areas under curves
•Implementing Metropolis-Hastings algorithm for Bayesian estimation
•Bootstrap confidence intervals for real-life datasets
•Model fitting and diagnostics using simulated and real data

Add additional sheet(s), if required

Section H: Text Book(s), Reference book(s) and any other study material
• Rizzo, M. L. (2019). Statistical Computing with R. Chapman and Hall/CRC. • Ross, S. M. (2022). Simulation, Academic Press. • Gentle, J. E. (2009). Computational Statistics (Vol. 308, p. 41). New York: Springer.

Section I: Please fill in all the rows for the applicable rows. For evaluation component not included in the list, use the last two rows and mention the evaluation component in the corresponding last column. Please see the NOTE below this box for the prorate policy.

	Component	Weightage %	Missed Graded Component Policy	Use of Gen AI policy	Any Other Information
☒	Mid Sem Exam	25.00	Assign marks on a Prorated bas	Prohibited: No Gen AI allowed	prorating only with appropriate permission
☒	End Sem Exam	40.00	I grade awarded on approval fro	Prohibited: No Gen AI allowed	other info
☒	Quiz(s)	5.00	Choose the best n from m comp	Prohibited: No Gen AI allowed	other info
☒	Assignment(s)	10.00	Assign marks on a Prorated bas	Conditional: Access allowed on	other info
☒	Lab	10.00	Retake of Graded Component	Prohibited: No Gen AI allowed	other info
☐	Project	0.00	Please Select	Please Select	other info
☒	Case Studies	10.00	Assign marks on a Prorated bas	Permitted: access allowed for G	other info
☐	Group Discussion	0.00	Please Select	Please Select	other info
☐	Any Other Component	0.00	Please Select	Please Select	other info
☐	Any Other Component	0.00	Please Select	Please Select	other info
	Total **Weightage** (%)	100.00			

Note:
a) While you may mark multiple evaluation components for pro-rate. However, if a particular student misses multiple evaluations, *not more than 20% of the evaluation can be prorated for that student*.
b) The best n out of m: Please make sure that n < m.
c) Award of 'I' grade is applicable only in the case of the End-term Exam. Additionally, end-term exams or final assessments cannot be prorated or waived.
d) Individual faculty can decide the prorate policy for each component.
e) 'None' as an option can only be used in exceptional cases, for example lab evaluated by an external expert

<table>
<tr><td colspan="4">Section J: Grading Policy (Tick the one You intend to follow)</td><td></td></tr>
<tr><td>☒</td><td>Relative Grading</td><td colspan="2">Students Scoring Above 90 Will Be Awarded An 'A' Grade. For All Other Scores, Relative Grading Will Be Applied.</td><td>None</td></tr>
<tr><td rowspan="11">☐</td><td rowspan="11">Absolute Grading</td><td>Grade</td><td>Range (replace M's appropriately)</td><td></td></tr>
<tr><td>A</td><td>M1 <= marks <= M2</td><td rowspan="10">Please Mention The Rounding Off Policy And Any Other Information</td></tr>
<tr><td>A-</td><td>M1 <= marks <= M2</td></tr>
<tr><td>B</td><td>M1 <= marks <= M2</td></tr>
<tr><td>B-</td><td>M1 <= marks <= M2</td></tr>
<tr><td>C</td><td>M1 <= marks <= M2</td></tr>
<tr><td>C-</td><td>M1 <= marks <= M2</td></tr>
<tr><td>D</td><td>M1 <= marks <= M2</td></tr>
<tr><td>E</td><td>M1 <= marks <= M2</td></tr>
<tr><td>F</td><td>M1 <= marks <= M2</td></tr>
</table>

Section K: Details about instructors teaching this course. For multiple instructors in a course, mention each name once after the other					
Name of the Instructor(s):	Qazi Azhad Jamal Prof XYZ Prof ABC			**Section(s)**	L1 L1, L2, L3
Office Location	A107d K 120 L 325	**Tel. Extension***	458	**Email:**	qazi.jamal@snu.edu.in abc@snu.edu.in xyz@snu.edu.in
About the Instructor(s): Click Here To Enter About 250 Words about each instructor teaching the course`					

***** - Optional

Section L: Office Hours
Will be announced at the beginning of semester . You may update this at the start of the semester.

Section M: Any other information
Programming software R/Python will be used for lab component.