

Course Handout

Course: CS G526, Advanced Algorithms and Complexity
Instructor: Aniket Basu Roy, BITS Pilani K K Birla Goa Campus
Semester: August–December 2026

1 Course Objectives

1. To master the discipline of algorithm design, viz., formalize a problem precisely, in terms of input, output, and the objective; design algorithm to solve the given problem, prove its correctness and analyze the computational complexity.
2. To build a working toolkit of core algorithmic techniques, viz., greedy, divide-and-conquer, dynamic programming, network flow, linear programming.
3. To understand the complexity-theoretic lens (NP-completeness, reductions) and to recognize which problems are tractable and which are not.
4. To tackle hard problems from the lens of approximation and randomized algorithms.
5. To write mathematical proofs with precision and rigor.

2 Lectures

- Time: Mon Wed Fri 9:00 AM – 9:50 AM
- Place: D103

3 Consultation Hours

- Time: Fri 11:00 AM – 12 noon
- Place: D256

4 Course Webpage

<https://aniket-basu-roy.github.io/teaching/2026/aac/aac.html>

5 Tentative List of Topics

- Motivation and Warmup: the Stable Matching Problem
- Growth of Functions and Asymptotic Notation
- Graph Theory Basics
- Greedy Algorithms
- Divide and Conquer
- Dynamic Programming
- Linear Programming: Formulation, and an Introduction to Duality
- Network Flow

- NP-Completeness and Reductions
- Approximation Algorithms
- Randomized Algorithms

6 References

1. Kleinberg, J., & Tardos, E. (2006). **Algorithm Design**. Pearson/Addison-Wesley.
2. Dasgupta, S., Papadimitriou, C. H., & Vazirani, U. V. (2006). **Algorithms**. McGraw-Hill.
3. Vazirani, V. V. (2001). **Approximation Algorithms**. Springer.
4. Motwani, R., & Raghavan, P. (1995). **Randomized Algorithms**. Cambridge University Press.

7 Evaluation Scheme

Component	Weight	Duration	Book
Comprehensive Examination (04 December Friday, 10:00 AM – 1:00 PM)	40%	180 min	Closed
Midsemester Examination (07 October Wednesday, 9:30 AM – 11:00 AM)	25%	90 min	Open
<i>Other Evaluative Components (35% total, open book by nature):</i>			
Problem Sets (4; 2 of N problems per set graded in depth)	15%	—	—
Paper Reading, Report Writing, and Presenting	10%	—	—
Lecture Scribing	10%	—	—

Note on Problem Sets: all problems on every set must be attempted. After submission, two problems per set are chosen (not announced in advance) for detailed grading; the remainder are checked for genuine attempt. A random sample of students may additionally be asked to explain any submitted solution — including ones not selected for detailed grading — in a short oral conversation.

8 Makeup Policy

A makeup sitting will be considered **only** for the Midsemester Examination and the Comprehensive Examination. None of the Other Evaluative Components — Problem Sets, Paper Reading and Report, or Scribing — carry a makeup; a missed deadline in any of these is not eligible for a later resubmission or makeup slot.

A makeup for the Midsemester or Comprehensive Examination will be granted **only on medical grounds**, and only when supported by documentation issued by the **Institute Medical Center**. Self-certified illness and medical certificates from external practitioners are not, by themselves, sufficient grounds for a makeup.

The format, difficulty, and coverage of a makeup examination are at the instructor’s discretion and need not replicate the missed examination.

9 NC (Not Cleared) Grade Policy

A student is awarded an **NC** grade — course not cleared — if their total marks across all evaluation components fall below a clearing threshold, computed as:

$$\text{Threshold} = \min \left(30\% \times \bar{m}_{95}, 40\% \times \tilde{m} \right)$$

where $\bar{m}_{95}$ is the average marks of students scoring above the 95th percentile of the class, and $\tilde{m}$ is the median marks of the class. A student must score at or above this threshold to clear the course; falling short results in an NC regardless of the student's absolute or relative standing on any individual component.

10 Academic Integrity

10.1 Institute Policy

BITS Pilani's guidelines for unfair means offences (on-campus programs, revised August 2022) define a graded schedule of offences and corresponding punishments, summarized below:

- *Possession* of a prohibited device or material during an examination, without being caught using it: a warning.
- *Possession* of material relevant to the subject, without being caught copying from it: cancellation of registration for the course.
- *Simple* (spontaneous, non-premeditated) copying, or tampering with an answer script: cancellation of registration for the course.
- *Severe* cases — including premeditated copying, copying in collaboration with other student(s), helping another student by unfair means, or premeditated tampering: cancellation of registration for the course, and debarment from registration for a further period ranging from one semester to two years, depending on severity as determined by the campus Examination Sub-Committee.
- *Impersonation* (having another person write an examination on one's behalf, or doing so for someone else): cancellation of registration for the course and discontinuation from the programme.

Critically, the guidelines define *examination* to include **any component of evaluation in the course** — so this schedule applies to problem sets, the paper report, and scribing exactly as it applies to the midsemester and comprehensive examinations. Repeat offences are handled with additional severity by the campus Sub-Committee, and decisions may be appealed through the Sub-Committee to the Examination Committee. This course-level policy operates within, and does not replace, that Institute framework.¹

10.2 Collaboration Policy

Discussion of problem sets among students is permitted and encouraged. However:

¹BITS Pilani, *Guidelines for the Award of Punishment to Unfair Means Cases (On Campus Programs)*, revised 2 August 2022. https://academic.bits-pilani.ac.in/Downloads/Unfair_Means_Offence_Revised_02_AUG_2022.pdf

- Every student must write up their own solutions independently, in their own words and notation.
- Every submission must list the names of anyone the student discussed the problems with, at the top of the submission. Discussing a problem and citing that discussion is not a violation; presenting someone else's write-up, in whole or in substantial part, as one's own is.
- Copying, or allowing one's work to be copied, from another student's submission is a violation regardless of whether it is acknowledged. Under the Institute schedule above, copying done in collaboration with another student is explicitly named as a *severe* offence, not a simple one.

10.3 Use of AI Tools

The use of AI tools (e.g., large language models) to explore a problem, check reasoning, or get unstuck is permitted. However:

- Every submission must reflect the student's own understanding. A student may be asked, at random and without notice, to explain any part of their submitted work in a short oral conversation; inability to do so will be treated as evidence the submission does not reflect the student's own understanding.
- Submitting AI-generated work as one's own unaided work, when directly asked whether it is, constitutes a misrepresentation and will be treated as a violation of this policy.
- This policy applies to take-home components (problem sets, the paper report, scribing). All examinations are closed to AI tools and external assistance of any kind, in addition to being closed or open book as specified above.

10.4 Consequences

A confirmed violation of this policy in any course component — including problem sets, the paper report, or scribing, per the Institute's definition of examination above — is handled under the Institute schedule in Section 10.1, not as a course-internal penalty. In practice this means even a first, simple instance of copying carries cancellation of registration for the course; collaborative or premeditated copying is treated as severe, carrying an additional debarment period. The instructor will report suspected violations to the Examination Sub-Committee for determination rather than deciding severity unilaterally.