MA423 Syllabus in Modules

Module I (9-10 lecture hours)

- Overview and preliminaries (flop counts, blocking, norms, BLAS)
- Solutions of triangular systems
- Gaussian elimination and its variants
- Equivalence of Gaussian elimination with various LU decompositions
- Cholesky decomposition for positive definite matrices

Module II (10-11 lecture hours)

- Sensitivity of linear systems and condition numbers
- Floating point computation
- IEEE floating point arithmetic and rounding errors
- Error analysis for computed answers
- Stability of algorithms for solving linear systems

Module III (10-11 lecture hours)

- Gram-Schmidt orthonormalization
- QR factorizations
- Householder reflectors and Givens rotators
- Least Squares Problems
- Singular Value decomposition and its applications

Module IV (11-12 lecture hours)

- Polar decomposition and its relationship with other decompositions (via lab sheet only)
- Review of eigenvalues and eigenvectors of matrices
- Schur's Theorem and Spectral Theorems
- Reduction to Hessenberg and tridiagonal forms
- Power Method and its variants
- Explicit and Implicit QR algorithm for the matrix eigenvalue problem

Note 1: Concepts and techniques from the previous modules will be necessary in subsequent modules.

Note 2: A day-wise schedule for the course is given on the last page of this document.

Note 3: A class group Grp_MA423-2021 has been created for the smooth conduct of the course in MS Teams. All announcements, assignments and lecture video releases will be made in this group. It will be the responsibility of the students to keep a tab of all activities of the class team.

Note 4: Pre-recorded lecture videos will be released on MS Stream and their links will be shared on the chat of the MS class group MA571-2021. There will be live interaction session each week usually on Thursday from 11a.m.-12noon.

Note 5: Lab sessions will be on Tuesday from 3 p.m - 5 p.m during which the instructor and TA will be available online for help. The software to be used is MATLAB. There will be 11-12 lab sessions during the entire semester during which a total of 8 lab sheets (2 per module) are expected to be covered. These will be posted in the assignment tab of the class group before the start of a session. The programs must be stored in a folder in google drive/one drive and **only the link to the folder is to be submitted**. There will be a preliminary submission deadline of 8 pm for submitting the work done during the lab session of that day followed by a final deadline by which all programs for that sheet must be in the folder. These will not be assessed but not for marks immediately. However, the TA will keep a track of them to note regularity and sincerity and there will be penalties for irregular submissions/empty folder submissions/other student's folder submission or any other kind of cheating and malpractices. Note that the lab assessments that will count towards marks later on will be either a part of or based on the programs written during the regular lab sessions.

Evaluation Policy

I. Evaluation will happen over a period of time as marked in the day-wise calendar in the last page of this document. **Besides Mid Semester and End Semester Examination, there will be two evaluations, one at the end of the first two modules and the other at the end of the last two modules. These additional evaluations will be conducted as group activities. The students must organize themselves into 13 groups each consisting of 4 members and two more groups, each consisting of 5 members. The groups have to be formed in such a way that the average CPI of all the groups remains within a reasonable range. A private channel within the class group on MS Teams will be created for each group. Every group will have to identify a co-ordinator who will be responsible for the smooth functioning of the group. All the members are expected to contribute to the group activity and the co-ordinator may maintain a log of the same and post it in the group's private channel. This assessment will be for 35 marks per evaluation (total 2*35 = 70). Each of them will be split into 14-15 marks of lab component and 20-21 marks of theory component.** The details are as follows:

(a) Lab component: As already stated there will be 2 lab sheets per module. After giving sufficient time to complete them, on a particular day of the declared evaluation period for the concerned modules, an assignment sheet containing some problems that are based on the lab sheets of the module will be posted in the assignment tab of the class group. **A link to a folder containing all the programs will have to be submitted by each member of the group within a time frame of at most 48 hours.**

(b) Theory component: The theory component will consist of assignment and/or a single test of at most one hour. **In case it is an assignment, the sheet will be posted within the declared evaluation period of the concerned modules and the work will have to be**

uploaded as a pdf file typed in latex by each member of the group within the deadline of 48-72 hours. If it is a quiz, a 24-hour notice will be given. As far as possible quizzes will be scheduled in one of the allotted class timings of the course.

(c) **To encourage healthy competition between the groups, a scheme of bonus marks will be implemented at the end of each module.** A bonus of 4 marks will be added if the score of a group for that module lies between 25-30 marks and a bonus of 5 marks will be added if it lies between 31-35 marks. Moreover, if the highest score lies in the 31-35 range and it has a gap 4 or more marks with the scores of the other groups, then a bonus of 7 marks will be given to that group.

(d) **Delayed submissions of both theory and lab components will be liable to penalties that will be applied to the individuals that submit late and not to the entire group.**

II. **Mid Semester and End Semester Examinations will be held as per the schedule declared by the institute in the exam slot (E). All students will be assessed individually for these examinations and not as a part of a group.** The Mid Semester examination will be of one-hour duration for 25 marks [=10 (lab) + 15(theory)]. The End Semester examination will be of two-hours duration for 45 marks [= 18(lab) + 27(theory)].

III. **Determination of individual scores:** Suppose that for a student the Mid-Semester + End-Semester score = X and the combined score obtained from all the group activities is Y. The following policy will be used to calculate the final score of the student at the end of the semester:

If	Final score of the student is
X >21	**X + Y**
X lies in (10, 21]	**X + 0.5*Y**
X lies in (5,10]	**X + 0.25*(Y – bonus marks)**
X lies in [0, 5)	**X + 0.1*(Y – bonus marks)**

IV. **Negative marks will be awarded for irregularities in submissions as already mentioned earlier and also for plagiarism or any kind of unfair practice in assessments. The instructor reserves the right to declare all penalties at the end of the semester. Groups/students indulging in unfair practices will have to forfeit all bonus marks.**

V. **The instructor and the TA reserves the right to modify the above rules if it is noticed at any point during the semester that students are taking unfair advantage of the system.**

Monsoon Semester AY 2020-2021

July 2021

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21 HOLIDAY	22	23	24	25
26	27	28	29 Thur-1 **Instruction for Module1 begins**	30 Fri-1	31	

August 2021

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
						1
2 Mon-1	3 Tue-1	4 Wed-1	5 Thur-2	6 Fri-2	7	8
9 Mon-2	10 Tue-2	11 Wed-2	12 Thur-3	13 Fri-3	14	15 HOLIDAY
16 Mon-3	17 Tue-3	18 Wed-3	19 **Instruction for Module1 ends**	20 Fri-4 **Instruction for Module2 begins**	21	22
23 Mon-4	24	25 Wed-4	26 Thur-4	27 Fri-5	28	29
30 Mon-5	31 Tue-5					

Sept 2021

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
		1 Wed-5	2 Thur-5	3 Techniche	4 Techniche	5 Techniche
6 Mon-6	7 Tue-6	8 Wed-6	9 Thur-6	10 Fri-6	11	12
13 Mon-7	14 Tue-7	15 Wed-7 **Instruction for Module2 ends**	16 **Evaluation for Module 1 & 2 begins** **Instruction for Module3 begins**	17 Fri-7	18	19
20	21	22	23	24	25	26

	Evaluation for Module 1 & 2 ends						
	27 Mon-8	28	29 Wed-8	30 Thur-8			
Oct 2021	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
					1 Fri-8	2 HOLIDAY	3
	4 Mon-9	5 Tue-9	6 Wed-9	7 Thur-9 Spirit (outside class hours)	8 Fri-9 Spirit (outside class hours)	9 Spirit	10 Spirit
	11 Mon-10	12 Tue-10	13 Wed-10	14	15 HOLIDAY	16	17
	18 Mon-11	19	20 Wed-11 **Instruction for Module3 ends**	21 Thur-11 **Instruction for Module4 begins**	22 Fri-10	23	24
	25 Mon-12	26	27 Wed-12	28 Thur-12	29 Fri-11	30	31
Nov 2021	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
	1 Mon-13	2 Tue-12	3 Fri-12	4 HOLIDAY	5 HOLIDAY	6	7
	8 Mon-14	9 Tue-13	10 Wed-13	11	12 Fri-13	13	14
	15 Fri-14 Evaluation for Module 3 & 4 begins **Instruction for Module4 ends**	16 Tue-14	17 Wed-14 **Additional sessions**	18 Thur-14 **Additional sessions**	19 HOLIDAY Evaluation for Module 3&4 ends	20	21
	22	23	24	25	26	27	28
	29	30					