Semester 4

Core Course (Major)

Course Code: 4MTMMJC1 (Credit: 4, Lectures: 60 Hours; Full Marks: 100)

Course Name: Linear Algebra-2 and Fourier Series

Marks and Credit distribution:

Theory: 3 Credits, Tutorial: 1 Credit

End Semester exam: 50 Marks, Continuous Assessment: 20 Marks, Attendance: 5 Marks, Tutorial: 25 Marks

Course Outcome: Upon completion, students will demonstrate mastery in Linear Algebra, encompassing linear transformations, inner product spaces, orthogonalization processes, and diagonalization techniques. Additionally, they will proficiently analyze Fourier Series, including computation, convergence, and application in solving numerical series. The knowledge of this course will equip them with analytical skills applicable across various mathematical disciplines

Group A (45 Hours Lecture)

Linear Algebra 2

1. Linear Transformation: Linear transformation on vector spaces: definition of linear transformation, null space, range space of an linear transformation, rank and nullity, rank-nullity theorem and related problems, isomorphisms, non-singular linear transformation, inverse of linear transformation, matrix of a linear transformation relative to ordered bases of finite-dimensional vector spaces, linear transformation is non-singular iff its representative matrix is non-singular, rank of L.T. = rank of the corresponding matrix.
2. Inner Product Spaces**:** Euclidean plane and dot product, real and complex inner product spaces, norm, orthogonality, Pythagorean Theorem, Cauchy-Schwarz's inequality, triangle inequality, parallelogram equality, orthonormal basis, Besssel's inequality, Gram-Schmidt's orthogonalization process, linear functionals, Riesz representation theorem, orthogonal complement, direct sum of subspace and its orthogonal complement, orthogonal projection and its properties, orthogonal transformations: reflection, rotation.
3. Diagonalization**:** invariant subspaces, eigen-values and eigen-vectors and their relevant theorems, diagonalizability criterion, Cayley–Hamilton theorem for square matrices, diagonalization of symmetric matrices.
4. Congruence of matrices**:** Statement of applications of relevant results, normal form of a matrix under congruence, bilinear form and associated matrices, real quadratic form involving three variables, Reduction to Normal Form (statements of relevant theorems and applications).

References
[1] Linear Algebra – Hoffman and Kunze.
[2] Linear Algebra – Friedberg, Insel and Spence.
[3] Linear Algebra Done Right - S. Axler.
[4] Linear Algebra with Applications - Steven J Leon.
[5] Linear Algebra – Bhimasankaram and Rao.
[6] Linear Algebra and its applications- Gilbert Strang
[7] Higher Algebra – S. K. Mapa.

Group B (15 Hours Lecture)

Fourier Series

1. Fourier series of a 2π -periodic Riemann integrable (on [-π, π]) function, computation of Fourier series in practice and related applications in finding the sum of a special kind of numerical series.
2. Fourier Sine and Cosine series.
3. Bessel's inequality, Dirichlet kernel and its properties, Convergence of Fourier series, Riemann-Lebesgue lemma, term by term differentiation of Fourier series, term by term integration of Fourier series.

References
[1] A first course in Real Analysis- Murray H. Protter and Charles B. Morrey
[2] Fourier Series and Boundary value problems- James Ward Brown and Ruel V. Churchill
[3] An Introduction to Analysis, Integral Calculus- K. C. Maity & R. K. Ghosh.