CMR Institute of Technology, Bangalore		
Department: Electronics and Communication Engineering (ECE)		
Semester: III	Sections: A,B, C and D	Lectures/week: 04
Subject: Transform Techniques and Optimization Theory		Code: 1BMATEC301
Course Instructors :Dr. B. Narasimha Rao & Dr. K. Meenakshi		
Course duration: 7th Sep 2026- 13th Jan 2027		
Course Site: https://sites.google.com/view/dr-b-narasimha-rao/home		

Course Objectives/ Expectations	1. To develop students' ability to apply Fourier series, Fourier transforms, and Z-transforms to analyze signals, solve differential/difference equations, and address engineering problems. 2. To develop problem-solving and optimization skills through Linear Programming, Transportation, and Assignment models for effective engineering and resource-allocation decisions.
Prerequisites	Basic Calculus Differential Equations Matrices and Algebra Sequences and Series

NOTE: First one to two sessions should be marked for expectations setting about the course.

Lesson Plan				
Lecture #	**Book & Sections**	**Topics**	**Portions coverage**	
			Teaching Aids/Course Delivery Methods	% of Syllabus Covered
1-8	TB1 21.1 to 21.18	**Module-1: Fourier Series and Practical Harmonic Analysis** Periodic functions, Dirichlet's condition, Fourier series with period 2π2\pi2π and arbitrary period, even and odd functions, half-range Fourier series, practical harmonic analysis.	Chalk and Talk,Video Lectures for some topics	08

Links to some useful online lectures: Videos, assignments, quizzes, answers to old external question papers, notes and other e-material can be included • https://youtu.be/r18Gi8lSkfM • http://.ac.in/courses.php?disciplineID=111,				
9-16	TB1 10.1 to 10.11	**Module-2: Fourier Transforms** Infinite Fourier transform, sine and cosine transforms, properties, inverse transforms, convolution theorem, transforms of derivatives and integrals, DFT, Inverse DFT and FFT.	Chalk and Talk,video lectures for some topics	08
Links to some useful online lectures: Videos, assignments, quizzes, answers to old external question papers, notes and other e-material can be included • **https://youtu.be/spUNpyF58BY**				
17-24	22.1 to 23.16	**Module-3: Z-Transforms** Z-transform of standard functions, linearity, damping and shifting properties, initial and final value theorems, inverse Z-transform, convolution theorem and applications to difference equations.	Chalk and Talk Video Lectures for some topics	08
Links to some useful online lectures: Videos, assignments, quizzes, answers to old external question papers, notes and other e-material can be included https://youtu.be/fEN4Y-hCL60?si=ebEtYzkEedBI8KM_				
25-32	TB1 and TB2	**Module-4: Linear Programming Problems** Introduction to optimization and Operations Research, Linear Programming, graphical method, Simplex method and Big-M method.	Chalk and Talk Video Lectures for some topics	08
Links to some useful online lectures: Videos, assignments, quizzes, answers to old external question papers, notes and other e-material can be included https://youtu.be/SJLeLxgSX5A?si=JJUtjXmkoqSAstvt				

33-40	TB1 32.1 to 35.5	**Module-5: Transportation Problems** Formulation of transportation problems, North-West Corner method, Least Cost method, Vogel's Approximation Method, optimal solutions, assignment problems and Hungarian method.	Chalk and Talk,Video Lectures for some topics	08
Links to some useful online lectures: Videos, assignments, quizzes, answers to old external question papers, notes and other e-material can be included https://youtu.be/gd8IU5Ei2Is?si=T7FdJWHPJ24zQheR				

Link to detailed syllabus:	https://drive.google.com/drive/folders/1v_uuol4w_QYmKL6SRZ1Ox-SKpAVy3E1p?usp=sharing
Course Objectives/ Expectations	🎬 Understand the concepts of **Fourier Series and Harmonic Analysis**. 🎬 Apply **Fourier Transforms, DFT and FFT** to engineering problems. 🎬 Apply **Z-Transforms** to solve difference equations. 🎬 Solve **Linear Programming Problems** using optimization techniques. 🎬 Apply **Transportation and Assignment Models** for resource allocation and decision-making.
Prerequisites	🎬 Basic **Calculus** 🎬 Basic **Differential Equations** 🎬 Knowledge of **Algebra** 🎬 Basic **Matrix Operations** 🎬 Familiarity with **Sequences and Series**

NOTE: First one to two sessions should be marked for expectations setting about the course.

	Text Books
1	**B.S. Grewal,** Higher Engineering Mathematics, 45th Edition, Khanna Publishers.
2	**Hamdy A. Taha,** Operations Research: An Introduction, Pearson Education**.**
3	**H.K. Dass and Er. Rajnish Verma,** Higher Engineering Mathematics, S. Chand Publications.
	Reference Books
1.	**Ruel V. Churchill and James Ward Brown,** Fourier Series and Boundary Value Problems**, McGraw-Hill Education.**
2.	**Erwin Kreyszig,** Advanced Engineering Mathematics, 10th Edition, Wiley India**.**
3.	Schaum's Outline of Fourier Analysis and Applications, **McGraw-Hill.**
4.	**Murray R. Spiegel, John Schiller and R. Alu Srinivasan,** Schaum's Outline of Probability and Statistics, **McGraw-Hill.**
5.	**S. D. Sharma, Operations Research, Kedar Nath Ram Nath Publications.V. Ramana:** "Higher Engineering Mathematics" McGraw-Hill Education, 11th Ed.

Syllabus for Internal Assessment Tests (IAT*)

IAT #	Syllabus
IAT-1	1-24
IAT-2	15-40

*See calendar of events for IAT schedule.

Evaluation: Quiz/Assignment/Seminar/Mini Project/Viva

- ***Evaluation of course delivery is based on any one of the above***
- ***Evaluation guidelines to be provided to help students understand how the evaluation would be done for assignments, quiz, and so on.***
- ***Evaluation tools/method to be mentioned e.g.: Easy polls, Survey Monkey, Type form or inbuilt poll option in video conferencing tool.***
- ***'Work-book' section includes additional activities to support self-learning e.g., exercises, game-based learning, case-study, and so on.***

Evaluation Method	Remarks
No of Assignments given -2	
Assignment 1: Issue Date: 29-09-2026 Submission Date: 25-10-2026 **Assignment 2:** Issue Date: 24-11-2026 Submission Date: 19-12-2026 **Mini Project:**18-12-2026	Assignments and Quiz dates will be decided while teaching the module

Evaluation tools/method	IAT/Assignments/Quiz/Seminar/Group Discussion/Miniproj/MOOC
Flipped Classroom process for students to understand	Flip classes would be conducted for a few topics.

Peer Learning (*teacher should list out the opportunities provided to interact with peers, through discussions & group work).*
Peer learning would be encouraged to acquire a basic understanding and knowledge about the environment and its allied problems.

Discussion Board (*teacher should set up problem-solving forums or discussion boards, and assign students or student teams to monitor and support or direct questions).*
Informal sessions would be arranged for doubts clarification and knowledge enhancement.

Mention the best practices identified as part of teaching this subject
1. **Sharing relevant videos of the concept and its applications** 2. **Make them involved in the subject by asking questions** 3. **Flip classes**

Mention the Importance of this subject along with Real Time Applications
1. **Fourier Series:** Used in signal analysis and communication systems. 2. **Fourier Transform & FFT :** Used in image processing, audio processing, and digital signal processing. 3. **Z-Transform:** Used in digital control systems and discrete-time signal processing. 4. **Linear Programming:** Used for resource allocation, production planning, and optimization. 5. **Transportation & Assignment Models:** Used in logistics, scheduling, and optimal resource distribution.
Course Outcomes (COs)
By the end of this course, students will be able to
CO1: Develop Fourier series representations of periodic functions and perform harmonic analysis for functions with different periodicities, discontinuities, and symmetry properties.
CO2: Apply Fourier transforms, including sine, cosine, discrete Fourier transforms (DFT), and Fast Fourier Transforms (FFT), to analyze signals and solve engineering problems involving differential equations.
CO3: Utilize Z-transforms, their properties, inverse transforms, and convolution techniques to analyze discrete-time systems and solve difference equations.
CO4: Formulate and solve Linear Programming Problems using graphical, simplex, and Big-M methods to obtain optimal solutions in engineering and management applications.
CO5: Apply transportation and assignment models, including optimization techniques such as Vogel's Approximation Method and Hungarian Method, to solve resource allocation and decision-making problems.

Table 02: Program Outcomes (PO) and Program Specific Outcomes (PSO)

Program Outcomes (PO), Program Specific Outcomes (PSO)	
PO1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	**Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4	**Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	**Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	**Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PSO1	Apply principles of electrical and electronic circuit theory to i) design and simulate basic electronic circuits and ii) make use of the measuring instruments including 'digital storage oscilloscope' in elaborate circuit analysis and in the design of analog and digital circuits
PSO2	Apply principles of mathematics, signal processing and communication theory to analyse different types of signals, operations on signals, design and realization of simple systems like digital filters, modulators, demodulators, microwave antennas and resonators and support activities of design of communication engineering and VLSI systems
PSO3	Take part in collaborative and consultancy projects as an electronic design engineer and support diverse tasks of circuit design projects, schedule, quality and efficiency management, and documentation and publication of reports.

CO-PO and CO-PSO Mapping																		
Course Outcomes		**Blooms Level**	**Modules covered**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO 1	Develop Fourier series representations of periodic functions and perform harmonic analysis for functions with different periodicities, discontinuities, and symmetry properties.	**3**	**1**	2	3	2	2	2	2	2	1	1	1	1	1	2	2	2
CO 2	Apply Fourier transforms, including sine, cosine, discrete Fourier transforms (DFT), and Fast Fourier Transforms (FFT), to analyze signals and solve engineering problems involving differential equations..	**3**	**2**	2	3	2	2	2	2	1	1	1	1	1	1	2	2	2
CO 3	Utilize Z-transforms, their properties, inverse transforms, and convolution techniques to analyze discrete-time systems and solve difference equations.	**3**	**3**	2	3	2	2	2	2	1	1	1	1	1	1	2	2	2
CO 4	Formulate and solve Linear Programming Problems using graphical, simplex, and Big-M methods to obtain optimal solutions in engineering and management applications.	**3**	**4**	2	3	2	2	2	1	1	1	1	1	1	1	2	2	2
CO 5	Apply transportation and assignment models, including optimization techniques such as Vogel's Approximation Method and Hungarian Method, to solve resource allocation and decision-making problems	**3**	**5**	2	3	2	2	2	1	1	1	1	1	1	1	2	2	2

Identified curriculum gap if any and Justification:

Identified Gap	Justification
Lack of Application-Oriented Tools	The syllabus focuses mainly on theoretical concepts but provides limited practical exposure to tools such as MATLAB/Python for solving real-world engineering problems.
Limited Integration of Real-World Case Studies	The syllabus has limited coverage of industry-based applications of Fourier transforms, Z-transforms, and optimization techniques, creating a gap between theoretical learning and practical implementation.
Limited Hands-on Problem Solving	The syllabus provides limited opportunities for practical, project-based learning, which is needed to strengthen students' problem-solving and analytical skills through real-world applications.

Proposed Actions to fill the identified gaps:

1. Guest lectures
2. Seminar

Course Instructor Signature/s	CCI Signature	HOD