(For Mechanical Engineering & Allied branches)
Choice Based Credit System (CBCS) and Outcome-Based Education (OBE)SEMESTER – IV

COMPLEX ANALYSIS, PROBABILITY AND LINEAR PROGRAMMING

Course Code	**21MATME41**	CIE Marks	50
Teaching Hours/Week (L: T:P)	(2:2:0)	SEE Marks	50
Credits	03	Exam Hours	03

Course Learning Objectives:

- To provide an insight into applications of complex variables and conformal mapping arising in potential theory, quantum mechanics, heat conduction and fieldtheory.
- To develop probability distribution of discrete, continuous random variables and joint probability distribution occurring in digital signal processing, design engineering and microwaveengineering.
- Analyze and solve linear programming models of real-life situations and learn about the applications to transportation and assignment problems.

Teaching-Learning Process (General Instructions):

These are sample Strategies; which teachers can use to accelerate the attainment of the various course outcomes.

- In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the delivered lessons shall develop students' theoretical and applied mathematical skills.
- State the need for Mathematics with Engineering Studies and Provide real-life examples.
- Support and guide the students for self–study.
- You will also be responsible for assigning homework, grading assignments and quizzes, and documenting students' progress.
- Encourage the students for group learning to improve their creative and analytical skills.

Show short related video lectures in the following ways

- As an introduction to new topics (pre-lecture activity).
- As a revision of topics (post-lecture activity).
- As additional examples (post-lecture activity).
- As an additional material of challenging topics (pre-and post-lecture activity).

As a model solution for some exercises (post-lecture activity).

Module-1

Calculus of complex functions: Analytic functions: Cauchy-Riemann equations in Cartesian and polar forms and consequences. Applications to flow problems

Construction of analytic functions: Milne-Thomson method-Problems. **(8 hours)**

Self-Study: Review of a function of a complex variable, limits, continuity, and differentiability.

(RBT Levels: L1, L2 and L3)

Pedagogy: Chalk and talk method and Powerpoint Presentations

Module-2

Conformal transformations: Introduction. Discussion of transformations

$w = z^2$, $w = e^z$, $w = z + \frac{1}{z}$, $(z \neq 0)$. Bilinear transformations- Problems.

Complex integration: Line integral of a complex function-Cauchy's theorem and Cauchy's integral formula and problems. **(8 hours)**

Self-Study: Residues, Residue theorem – problems

(RBT Levels: L1, L2 and L3)

Pedagogy: Chalk and talk method and Powerpoint Presentations

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Module-3
Probability Distributions: Review of basic probability theory. Random variables (discrete and continuous), probability mass/density functions. Mean-Variance and Standard Deviations of a random variable. Binomial, Poisson, exponential and normal distributions- problems. **(8 hours)** **Self-Study**: Two-dimensional random variables, marginals pdf's, Independent random variables **(RBT Levels: L1, L2 and L3)**
Pedagogy: Chalk and talk method and Powerpoint Presentations
Module-4
Linear Programming Problems (L.P.P): General Linear programming Problem, Canonical and standard forms of L.P.P. Basic solution, Basic feasible solution, Optimal solution, Simplex Method-Problems. Artificial variables, Big-M method, Two-Phase method-Problems. **(8 hours)** **Self-Study:** Formulation of an L.P.P and optimal solution by Graphical Method. **(RBT Levels: L1, L2 and L3)**
Pedagogy: Chalk and talk method and Powerpoint Presentations
Module-5
Transportation and Assignment Problems: Formulation of transportation problems, Methods of finding initial basic feasible solutions by North-West corner method, Least cost method, Vogel approximation method. Optimal solutions-Problems. Formulation of assignment problems, Hungarian method-Problems. **(8 hours)** **Self-Study**: Degeneracy in Transportation problem. **(RBT Levels: L1, L2 and L3)**
Pedagogy: Chalk and talk method and Powerpoint Presentations
Course outcomes: At the end of the course the student will be able to: • Use the concepts of an analytic function and complex potentials to solve the problems arising in fluid flow. • Utilize conformal transformation and complex integral arising in aerofoil theory, fluid flow visualization and image processing. • Apply discrete and continuous probability distributions in analyzing the probability models arising in the engineering field. • Analyze and solve linear programming models of real-life situations and solve LPP by the simplex method • Learn techniques to solve Transportation and Assignment problems.
Assessment Details (both CIE and SEE) The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together **Continuous Internal Evaluation:** Three Unit Tests each of **20 Marks (duration 01 hour)** First test at the end of 5th week of the semester Second test at the end of the 10th week of the semester Third test at the end of the 15th week of the semester Two assignments each of **10 Marks** First assignment at the end of 4th week of the semester Second assignment at the end of 9th week of the semester Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks (duration 01 hours)** At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

The question paper will have ten questions. Each question is set for 20 marks. Marks scored shall be reduced proportionally to 50 marks

There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:

Text Books:

- B. S. Grewal: "Higher Engineering Mathematics", Khanna publishers, 44th Ed.2018
- E. Kreyszig: "Advanced Engineering Mathematics", John Wiley & Sons,10th Ed. (Reprint),2016.
- S.D. Sharma: "Operations Research" Kedarnath Publishers Ed. 2012

Reference Books

- V. Ramana: "*Higher Engineering Mathematics*" McGraw-Hill Education,11th Ed.
- Mokhtar S.Bazaraa, John J.Jarvis & Hanif D.Sherali(2010*), Linear Programming and Network Flows(* 4th *Edition), John Wiley & sons.*
- G.Hadley (2002) *Linear Programming, Narosa Publishing House*
- F.S. Hillier, G.J. Lieberman: Introduction to Operations Research- Concepts and Cases, 9th Edition, Tata Mc-Graw Hill, 2010.
- Srimanta Pal & Subodh C. Bhunia: "Engineering Mathematics" Oxford University Press,3rdReprint, 2016.
- N.P Bali and Manish Goyal: "A textbook of Engineering Mathematics" Laxmi Publications, Latest edition.
- C. Ray Wylie, Louis C. Barrett: "Advanced Engineering Mathematics" McGraw – Hill Book Co. New York, Latest ed.
- H.K. Dass and Er. RajnishVerma:"Higher EngineeringMathematics"S.ChandPublication(2014).

Web links and Video Lectures (e-Resources):

- http://.ac.in/courses.php?disciplineID=111
- http://www.class-central.com/subject/math(MOOCs)
- https://www.coursera.org/learn/operations-research-modeling
- https://www.careers360.com/university/indian-institute-of-technology-madras/introduction-operations-research-certification-course
- http://people.whitman.edu/~hundledr/courses/M339.html
- VTU e-Shikshana Program
- VTU EDUSAT Program

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Quizzes
- Assignments
- Seminars