# **Second Semester 2020-2021**

**Course Handout Part II**

Date: 16/01/2021

In addition to part I (General Handout for all courses appended to the time table), this part II provides further details regarding the Complex Analysis MATH F354 course.

**Course Title** : Complex Analysis **Course Number** : MATH F354 **Instructor-In-charge** : Nijjwal Karak

# **Scope and Objective**

In an introductory Calculus course, we study real valued functions of a real variable and associated concepts/definitions such as: continuity, derivative, integration, relation between derivative and integral, intermediate value theorems, Taylor’s series et cetera. Analogously, Complex Analysis is the study of Complex valued functions of a Complex variable. In Complex Analysis, we emulate the various definitions/concepts of Calculus by replacing real numbers by complex numbers. It turns out that analytic features of functions of a complex variable are very intriguing and often they incorporate concepts from geometry, number theory, topology etcetera. The methods and theorems of Complex Analysis are very powerful and elegant. Complex Analysis has many applications in Physics and also in other areas of Mathematics like number theory, functional analysis, geometry etc.

# **Text Books:**

1. J. B. Conway, Functions of One Complex Variable, Springer, 1997

# **Reference Books:**

1. L. V. Ahlfors, Complex Analysis

2. R. E. Rodriguez, I. Kra, J. P. Gilman; Complex Analysis - spirit of Lipman Bers, Graduate Texts in Mathematics No. 245, Second Edition, Springer-Verlag, 2012

3. M. Beck, G. Marchesi, D. Pixton, L. Sabalka, A First Course in Complex Analysis, open textbook (print version published by Orthogonal Publishing), 2002-2018 Available online at <http://math.sfsu.edu/beck/complex.html>

4. Raghavan Narasimhan and Yves Nievergelt, Complex Analysis in One Variable, Sec- ond Edition, Birkhauser, 2000

**Course Plan:**

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| --- | --- | --- | --- |
| Lectures | Learning Objectives | Topics | Chapter in the text book |
| 1-2 | To recall the basic theory of complex numbers | Review of complex numbers and basic definitions from calculus and real analysis | Chapter I |
| 3-5 | To learn several definitions of analytic functions | Analytic functions, power series and Cauchy-Riemann equations | Chapter III (Sections 1-2) |
| 6-9 | To understand conformal mappings | Topology, analytic functions as mappings, conformal mappings | Chapter II and Chapter III (Section 3) |
| 10-12 | To understand the concept of complex integration | Complex integration, power series representation of analytic functions | Chapter IV (Sections 1-2) |
| 13-16 | To learn about zeros of analytic functions | Cauchy’s Estimate, zeros of an analytic function and applications | Chapter IV (Sections 3-4) |
| 17-19 | To prove Cauchy’s theorem and Morera’s theorem | Cauchy’s theorem and integral formula, Morera’s theorem | Chapter IV (Section 5) |
| 20-22 | To prove open mapping theorem and Goursat’s theorem | Open mapping theorem, Goursat’s theorem | Chapter IV (Sections 7-8) |
| 23-28 | To classify the singularities of functions | Singularities, Taylor and Laurent series, calculus of residues | Chapter V |
| 29-31 | To understand Maximum Modulus Theorem and Schwarz’s lemma | Maximum Modulus Theorem, Schwarz’s Lemma | Chapter VI (Sections 1-2) |
| 32-35 | To learn how to factorize an entire function | Riemann mapping theorem, Weierstrass factorization theorem, Mittag-Leffler’s theorem | Chapter VII (Sections 1-6) and Chapter VIII |
| 36-40 | To understand the basic theory of Harmonic functions | Analytic continuation, Harmonic functions, Jensen’s formula | Chapter IX (Sections 1-2) , Chapter X (Sections 1-2) and Chapter XI (Section 1) |

# **Evaluation Scheme:**

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| --- | --- | --- | --- | --- | --- |
| No | Evaluation Component | Duration | Weightage | Date and Time | Nature of Component |
| 1 | Quiz-I | To be announced in the class | 10% | To be announced in the class | Open Book |
| 2 | Mid-semester Test | 90 min | 30% | 03/03 3.30 - 5.00PM | Open Book |
| 3 | Assignment-I | To be announced in the class | 10% | To be announced in the class | Open Book |
| 4 | Quiz-II | To be announced in the class | 10% | To be announced in the class | Open Book |
| 5 | Compre. Exam. | 120 min | 40% | 08/05 FN | Open Book |

**Total Marks:** 100

# **Chamber Consultation Hour:** To be announced in the class.

# **Notices:** General class related announcements will be made in the Google Classroom Page.

# **Make-up Policy:** Make-up for mid-semester/comprehensive examination shall be granted in genuine cases.

# **Academic Honesty and Integrity Policy:** Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.

## Instructor In-charge

## MATH F354