# Course Specification Math 483

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| Institution: Majmaah University |
| College/Department : College of Science in Zulfi/ Mathematics department |

**A Course Identification and General Information**

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| 1. Course title and code: : Complex analysis Math 483 |
| 2. Credit hours: 4(3+1) |
| 3. Program(s) in which the course is offered. Mathematics |
| 4. Name of faculty member responsible for the course: Hedi Hsine Ben Messaoud |
| 5. Level/year at which this course is offered: level eighth, forth year |
| 6. Pre-requisites for this course (if any) Math 202 |
| 7. Co-requisites for this course (if any): |
| 8. Location if not on main campus: |

**B Objectives**

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| 1. **Summary of the main learning outcomes for students enrolled in the course.**   **This module aims to provide students with various kinds of complex analysis.**  **On Completing this module ,student should Understanding to use complex calculus in various situations.**  **The student has the knowledge of**   1. **Complex numbers and their properties, polar form of a complex number, power and roots of a complex number, De Moivre formula. Exponential notation. Complex Exponential Function. The equation exp(z) = 1.** 2. **Trigonometric and hyperbolic Functions. The zeros of trigonometric and hyperbolic function in C.** 3. **Real part and imaginary part of a complex function. Continuity of a complex function. IR-derivability and C-derivability of a complex function at a point. Cauchy-Riemann Conditions. Holomorphic function in an open part of C. Hamonic function.** 4. **Examples of holomorphic function : function defined by a power series. Maximum principle for a holomorphic function and a harmonic function.** 5. **Complex integral on a path of a complex Function. Primitive of a complex function.** 6. **Cauchy s theorem for a triangle, Cauchy s theorem for a star-shaped domain. Cauchy s integral formulas and applications. Taylor series of a holomorphic function.** 7. **Zeros of a holomorphic function. Isolated singularity of a complex function. Pole of a complex function. Laurent series near a pole. Residue.** 8. **Residue theorem in a star-shaped domain. Application: Evaluation of real trigonometric and real improper integrals.** 9. **Conformal mappings, linear Fractional Transformation. Dirichlet s problem.** |
| 2. Briefly describe any plans for developing and improving the course that are being implemented. (eg increased use of IT or web based reference material, changes in content as a result of new research in the field)  - Looking for any new papers and research in this course and looking for new good references  - Making seminars in the department in this field. |

**C. Course Description** (Note: General description in the form to be used for the Bulletin or Handbook should be attached)

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| 1. Topics to be Covered | | |
| List of Topics | No of  Weeks | Contact hours |
| Complex numbers and their properties, polar form of a complex number, power and roots of a complex number, De Moivre formula. Exponential notation. Complex Exponential Function. The equation exp(z) = 1.  Trigonometric and hyperbolic Functions. The zeros of trigonometric and hyperbolic function in C.  . | 3 | 12 |
| Real part and imaginary part of a complex function. Continuity of a complex function. IR-derivability and C-derivability of a complex function at a point. Cauchy-Riemann Conditions. Holomorphic function in an open part of C. Hamonic function | 2 | 8 |
| Examples of holomorphic function : function defined by a power series. Maximum principle for an holomorphic function and a harmonic function | 1 | 4 |
| Complex integral on a path of a complex Function. Primitive of a complex function. Cauchy s theorem for a triangle, Cauchy s theorem for a star-shaped domain. Cauchy s integral formulas and applications. Taylor series of a holomorphic function | 2 | 8 |
| Zeros of a holomorphic function. Isolated singularity of a complex function. Pole of a complex function. Laurent series near a pole. Residue | 2 | 8 |
| Residue theorem in a star-shaped domain. Application : Evaluation of real trigonometric and real improper integrals | 2 | 8 |
| Conformal mappings, linear Fractional Transformation. Dirichlet s problem | 3 | 12 |

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| 2. Course components (total contact hours and credits per semester): | | | | | | | | |
| Credit | | Contact Hours | | | | Self-Study | Other | Total |
| ECTS | **NCCCA** | Lecture | Tutorial | Laboratory | Practical |
| 7 cp | 4 ch | 45 | 15 | 0 | 0 | 76 | 14 | ch150 |

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| 1. Additional private study/learning hours expected for students per week. (This should be an average :for the semester not a specific requirement in each week)   At least 7-8 hours per week study at home independently |
| 4. Development of Learning Outcomes in Domains of Learning  For each of the domains of learning shown below indicate:   * A brief summary of the knowledge or skill the course is intended to develop; * A description of the teaching strategies to be used in the course to develop that knowledge or skill; * The methods of student assessment to be used in the course to evaluate learning outcomes in the domain concerned. |
| **a. Knowledge** |
| We expect from the student to have the knowledge of:   1. Complex numbers and holomorphic function.   2- Complex integral, singularity and poles.   1. Evaluation of real trigonometric and real improper integrals.   4- Conformal Mappings.  5- Boundary-value problems : Dirichet s problem. |
| (ii) Teaching strategies to be used to develop that knowledge   1. Each topic begins with the explanation of various basic ideas giving plenty of examples so that the students can understand the ideas and solve some exercises. Provided with a problem sheets at the beginning of the semester and ask the students to solve these exercises 2. Students are encouraged to ask questions during the lectures and in the tutorial classes to come on the board and solve some given problems 3. Students are advised to go to the Library and consult the relevant books on the topic |
| (iii) Methods of assessment of knowledge acquired   1. Sometime surprise quizzes are given in the class room 2. Homework 3. Two Mid Term exams are conducted one after 5 to 6 weeks of teaching and the other after 12 to 13 weeks of teaching. 4. Final Semester examination. |
| **b. Cognitive Skills** |
| (i) Cognitive skills to be developed   1. Things are tried to explain in the perspective of the students earlier acquired knowledge 2. In each lecture it is thoroughly explained as to why the current topic is being discussed 3. What relationship the current topic has with the previous topic and what should be the natural subsequent topic |
| (ii) Teaching strategies to be used to develop these cognitive skills  Generally diagrams, pictorial notation wherever possible are given to explain the complete and clear ideas |
| (iii) Methods of assessment of students cognitive skills  **Please refer to method of assessments of knowledg** |
| **c. Interpersonal Skills and Responsibility** |
| (i) Description of the interpersonal skills and capacity to carry responsibility to be developed  N/A |
| (ii) Teaching strategies to be used to develop these skills and abilities  N/A |
| (iii) Methods of assessment of students interpersonal skills and capacity to carry responsibility  N/A |
| **d. Communication, Information Technology and Numerical Skills** |
| (i) Description of the skills to be developed in this domain.  Please refer to earlier item 4a knowledge 1-5 |
| (ii) Teaching strategies to be used to develop these skills  Please refer to earlier item 4a knowledge 1-5 |
| (iii) Methods of assessment of students numerical and communication skills  Please refer to earlier item 4a knowledge 1-5 |
| **e. Psychomotor Skills (if applicable)** |
| (i) Description of the psychomotor skills to be developed and the level of performance required  N/A |
| (ii) Teaching strategies to be used to develop these skills  N/A |
| (iii) Methods of assessment of students psychomotor skills  N/A |

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| 5. Schedule of Assessment Tasks for Students During the Semester | | | |
| Assessment | Assessment task (eg. essay, test, group project, examination etc.) | Week due | Proportion of Final Assessment |
| 1 | First Mid Term Examination | 6 | 25% |
| 2 | Second Mid term Examination | 12 | 25% |
| 3 | Tutorial over the whole semester |  | 10% |
| 4 | Final Semester Examination | 16 | 40% |

**D. Student Support**

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| 1. Arrangements for availability of faculty for individual student consultations and academic advice. (include amount of time faculty are available each week)  students are encouraged to come during the office hours (4 hours per week) to discuss their mathematical problems and difficulties they face |

##### E Learning Resources

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| 1. Required Text(s)   (1) W. Rudin : Real and Complex analysis .  (2) John B. Conway : Functions of one Complex variable. Springer 2002  *(3) L ars V. Ahlfors:” Complex Analysis* Mc Graw-Hill 1980 |
| 1. Essential References   1- Dennis G. Zill Patrick D. Shahanan : A First Course in Complex Analysis with applications. Advanced Engineering Mathematics (sd edition). John and Bartlett Publishers. ISBN 07637 1437 2 |
| 3- Any papers or books in the library having the same topics |
| 4-.Electronic Materials, Web Sites etc  http://www.sciencedirect.com/  -<http://www.siam.org//>  <http://www.cmi.univ-mrs.fr//>  <http://www.arxiv.org//>  <http://www.lms.ac.uk/>  <http://www.ams.org/>  http:// mathforum.org/advanced/numerical.html/  <http://www.ingentaconnect.com/> content/  <http://www.zentrablblatt-math.org/> zmath/en/  <http://www.ma.hw.ac.uk> |
| 5- Other learning material such as computer-based programs/CD, professional standards/regulations  N/A |

**F. Facilities Required**

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| Indicate requirements for the course including size of classrooms and laboratories (ie number of seats in classrooms and laboratories, extent of computer access etc.) |
| 1. Accommodation (Lecture rooms, laboratories, etc.)  Lecture rooms must be suitable to the number of students |
| 2. Computing resources  Computer and Projector |
| 3. Other resources (specify --eg. If specific laboratory equipment is required, list requirements or attach list)  N/A |

**G Course Evaluation and Improvement Processes**

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| 1 Strategies for Obtaining Student Feedback on Effectiveness of Teaching  At the end of the semester feedback is taken from the students on a prescribed Performa |
| 2 Other Strategies for Evaluation of Teaching by the Instructor or by the Department  Departmental meetings, frequent meetings/ consultation among the teaching staffs,  meeting between course coordinators and the tutors |
| 3 Processes for Improvement of Teaching  This may be done from time to time by the course coordinator in consultation with other faculty members teaching this course, and expert opinion may be taken |
| 4. Processes for Verifying Standards of Student Achievement (eg. check marking by an independent faculty member of a sample of student work, periodic exchange and remarking of a sample of assignments with a faculty member in another institution)  The course material and knowledge acquired by the students are periodically reviewed and changes if necessary are approved by the department  **Please refer to The Salient features** |
| 5 Describe the planning arrangements for periodically reviewing course effectiveness and planning for improvement.  The chairman and the faculty implement the proposed changes, if any. |

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| Workload with respect to Topics to be cover | | | | | | | | | | | |
| List of Topic | No. of Weeks | Contact hours | | | | Total of contact | Self- Study | | | Discussions | total |
| Lecture | tutorials | Lab | Office Hours | Internet | Library | Homework |
| Complex Numbers - Cartesian and polar representation of complex numbers- powers and roots of complex numbers. | 2 | 6 | 2 |  | 1 | 9 | 2 | 2 | 1 | 1 | 11 |
| Limits and continuity of complex functions-Analytic functions- | 2 | 6 | 2 |  | 2 | 10 | 2 | 4 | 2 | 2 | 20 |
| Exponential, trigonometric - hyperbolic functions and logarithmic functions | 2 | 6 | 2 |  | 2 | 10 | 2 | 4 | 2 | 2 | 20 |
| Mid-term 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| Complex Integration- contour integral -Cauchy’s theorem- Cauchy’s integral formula | 1 | 3 | 1 |  | 1 | 5 | 2 | 2 | 1 | 1 | 11 |
| Cauchy- Riemann equations. Harmonic functions | 4 | 12 | 4 |  | 2 | 20 | 4 | 8 | 4 | 4 | 40 |
| Mid-term 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| Bounds on analytic functions -Taylor and Laurent series-Power series- Zeros and singularities- Residue theory-Applications to real and improper integrals. | 4 | 12 | 4 |  | 2 | 20 | 4 | 8 | 4 | 4 | 40 |
| Review | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 4 |
| Final Exam | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 2 |
| Total | 15 | 45 | 15 |  | 10 | 74 | 16 | 28 | 16 | 16 | 150 |
|  |  | Note: one credit hour is equal 25 – 30 load work hour | | | | | | | | | |