



کراچی یونیورسٹی
University of Karachi
 Department of Mathematics
PHY 510 • Methods of Mathematical Physics II

Time Allowed: 3 hours • Maximum Marks: 80 • Date: Monday, January 7, 2013 • Paper Format: A

Student's Name _____ (in CAPITAL LETTERS using a "marker")

Questions 1-4 constitute the terminal and 5-7 midterm. Each part of **Question 1** is of 4 marks. **Questions 2-7** are of 10 marks each. Note down the time spent on solving each part of question and time spent on revision by making the following "Time Chart" on the answerbook front page (**2 marks**). Time spent on revision must be at least 10% of the total time.

Question No.	1a	1b	1c	1d	2	3	4	5	6	7	Revision
Time (minutes)											

a) DO NOT TURN PAPER AROUND unless the invigilator says: *Start now*

b) This is a closed-book examination. Deposit all BOOKS, NOTES, MOBILE PHONES (switched off), DIGITAL DIARIES and LAPTOPS in the designated area. Remove everything from your desk, except markers, pens, pencils, stapler and calculator.

c) If you want to use a calculator, **it must bear a "sticker"** displaying your NAME and your SEAT NUMBER, large enough so that it is visible from a distance of 5 meters. **Absolutely, NO sharing of calculators.**

d) Use your own material. **Nothing can be borrowed from or given to** a friend.

e) The papers may be of different formats. Therefore, work on your own **without consulting anyone** (We have a record of your seating arrangement).

f) Write your "NAME" on all pages of **your question paper** (5 marks shall be deducted for failing to comply) [NOTHING ELSE SHOULD BE WRITTEN ON THE QUESTION PAPER] and "PAPER FORMAT" on the front page of **your answerbook** (the upper-right-hand corner) and **the Yellow Sheet** using a "marker". Start your work from **Page 2** of your answerbook. The only thing that could be written on the front page is the "Time Chart" (see above) and the "Honor Statement" (see below).

g) The following statement must be copied on the front page of your answerbook and signed (**2 marks**): "My signatures, below, testify that I am the person, whose name and photograph appear on the Admit Card. Upon my honor, I declare that the following work is my own, completed without giving or receiving unacknowledged help, without copying, or the use of any unfair means." Signatures _____

h) This paper contains TWO PAGES (this page and the back page). On invigilator's signal (*Start now*) turn the paper around, check if you have the back page printed, correctly. Last line of the second

page reads: <END>. Start working on the paper, immediately.

i) Put your pens down and your papers turned (so that this page is facing you) and the FRONT PAGE of your answerbook should be facing you as soon as you hear "ALL PENS DOWN". Failure to do as directed shall result in "deduction of 5 marks" from your score.

j) If you use extra copies, it is "**your responsibility**" to write YOUR NAME, COPY NUMBER and all OTHER INFORMATION on each copy used. All the extra copies must be stapled with the main copy, before turning in your paper (you may wish to bring in a stapler with you for this purpose).

k) If you have a question of "Fill in the blanks" in your paper you must write the complete sentence with the filled word underlined.

l) Nobody is allowed to leave the examination hall, **for whatsoever reason**, once the examination has started. Bring your own DRINKING WATER.

m) Students are not allowed to LEAVE THEIR SEATS or STAND UP during the examination. If you have a query, "raise your hand" and someone will help you.

n) All work, including rough work, must be on the official answerbook. No extra sheet may be used.

o) Students are *not* allowed to use RED anywhere. All work (except figures) must be in pen or ballpoint.

p) The result shall be displayed on my homepage on **Monday, January 21, 2013 at 0900h**. DO NOT contact the Course Supervisor. Students are not permitted to see the answerbooks.

q) Anyone found cheating in the examination should be facing disciplinary action, which may result in **EXPLUSION or SUSPENSION** for 2 or more years as per University of Karachi rules. **Absolutely, no conversation among students. DON'T TURN THE PAPER, YET. Wait for "signal" from the invigilator.**

Student's Name _____ (in CAPITAL LETTERS using a "marker")

TERMINAL

- 1-a) List 2 integral transforms, discussed in class. Which one deals with real variables and which one imaginary?
- 1-b) Kronecker delta is a _____ (mixed, contravariant or covariant) tensor of rank ____ (zero, one or two).
An $n \times n$ matrix can be used to represent a tensor of _____ (1^{st} , 2^{nd} , 3^{rd}) rank. Scalars are _____ (covariant, invariant or contravariant) under coördinate transformations.
- 1-c) What is relationship between the eigenvalues of a matrix and its trace?
- 1-d) Let A_q^p and B^r be tensors. What do A_p^p , $A_q^p B^r$ and $A_q^p B^q$ represent? Can we form another product of these tensors?
- 2) Evaluate: $\delta_p^i \delta_j^q \delta_r^m A_{ms}^{ij}$ Write the terms of the indicated sum: X_{1ji}^{ij3} , for $N=3$.
- 3) Solve IVP: $y^{(iv)} = 1$, $y(0) = y''(0) = 0$, while $y'(0) = y'''(0) = 1$
- 4) Find inverse Laplace transform: (a) $\frac{1+4s^2-4s^3}{s^2(4s^2+1)}$, (b) $\frac{1+s}{s^2+s-6}$

MIDTERM

- 5) Prove the following: $\mathcal{L}[F'(t)] = sf(s) - F(+0)$
- 6) Find the eigenvalues and normalized eigenfunctions of the Pauli spin matrix σ_1 , whose elements are given by $(\sigma_1)_{11} = (\sigma_1)_{22} = 0$, $(\sigma_1)_{12} = (\sigma_1)_{21} = 1$
- 7) What rank is the tensor $A_q^p B^q$? Prove your answer, by using law of transformations of tensors.

Web address of this document: http://www.ngds-ku.org/M509-10/Exams509-10/510-12_Paper.pdf
(paper shall be uploaded 12 hours after the examination ends)

Exam paper solution: **Monday, January 21, 2013 at 1600h, i. e., 4: 00 p. m.,
Mathematics Room No. G8**