

**Peer review report by Prof. Michel Waldschmidt and Prof. Sinnou David  
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**Comments on the proposed Post Graduate Diploma in Mathematics to be offered from  
December 2009 for the in-service school teachers**

**General comments:**

The proposed curriculum is ambitious and we have a feeling that it might not be possible to deliver it within a span of thirty working days. The curriculum has enough materials to enhance the knowledge level of the target group. Even if it is delivered in the stipulated time, the students may not be able to grasp as lot of materials on mathematics has been thrown through the tutors of the four modules.

On the delivery of the course it would be better if four hours of lecture delivery and four hours of tutorial in a smaller group everyday are planned. This would mean that a tutor has one lecture each day and four hours direct contact with the students. Tutorials are done in smaller groups so that the tutor has an opportunity to assess the analytical and problem solving skills of the taught.

The tutors should make sure, in spite of the fact that they are teaching the modules in isolation Mathematics is a single subject. The inter-link between various branches of mathematics be explained clearly so that the students get the idea of convergence of these branches. This is important especially for the teachers who could inspire the bright young minds towards mathematics.

On the examination and evaluation process, internal marks could be awarded on the basis of small class tests conducted during the tutorial classes. Given the limited amount of time and the intensive structure of the schedule, assignments cannot be reasonably be assesses and used for evaluation.

Further, every student who fails in the final examination should get a second chance to make good of the initial failure. So before they start the next session, give a chance to write the exams. Perhaps this could be done during the summer recess of the subsequent academic session.

On the credit levels, we are of the feeling that the students have thirty days of eight hours each and course-end examination will earn at the most twenty five credits each year. Therefore by the end of three years, a student would have earned only seventy five credits.

But the requirement to earn a Post Graduate Diploma is one hundred twenty credits (The Wheel of Academic Law – Chapter B8 – 5.1.2 Pp63). Some mechanism has to be devised to bridge the gap of forty five credits. Further, the incumbents are not graduates in mathematics and the name “Post Graduate Diploma” could be reconsidered and renamed to suit the credit levels achieved by the students.

### **Module Specific Comments**

- The present Algebra II course is too heavy for the level of the target group. Homomorphism, automorphism and Cayley’s theorem could be omitted. Introduce number theory, integer modulo  $n$ , properties of  $Z$  and quotients of  $Z$  (integer modulo, divisibility, residue, LCM, GCD, Euclidean algorithm and up to Chinese remainder theorem). Polynomial rings over a field with the same properties of  $Z$  be included. Algebra II be swapped with Algebra III and keep the contents of the latter as it is.
- In Geometry I, instead of dividing the conics into different types, introduce equations of degree one and equations of degree two. First part deals with the straight lines and the second part deals with the conics. Tangents and normal be dealt for general second degree conics and special cases be deduced from the general case. Introduce geometrical representation of complex numbers and explain their properties. Let there be introduction on affine geometry and bary-centers and the link between these two geometries be established through transformation.
- In Geometry II, the study of three dimensional objects be restricted only up to tangent planes, intersection with planes and straight lines. Relate these topics to Geometry I and draw their attention towards making comparisons and parallel conclusions. Give a brief introduction to projective geometry and stereographic projection – transformation and re-scaling.
- In Calculus I, delete units III and IV and bring sequences and Taylor’s series from Analysis I. Include truncated series expansion.
- In Analysis I, add complex numbers and explain their interlinks in the branches of Mathematics like Algebra, Analysis and Geometry. Also add real and complex sequences.

- In Analysis II, remove infinite series convergence tests part and include simple examples of residue theorem with power series and introduce multi variable calculus up to two independent variables and explain implicit function theorem.
- In Differential Equations, Fixed Point Theorem to be included.
- In Financial Mathematics, introduce exponential functions and their properties.
- In Statistics, move elementary probability to the beginning and include law of large numbers. At least one discrete distribution – preferably binomial distribution – be included.
- Rest of the modules may be kept as they are.

### **Conclusions**

With these changes, we feel that the course would be complete and could improve the knowledge levels and understanding of the target group. The skepticism of delivery and complete understanding by the audience still prevails with us. In order to address this issue and to make the students earn more credits, some lectures could be recorded and given to the students so that they do their home work before coming for the subsequent session.

Hope the course goes well and serves the purpose. Our wishes and possible support is always with the Royal University of Bhutan. We will explore and direct the interested professors from our university who are willing to extend their expertise in this area to the Director of Sherubtse College.

Recorded by R.Balamurugan during the discussion held on the 1<sup>st</sup> of December 2008.

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