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Course outline

Instant Hangout

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Commutative Algebra

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ABOUT THE COURSE:

Commutative algebra is essentially the study of the rings occurring in algebraic number theory andalgebraic geometry.In algebraic number theory, the rings of algebraic integers in number fields constitute an importantclass of commutative rings — the Dedekind domains. This has led to the notions of integralextensions and integrally closed domains.The notion of localization of a ring (in particular the localization with respect to a prime ideal leadsto an important class of commutative rings — the local rings.The set of the prime ideals of a commutative ring is naturally equipped with a topology — theZariski topology. All these notions are widely used in algebraic geometry and are the basic technicaltools for the definition of scheme theory — a generalization of algebraic geometry introduced byGrothendieck.The main purpose of this course is to provide important workhorses of commutative algebraassuming only basic course on commutative algebra. Special efforts are made to present the conceptsat the center of the field in a coherent, tightly knit way, streamlined proofs and a focus on the coreresults. Virtually all concepts and results of commutative algebra have natural interpretations. Itis the geometric view point that brings out the true meaning of the theory. The main focus in thecourse are the folloing core results :• Noether's Normalisation.• Dimension theory.• Homological characterisation of Regular local rings.• Discrete Valuation rings and Dedekind Domains.Apart from deepening the knowledge in commutative algebra, participants of this course areprepared to continue their studies in different directions, for example, algebraic geometry. Anotherpossible direction to go in computational aspects of commutative algebra.

INTENDED AUDIENCE: ME / MSc / PhD

CORE/ELECTIVE: Elective

UG/PG: PG

PREREQUISITES: Linear Algebra ;Algebra – First Course ;Commutative Algebra – Basic Course ;Homological Algebra – Elementary Level

INDUSTRY SUPPORT: None

ABOUT THE INSTRUCTOR:

Dilip P. Patil received B. Sc. and M. Sc. in Mathematics from the University of Pune in 1976 and1978, respectively. From 1979 till 1992 he studied Mathematics at School of Mathematics, TataInstitute of Fundamental Research, Bombay and received Ph. D. through University of Bombay in1989. Currently he is a Professor of Mathematics at the Departments of Mathematics, Indian Instituteof Science, Bangalore. At present he is a Visiting Professor at the Department of Mathematics,IIT Bombay. He has been a Visiting Professor at Ruhr-Universität Bochum, Universität Leipzig,Germany and several universities in Europe and Canada. His research interests are mainly inCommutative Algebra and Algebraic Geometry.

COURSE LAYOUT:

Week 1 : Noether's Normalisation Lemma — Classical Version
Week 2 : Noether's Normalisation Lemma — Classical Version
Week 3 : Dimension of Graded Rings and Modules
Week 4 : Digression on Basic Concepts
Week 5 : Dimension Theorem
Week 6 : Krull's Principal Ideal Theorem and its Generalisation
Week 7 : Digression on the Language of Algebraic Geometry
Week 8 : Regular Local Rings
Week 9 : Homological Dimension of Modules and Global Dimension of Rings
Week 10 : Homological Characterisation of Regular Local Rings
Week 11 : Discrete Valuation Rings
Week 12 : Dedekind Domains

SUGGESTED READING MATERIALS:

Atiyah, M. F. ; Macdonald I. G. : Introduction to Commutative Algebra, Addison-Wesley,London, 1969.[2] Eisenbud, D. : Commutative Algebra With a View Towards Algebraic Geometry, GTM 150,Springer, New York/Berlin/Heidelberg, 1995.[3] Nagata, M. : Local Rings, Wiley, New York, 1962.[4] Patil, D. P. ; Storch, U. : Introduction to Algebraic Geometry and Commutative Algebra,IISc Lecture Notes Series, No. 1, IISc Press/World Scientific Publications Singapore/Chennai,2010. — Indian Edition Published by Cambridge University Press India Pvt. Ltd. 2012.[5] Raghavan, S. ; Singh, B. and Sridharan, R. : Homological Methods in Commutative Alge-bra, TIFR Mathematical Phamphlet No. 5 (Oxford University Press), 1975.[6] Serre, J. -P. : Local Algebra, Springer Monographs in Mathematics,Springer, Berlin/Heidelberg, 2000.[7] Singh, B. : Basic Commutative Algebra, World Scientific Publications Singapore, 2011.

CERTIFICATION EXAM :

- The exam is optional for a fee.
- Date and Time of Exams: **April 28 2019(Sunday).** Morning session 9am to 12 noon; Afternoon Session 2pm to 5pm.
- Registration url: Announcements will be made when the registration form is open for registrations.
- The online registration form has to be filled and the certification exam fee needs to be paid. More details will be made available when the exam registration form is published.

CERTIFICATION:

- Final score will be calculated as : 25% assignment score + 75% final exam score
- 25% assignment score is calculated as 25% of average of Best 8 out of 12 assignments
- E-Certificate will be given to those who register and write the exam and score greater than or equal to 40% final score. Certificate will have your name, photograph and the score in the final exam with the breakup.It will have the logos of NPTEL and IIT Bombay.It will be e-verifiable at nptel.ac.in/noc.