Indian Institute of Technology, Kanpur
Proposal for a new course

Course No.: MTH 6XX/7XX (PG level) - MTH 619

Course Title: Representation theory of quivers

Pre-requisites: Instructor's consent. However, knowledge of linear algebra (MTH204) and abstract algebra (MTH201) will be assumed.

Aims of the course: Around half a century ago, representations of quivers (directed graphs with the possibility of loops and parallel arrows) were originally introduced and studied by Gabriel, where he completely classified finite dimensional hereditary associative algebras that have only finitely many (iso-classes of) indecomposable modules using Dynkin diagrams that were previously used in the classification of finite dimensional semisimple Lie algebras. The utility of the quiver-theoretic techniques in the representation theory of finite groups was essentially demonstrated by Gel'fand and Ponomarev. In fact, representation theory of quivers became a synonym for the representation theory of finite-dimensional associative algebras during the development of Auslander-Reiten theory. The current century has seen exponential growth in the literature on quivers and related topics, especially due to connections with cluster algebras and topological data analysis.

The basic aim of this course is to give a self-contained introduction to this interesting branch of representation theory, where the necessary preliminaries from module theory over non-commutative rings and homological algebras will be covered. After successful completion of the course, the students will be equipped to read recent literature and tackle problems in the field.

Credits: 3-0-0-0 [9]

Semester: Odd Semester

Department/IDP: Mathematics and Statistics

Other departments which may be interested: PHY, CSE

Instructor: Amit Kuber

Course contents:

1. Quivers and representations: definitions, examples, category of representations, classification problem, special representations: simple, projective and injective [4 lectures]
2. Gabriel's theorem: root systems and Weyl groups, Dynkin diagrams, reflection functors, quadratic form, Coxeter functors [9 lectures]
3. Modules over associative algebras: associative algebras, Jacobson radical, local algebras, indecomposability, primitive idempotents, basic and connected algebras [4 lectures]
4. Bound quiver algebras: path algebras for quivers, arrow ideal, admissible ideals, bound quiver algebras, modules are representations and vice versa [4 lectures]
5. Auslander-Reiten quivers: ideals in module categories, radical of the module category and its powers, irreducible morphisms, A-R quiver examples [3 lectures]
6. Homological algebra: Hom-functors, duality, chain complexes and exact sequences, homology, projective and injective modules, resolutions and presentations, global dimension, Ext functor, tensor products and Hom-tensor adjunction [7 lectures]
7. Auslander-Reiten theory: Nakayama functor, A-R translate, stable categories, A-R sequences, A-R formulas, Coxeter transformation [7 lectures]
8. Representation types of finite-dimensional algebras [3 lectures]

Recommended texts/references:

1. Schiffler, Ralf. Quiver representations. (2014). CMS Books in Mathematics, Springer.

2. Auslander, M., Reiten, I., & Smalo, S. (1995). Representation Theory of Artin Algebras (Cambridge Studies in Advanced Mathematics). Cambridge: Cambridge University Press.
3. Assem, I., Skowronski, A., & Simson, D. (2006). Elements of the Representation Theory of Associative Algebras: Techniques of Representation Theory (London Mathematical Society Student Texts). Cambridge: Cambridge University Press.
4. Crawley-Boevey W., Lectures on representations of quivers. Available at https://www.math.uni-bielefeld.de/~wcrawley/quivlecs.pdf
5. Krause, H., Representations of quivers via reflection functors, Lecture notes available at https://arxiv.org/abs/0804.1428

Dated: 10/01/2025

Proposer: Amit Kuber

This course is approved/not approved

Convener, DPGC Maths and Stats

This course is approved/not approved

Chairman, SPGC

PGDesk-IITK-DOAA

From: spgc <spgc@iitk.ac.in>
Sent: 22 February 2025 13:09
To: Pgdesk
Cc: Course Related Data; DPGC Math
Subject: Fwd: New Math and Stats PG course proposal: Representation theory of quivers

Follow Up Flag: Follow up
Flag Status: Flagged

Categories: Orange Category, Green Category, Blue Category

@pgdesk: for next SPGC meeting please.

Regards,

Sudhanshu
Chairperson, SPGC

-------- Original Message --------

Subject: Fwd: New Math and Stats PG course proposal: Representation theory of quivers
Date:2025-02-20 14:38
From:"DPGC, Math and Stat" <dpgc_math@iitk.ac.in>
To: Spgc <spgc@iitk.ac.in>
Copy: Pgdesk <pgdesk@iitk.ac.in>, Courses <courses@iitk.ac.in>, AMIT KUBER <askuber@iitk.ac.in>

Dear SPGC Chair,

Could you please put the course proposal below as an agenda item for the next SPGC meeting?

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Best,
Sudhanshu

Office: FB 560

Call: +91-512-XXX-7834
[XXX could be 259, 333, 679]

--------Original Message --------

Subject: New Math and Stats PG course proposal: Representation theory of quivers

Date:20-01-2025 21:50
From:"DPGC, Math and Stat" <dpgc_math@iitk.ac.in>
To: Acadstaff <acadstaff@lists.iitk.ac.in>
Copy:askuber@iitk.ac.in

Dear colleagues,

Here is a link to the proposal for a new Math & Stat PG course by Professor Amit Shekhar Kuber.

https://iitk.ac.in/doaa/data/NewCourses/Course-proposal-MTH6XX-Representation-theory-of-quivers.pdf

Please provide your feedback to askuber@iitk.ac.in with CC to dpgc_math@iitk.ac.in by February 12, 2025.

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Best,
Sudhanshu

Office: FB 560

Call: +91-512-XXX-7834
[XXX could be 259, 333, 679]

INDIAN INSTITUTE OF TECHNOLOGY KANPUR
POSTGRADUATE OFFICE

No. A(P)/IITK/course approval/
March 25, 2025

The Convener, DPGC
Departments of **DOMS/MTH/SEE**
IIT Kanpur

I am directed to communicate the concurrence of the SPGC (2024-25) in its 6th meeting held on 27/02/2025 for the approval of new/modification PG course proposal. After detailed discussion the following courses were approved.

Course No	Title	Credits	Instructor	SPGC Decision
DMS613	Introduction to Mathematical Finance	3-0-0-0-[9]	Dr. Sourav Majumdar	Approved
MBA644	Cyber Security and Privacy for Managers	3-0-0-1-[10]	Dr. Sourya Joyee De	Approved
MBA788M	Monte Carlo Methods in Finance	3-0-0-1-[5]	Dr. Sourav Majumdar	Approved
MBA789M	Management Sciences	3-0-0-1-[5]	Dr. Harshal Rajan Mulay	Approved
MBA790M	Private Equity, Venture Capital and other Alternative Assets	3-0-0-1-[5]	Dr. Harshal Rajan Mulay	Approved
MTH619	Representation theory of quivers	3-0-0-0-[9]	Dr. Amit Kuber	Approved
SEE627	Electric Mobility [Modification]	3-0-0-2-[11]	Dr. Amarendra Edpuganti	Approved

Joint/Assistant Registrar
Academic Affairs

CC: OARS (DOAA Office) For necessary action

MINUTES
FOR THE 6th MEETING OF THE SENATE POSTGRADUATE COMMITTEE (2024-25) HELD
ON February 27, 2025 (Thursday) AT 11:00 AM
CONFERENCE ROOM (208), ACADEMIC AFFAIRS BUILDING

Members Present: Prof(s): D. Chaitanya Kumar Rao on behalf P M Mohite (AE), Suresh Kumar (BSBE), Basker Sundararaju (CHM), Ark Verma (CGS), Gourabananda Pahar (CE), Soumik Das on behalf of Dipin S Pillai (CHE), J Ramkumar (DES), Sukumar Vellakkal (ECO), Imon Mondal (EE), Animesh Mandal (ES), Rajarshi Sengupta (HSS), Subhankar Mukherjee (DoMS), Anikesh Pal (ME), Sudhanshu S Singh (MSE), Pritam Chakraborty (MSP), Sudhanshu Shekhar (MATH), Sagar Chakrabarty (PHY), Kunal P Mooley (SPASE), Prabodh Bajpai (SEE)

Members Absent: Prof(s), Piyush Rai (CSE), Pankaj Wahi (NET), Sapam Ranjita Chanu (PSE)

Senate Nominee : Prof. Abheejeet Mohapatra

Student representatives: Saurabh Sona Lahamate (231250121

(A) Ratification of minutes of 5th SPGC meeting held on January 24, 2025

No comments were received. Minutes is confirmed

(B) Item requiring SPGC Approval

a) New course approval

Course No	Title	Credits	Instructor	SPGC Decision
DMS613	Introduction to Mathematical Finance	3-0-0-0-[9]	Dr. Sourav Majumdar	Approved
MBA644	Cyber Security and Privacy for Managers	3-0-0-1-[10]	Dr. Sourya Joyee De	Approved
MBA788M	Monte Carlo Methods in Finance	3-0-0-1-[5]	Dr. Sourav Majumdar	Approved
MBA789M	Management Sciences	3-0-0-1-[5]	Dr. Harshal Rajan Mulay	Approved
MBA790M	Private Equity, Venture Capital and other Alternative Assets	3-0-0-1-[5]	Dr. Harshal Rajan Mulay	Approved
MTH619	Representation theory of quivers	3-0-0-0-[9]	Dr. Amit Kuber	Approved
SEE627	Electric Mobility [Modification]	3-0-0-2-[11]	Dr. Amarendra Edpuganti	Approved

b) Termination under 5.7

S. No	Roll No	Name	Dept.	Prog.	Supervisor & DPGC Recommendation	SPGC Decision
1.	241250026	Jatin Chaudhary	DOMS	MBA	Recommended	Approved to be reported to Senate
2.	241010003	Adhikari Thakur Prasad Das	AE	MTech	Recommended	Approved to be reported to Senate

c) Full Time to Part-Time

S. No	Roll No	Name	Dept	Prog	Supervisor and DPGC Recommendation	Remark	SPGC Decision
1.	231040115	Swati Gupta	EE	MTech	Recommended	CU=78 TU=54 CPI=9.38 NOC - attached	Approved
2.	231040036	Bingi Poojari Venkatesh	EE	MTech	Recommended	CU=78 TU=54 CPI=9.38 NOC - attached	Approved

Sudha