## School of Liberal Studies Ambedkar University Delhi

# **Course Outline**

### Time Slot: Tuesday 9-11, Thursday 1.45-3.45

Course Code: SLS2EC232

Title: Networks: Theory and Applications

Type of Course: Elective

Cohort for which it is compulsory: None

Cohort for which it is elective: MA Economics

No of Credits: 4

Semester and Year Offered: 4th Semester, Winter 2018

Course Coordinator: Rajendra P. Kundu

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**Pre-requisites**: High school mathematics, basic statistics and probability, basic game theory. Apart from these the course would be self-contained. However, students will be expected to work with mathematical models and analytical reasoning. Knowledge of economics at the undergraduate level would help in better appreciation of the material.

**Aim**: The objective of this course is to introduce the tools for the study of networks and to show, using those tools, how certain common principles permeate the functioning of these diverse networks. While we draw on studies from a wide variety of academic disciplines our primary focus would be on economic analysis of the issues involved in the study of networks.

The course begins with some empirical background on networks, and an overview of concepts used to describe and measure networks. We will then discuss a series of models of how networks impact behaviour, including contagion, diffusion, learning, and peer influences. Finally, we will cover a set of models of how networks form, including random network models as well as strategic formation models.

#### **Brief description of modules/ Main modules:**

1. Introduction and Empirical Background [3-4 lectures]

The course will begin with an informal discussion on what networks are and why they are important followed by a presentation of data on some real world networks. Similarities and differences in the empirical properties of different networks would be highlighted here with the objective of offering an explanation of these empirical observations in the later part of the course.

Some familiarity with basic statistics (idea of a random variable, frequency distribution, measures of central tendency and dispersion) may come in handy.

Readings:

EK (Chapters 1 - 4), MJ (Chapters 1, 3)

Other Readings:

Granovetter M. 1973. The strength of weak ties. Am. J. Sociology. 78: 1360 – 80.

Padgett, J.F., and C.K. Ansell (1993) Robust Action and the Rise of the Medici, 1400–1434, American Journal of Sociology 98:1259–1319.

2. Definitions and Measures [4-5 lectures]

This part of the course will introduce all concepts which are necessary for a formal description of network structures and then would go on to discuss some important network measures. This essentially would be a basic introduction to graph theory and its use in network analysis.

Familiarity with sets, relations and graphs would be useful.

Readings: EK (Chapters 1 - 4), MJ (Chapters 2)

#### 3. Introduction to Game Theory [4-5 lectures]

Some basic concepts of game theory required for analysis of the strategic issues involved in networked interactions will be introduced at this stage.

All concepts will be developed in the lectures. Prior knowledge of game theory will help in better appreciation of some of the optional readings.

Readings: EK (Chapters 6,7, 9)

4. Networks and Behaviour [6-7 lectures]

This topic would introduce some models to develop an understanding of how networks influence behaviour. The objective here is to study contagion, diffusion, learning, and peer influences and to see how economic activities are affected by these phenomena. Some models of networked interactions in the context of labour markets, public goods, investments in R&D, insurance, trade etc. will be covered in this part.

The models discussed here build upon the concepts introduced in topics 2 and 3.

Readings:

EK (Chapters 10-12, 16, 17, 19) MJ (Chapters 7-10)

Bala, Venkatesh, and Sanjeev Goyal. Learning from neighbours. The Review of Economic Studies 65, no. 3 (1998): 595-621.

Bala, Venkatesh, and Sanjeev Goyal. Conformism and diversity under social learning. Economic Theory 17, no. 1 (2001): 101-120.

Bramoulle, Yann, and Rachel Kranton. "Public goods in networks." Journal of Economic Theory 135, no. 1 (2007): 478-494.

Calvo-Armengol, Antoni, and Matthew O. Jackson. The effects of social networks on employment and inequality. The American Economic Review 94, no. 3 (2004): 426-454.

Furusawa, Taiji, and Hideo Konishi. Free trade networks. Journal of International Economics 72, no. 2 (2007): 310-335.

#### 5. Network Formation [6-7 lectures]

Finally, some models which analyse formation of networks would be taken up. The discussion would begin with models of random network formation highlighting the fact that properties of many real world networks (discussed earlier) often deviate from the properties of random networks. One possible explanation of this divergence is the fact that incentives (disincentives) created by network structures influence how agents form links. Hence the need for other models. Here models of strategic network formation would be introduced and would be followed by a discussion on how network structures and behaviour are likely to evolve together over time.

This part of the course would build upon topics 2, 3 and 4. Some familiarity with probability and distribution may be helpful.

Readings: EK (Chapters 16, 18, 19, 20) MJ (Chapters 4, 5, 11)

Jackson, Matthew O., and Asher Wolinsky. A strategic model of social and economic networks. Journal of economic theory 71, no. 1 (1996): 44-74.

Bala, Venkatesh, and Sanjeev Goyal. A noncooperative model of network formation. Econometrica 68, no. 5 (2000): 1181-1229.

Assessment Details with weights: Class tests: 3 tests with 1/3 weightage each.