5 -Year Integrated M.Sc. Programme in Quantitative Economics and Data Science

Centre for Quantitative Economics and Data Science
Birla Institute of Technology Mesra
Ranchi-835215, Jharkhand

Revised Course Structure and Curriculum (R1)

1. Program Highlights:

- Admission Criteria: Indian students - Based on AIR in JEE-Main through CSAB (Central Seat Allocation Board) / JoSAA (Joint Seat Allocation Authority). NRI/OCI/ Foreign National (FN) – Based on marks obtained by the candidates in Class 12 / equivalent qualifying examination
- Students will get a degree of Integrated M.Sc. QEDS after completing the 5th year if required eligibility is fulfilled.

1.1. Centre's Vision

To become a globally recognized Centre of excellence in teaching and research by producing academicians, professionals, and innovators to create a better world where a profound understanding of the field of Quantitative Economics and Data Sciences drives positive change in business and society.

1.2. Centre's Mission

• To set-up a world-class Quantitative Economics and Data Science centre by producing original & robust research insights, delivering high-quality & evidence-based education and engaging with people & organisations worldwide, across the private & public sectors, who are motivated to transform the world by tackling real world challenges.

• To intellectually transform students for productive and stimulating careers by providing them a strong grasp of fundamentals through a diverse living environment, exposure to new ideas and interaction with people who come from different walks of life and have evolving identities.

1.3. Programme Outcomes (POs)

A graduate of this program is expected to gain:

1. Knowledge: attainment of in-depth understanding of basic principles and concepts of Economic theories and Data Sciences to facilitate their applications in fields related to economics, mathematics, statistics, finance, and others.

2. Problem Analysis: be capable of searching for new research questions, analysing data, apply latest methodologies, and develop insights using the results obtained to solve real-life problems.

3. Design/Development of Solution: be able to ask difficult questions, explore unfamiliar terrain, and indulge in the passion for discovery to arrive at innovative solutions, while keeping in mind public health and safety, and the cultural, societal, and environmental considerations.

4. Conduct Investigations of Complex Problems: ability to actively engage with accepted thinking and constantly questioning the relevance, impact, and potential of different positions.

5. Modern Tool Usage: Able to think critically and strategically to apply innovations in data analytics by incorporating visual analytics, predictive models, as well as recent advances in computational and machine learning tools.

6. The Professional and Society: ability to understand the socio-economic dynamics of societies to shape critical academic achievement; collective obligation; critical consciousness.

7. Environment and Sustainability: understand the scientific and economic dimensions of environmental issues and apply the practical tools of analysis and quantitative methods for a sustainable future.

8. Ethics: develop an understanding of how psychological, organizational, and cultural forces influence ethical behaviour and explore ways to nurture the ethical behaviours.

9. Individual and Team Player: demonstrate the ability to work together with others in a group while taking accountability as an individual, a member or a leader of a team in a multi-disciplinary setting.

10. Communication skills: ability to express his/her ideas and findings in the right way for the right audience as thorough professionals.

11. Project Management and Finance: demonstrate active decision-making skills to manage projects that involve economic, legal, and ethical responsibilities to multiple parties.

12. Lifelong Learning: Engage in mastering new skills and knowledge for keeping pace in a world where automation technologies are reshaping roles and institutions.

1.4. Programme Specific Outcomes (PSOs)

a. **PSO 1:** Apply in-depth knowledge gained during the Integrated Quantitative Economics and Data Analytics program in order to become society's most innovative thinkers, leaders, and doers.
b. **PSO 2:** Apply modern technical tools of empirical analysis and mathematical methods to be successful assets in workplace to foster intellectual, social, and personal transformations.
c. **PSO 3:** Capable of using his/her knowledge of Quantitative Economics and Data Sciences to usher development at the frontiers of research.

1.5. Program Educational Objectives (PEOs)

a. PEO1. To provide a well-founded educational base as well as well-resourced learning environment in Quantitative Economics and Data Sciences for formulating and analysing real-world problems with a sustainable approach.
b. PEO2. To enable students to take up the fundamental and genuine challenges of Data in the current era for better analytical approaches to assimilating data, and demonstrative applications in various fields such as economics, mathematics, statistics, finance, and others, from the convergence of third paradigm technologies point of view.
c. PEO3. To train the students in analytical decision making and strategic policy formulation for organizations in domains like Banking, Finance, Energy, Technology, Environment, Healthcare etc.
d. PEO4. To equip the students with the tools of analytical and computational skills in Quantitative Economics and Data Sciences.
e. PEO5. To develop a deep understanding of the theory and practice for building a strong academic-industrial relationship, with a focus on collaboration projects, including research-data partnerships.
f. PEO6. To nurture and nourish strong communication and interpersonal skills for working in a team as well as upholding ethical standards.

2. Academic Details

Undergraduate Programme (Semesters I - VI)								
Semester/ Session of Study		Category of Structure	Course Code	Subjects	Mode of delivery and credits: L- Lecture T- Tutorial P- Practical			Total Credits
					L (Periods/ week)	T (Periods/ week)	P (Periods /week)	
FIRST MONSOON/ SEMESTER I	THEORY							
		PC (Program Core)	ED101	Introductory Analysis	3	1	0	4
			ED103	Statistical Methods - I	3	0	0	3
			ED105	Introduction to Economics and Essential Mathematics	3	0	0	3
			ED107	Probability I	3	1	0	4
		Generic Elective (GE)	ED109	Introduction to Programing and Data Structure	3	0	0	3
		Humanities and Social Sciences (HSS)	MT132	Communication Skill 1	0	0	3	1.5
	LABORATARIES							
		MC	MC 105/106/107/ 108	Choice of: NCC/NSS/ PT & Games / Creative Arts (CA)	0	0	2	1
		PC	ED104	Statistical Methods – I Lab	0	0	3	1.5
		GE	ED110	Introduction to Programing and Data Structure Lab	0	0	3	1.5
Total (Semester I)								22.5

SECOND SPRING/ SEMESTER II	**THEORY**							
		PC	**ED111**	**Intermediate Analysis**	**3**	**1**	**0**	**4**
			ED113	**Statistical Methods II**	**3**	**1**	**0**	**4**
			ED115	**Introductory Microeconomics**	**3**	**1**	**0**	**4**
			ED117	**Linear Algebra andVectors and Matrices**	**3**	**0**	**0**	**3**
		GE	**ED119**	**Programming Language and Data Base Management System**	**3**	**0**	**0**	**3**
		Foundation Science (FS)	**CE101**	**Environmental Science**	**1**	**0**	**2**	**2**
	LABORATORIES							
		MC	**MC 105/106/107/108**	**Choice of: NCC/NSS/ PT & Games / Creative Arts (CA)**	**0**	**0**	**2**	**1**
		PC	**ED114**	**Statistical Methods II Lab**	**0**	**0**	**3**	**1.5**
		PC	**ED120**	**Programming Language and Data Base Management System Lab**	**0**	**0**	**3**	**1.5**
Total (Semester II)								**24**
TOTAL (FIRST YEAR)								***46.5***
THIRD AUTUMN/ SEMESTER III	**THEORY**							
		PC	**ED201**	**Differential Equations**	**3**	**1**	**0**	**4**
			ED203	**Intermediate Microeconomics**	**3**	**1**	**0**	**4**
			ED205	**Introductory Macroeconomics**	**3**	**1**	**0**	**4**
			ED207	**Probability II**	**3**	**1**	**0**	**4**
		GE	**ED209**	**Introduction to Sociology and Political Science**	**3**	**0**	**0**	**3**

		Skill Enhancement Course (SEC)	**ED211**	**Linear Statistical Models and Regression Analysis**	**3**	**0**	**0**	**3**
	LABORATORIES							
		MC	**MC 105/106/107/108**	**Choice of: NCC/NSS/ PT & Games / Creative Arts (CA)**	**0**	**0**	**2**	**1**
		SEC	**ED212**	**Linear Statistical Models and Regression Analysis Lab**	**0**	**0**	**2**	**1**
Total (Semester III)								**24**
FOURTH SPRING/ SEMESTER IV		**THEORY**						
		PC	**ED213**	**Optimization Techniques**	**3**	**1**	**0**	**4**
			ED215	**Intermediate Macroeconomics**	**3**	**0**	**0**	**3**
			ED217	**Stochastic Processes**	**3**	**1**	**0**	**4**
			ED219	**Economic Development and Demography**	**3**	**0**	**0**	**3**
		GE	**ED221**	**Introduction to Psychology**	**3**	**0**	**0**	**3**
		SEC	**ED223**	**Sampling Techniques and Design of Experiments**	**3**	**1**	**0**	**4**
	LABORATORIES							
		MC	**MC 105/106/107/108**	**Choice of: NCC/NSS/ PT & Games / Creative Arts (CA)**	**0**	**0**	**2**	**1**
		PC	**ED218**	**Stochastic Processes Lab**	**0**	**0**	**2**	**1**
		SEC	**ED224**	**Sampling Techniques and Design of Experiments Lab**	**0**	**0**	**2**	**1**

Total (Semester IV)							**24**
TOTAL (SECOND YEAR)							***48***
FIFTH MONSOON/ SEMESTER V		**THEORY**					
		PC	**ED301**	**International Trade**	**3**	**0**	**0**	**3**
			ED303	**Multivariate Data Analysis**	**3**	**0**	**0**	**3**
			ED305	**Basic Econometrics**	**3**	**0**	**0**	**3**
			ED307	**Parametric Inference**	**3**	**0**	**0**	**3**
			MT133	**Communication Skill 2**	**0**	**0**	**3**	**1.5**
		Discipline Specific Elective (DSE)	**DSE-1**	**ED309 Topics on Indian Economy/ ED323 Behavioural Economics/ ED325 Economics of Social Sector**	**3**	**0**	**0**	**3**
			DSE-2	**ED311 Public Economics/ ED327 Environmental Economics-I/ ED329 Open Economy Macroeconomy**	**3**	**0**	**0**	**3**
		LABORATORIES						
		PC	**ED304**	**Multivariate Data Analysis Lab**	**0**	**0**	**2**	**1**
			ED306	**Basic Econometrics Lab**	**0**	**0**	**2**	**1**
			ED308	**Parametric inference Lab**	**0**	**0**	**2**	**1**
Total (Semester V)								**22.5**
		PC	**ED313**	**Nonparametric Methods and Decision Theory**	**3**	**1**	**0**	**4**
			ED315	**Applied Econometrics**	**3**	**0**	**0**	**3**

SIXTH SPRING / SEMESTER VI			**ED317**	**Statistical Machine Learning I**	**3**	**0**	**0**	**3**
			ED319	**Game Theory**	**3**	**1**	**0**	**4**
		DSE	**DSE-3**	**ED321 Financial Economics/ ED331 Money and Financial Institutions/ ED333 Entrepreneurial Economics**	**3**	**1**	**0**	**4**
	LABORATORIES							
		PC	**ED314**	**Nonparametric Methods and Decision Theory Lab**	**0**	**0**	**2**	**1**
			ED316	**Applied Econometrics Lab**	**0**	**0**	**3**	**1.5**
			ED318	**Statistical Machine Learning I Lab**	**0**	**0**	**3**	**1.5**
		Dissertation	**ED300**	**Dissertation**	**-**	**-**	**-**	**6**
Total (Semester VI)								**28**
TOTAL (THIRD YEAR)								***50.5***
GRAND TOTAL FOR THE UNDERGRADUATE (B. Sc. (Hons.)) PART OF THE 5-YEAR INTEGRETAED COURSE **Minimum requirement for the award of the degree *B.Sc. Honors in Quantitative Economics and Data Science* (Semesters I-VI)**								**145**

Postgraduate Programme (Semesters VII-X)

Semester/ Session of study		**Category of Structure**	**Course Code**	**Subjects**	**Mode of delivery and credits: L-Lecture T- Tutorial P-Practical's**			**Total Credits**
					L (Periods /week)	**T (Periods /week)**	**P (Periods /week)**	
	THEORY							
		PC	**ED401**	**Advance Analysis**	**3**	**1**	**0**	**4**
			ED403	**Large Sample Theory**	**3**	**0**	**0**	**3**

SEVENTH MONSOON/ SEMESTER VII			**ED405**	**Time Series Econometrics**	**3**	**0**	**0**	**3**
			ED407	**Statistical Machine Learning II**	**3**	**0**	**0**	**3**
			ED409	**Regression Techniques**	**3**	**0**	**0**	**3**
			ED411	**Advance Microeconomics**	**3**	**0**	**0**	**3**
	LABORATORIES							
		PC	**ED404**	**Large Sample Theory Lab**	**0**	**0**	**3**	**1.5**
			ED408	**Statistical Machine Learning II Lab**	**0**	**0**	**3**	**1.5**
Total (Semester VII)								**22**
EIGHTH SPRING/ SEMESTER VIII	**THEORY**							
		PC	**ED413**	**Advance Optimization**	**3**	**0**	**0**	**3**
			ED415	**Categorical Data Analysis and Statistics in Bayesian Paradigm**	**3**	**0**	**0**	**3**
			ED417	**Algorithms For Big Data I**	**3**	**0**	**0**	**3**
			ED419	**Resampling Techniques and Statistical Computation**	**3**	**0**	**0**	**3**
			ED421	**Developmental Economics**	**3**	**0**	**0**	**3**
			ED423	**Advance Macroeconomics**	**3**	**0**	**0**	**3**
	LABORATORIES							
		PC	**ED416**	**Categorical Data Analysis and Statistics in Bayesian Paradigm Lab**	**0**	**0**	**3**	**1.5**

		PC	**ED418**	**Algorithms For Big Data I Lab**	**0**	**0**	**3**	**1.5**
		PC	**ED420**	**Resampling Techniques and Statistical Computation Lab**	**0**	**0**	**2**	**1**
Total (Semester VIII)								**22**
TOTAL (FOURTH YEAR)								***44***
MONSSON/ SEMESTER IX		**THEORY**						
		PC	**ED501**	**Design and Analysis of Algorithms**	**3**	**0**	**0**	**3**
			ED503	**Randomized Control Trials**	**3**	**0**	**0**	**3**
			ED505	**Cross- section and Panel Econometrics**	**3**	**0**	**0**	**3**
		PE	**Subject Codes would be decided based on selection.**	**Track I/ Track II/ Track III**	**3**	**0**	**0**	**3**
			Subject Codes would be decided based on selection.	**Track I/ Track II/ Track III**	**3**	**0**	**0**	**3**
			Subject Codes would be decided based on selection.	**Track I/ Track II/ Track III**	**3**	**0**	**0**	**3**
		PC	**ED24500**	**Project I**				**6**
	LABORATORIES							
		PC	**ED502**	**Design and Analysis of Algorithms Lab**	**0**	**0**	**3**	**1.5**
			ED504	**Randomized Control Trials Lab**	**0**	**0**	**3**	**1.5**

Total (Semester IX)								**27**
TENTH SPRING/ SEMESTER X		**THEORY**						
		PC	**ED511**	**Project II /Industry Internship**	**0**	**0**	**0**	**7**
		PC	**ED512**	**Comprehens ive Viva**	**0**	**0**	**0**	**2**
Total (Semester X)								**9**
TOTAL (FIFTH YEAR)								***36***
GRAND TOTAL FOR THE POSTGRADUATE (M. Sc.) PART OF THE 5-YEAR INTEGRETAED COURSE **Minimum requirement for the award of the degree 'M.*Sc. in Quantitative Economics and Data Science*' (Semesters VII-X)**								**80**
Minimum requirement for the award of the degree '5-Year Integrated M.*Sc. in Quantitative Economics and Data Science* (Semesters I-X)								**225**

The students of Final year are required to take a total of three courses from the below listed courses in the Ninth semester.

Track I: Economics: - Public Policy, Health Economics, Environmental Economics II, Agricultural Economics, Industrial Economics, Growth Theory, Labour Economics, International Macroeconomics and Policies, and International Finance.

Track II: Finance: -Quantitative Finance, Computational Finance, Corporate Finance, Financial Econometrics.

Track I Economics		**Track II Finance**		**Track III Data Analytics**	
ED507	**Public Policy**	**ED527**	**Quantitative Finance**	**ED535**	**Data Mining and Data Visualization**
ED509	**Health Economics**	**ED529**	**Computational Finance**	**ED537**	**Digital Signal and Image Processing**
ED513	**Environmental Economics II**	**ED531**	**Corporate Finance**	**ED539**	**Social and Economic Networks: Theory and Applications**
ED515	**Agricultural Economics**	**ED533**	**Financial Econometrics**	**ED541**	**Algorithms for Big Data II**
ED517	**Industrial Economics**			**ED543**	**Business Intelligence and Data Engineering**
ED519	**Growth Theory**			**ED545**	**Foundations of Data Science**
ED521	**Labour Economics**			**ED547**	**Big Data Analytics**

ED523	**International Macroeconomics and Policies**			**ED549**	**Introduction to Artificial Intelligence**
ED525	**International Finance**			**ED551**	**Probabilistic Machine Learning**
				ED553	**Deep Learning**

Track III: Data Analytics: - Data Mining and Data Visualizations, Digital Signal & Image Processing, Social and Economic Network: Theory and Applications, Algorithms for Big Data II, Business Intelligence and Data Engineering, Foundations of Data Science, Big Data Analytics, Introduction to Artificial Intelligence, Probabilistic Machine Learning, Deep Learning