



IEOR HANDBOOK

ACADEMIC YEAR 2016-17

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ABOUT THE DEPARTMENT

Industrial Engineering and Operations Research (IEOR) is an academic discipline concerned with making systems more efficient. Often this goal is achieved through the use of modelling and other computational methods.

Industrial Engineering and Operations Research (IEOR) at IIT Bombay offers research based M. Tech., Ph.D. and M.Sc.–Ph.D. dual degree programmes, and is actively involved in research (including sponsored projects), consulting and continuing education. The discipline offers a blend of theory, modelling and application, drawing from traditional as well as modern areas of operations research, together with a systems view derived from long-standing principles of industrial engineering. This approach provides a backdrop for technically sound decisions at operational and tactical levels and occasionally at the strategic level, for a variety of organizations.

Established as one of the first interdisciplinary programmes in IIT Bombay, IEOR contributes significantly to achieve the goals of IIT through various activities such as offering academic programmes, conducting continuing education programmes (CEP), carrying out research projects of different types.

The IEOR programme also has steady interaction with a wide spectrum of industries and sectors of the economy and society through participation in conferences, hosting visitors from academia and industries, carrying out sponsored projects and placement of students in different sectors etc.

IEOR graduates work in a variety of research labs and industries, including: manufacturing, communications, transportation, banking, pharmaceuticals, finance, travel, semiconductor, e-business, sports, health, and information technology.

Message from the convener

Dear Students,

Welcome to Industrial Engineering and Operations Research, IIT Bombay for your Postgraduate studies. IEOR, IITB is one of its kind in this part of the world and I am sure that you will immensely benefit from its vibrant academic atmosphere. Whatever be your undergraduate background, I can assure you that this place has something to offer, be it modelling of a wide variety of decision problems arising from technological or managerial settings, or large scale computations, or theory or insightful theoretical models for decision making. We wish you an academically fruitful stay culminating with a launch into a rewarding professional career; we are sure that your stay adequately prepares you for that.

Sincerely,

N. Hemchandra.

Facilities in Department

○ Library

The departmental library is located in the IEOR M. Tech. Lab (324-A, 2nd floor, Mechanical Engineering building). Though small, it proves to be a valuable resource for IEOR students because a number of IEOR specific books which are not available in central library and are costly to buy are available here.



Conference Room

Library has mainly got two

sections, namely book section and Xerox section. Some M. Tech. Dissertations are also available in our library, so that students can refer to them and get some ideas about writing a dissertation. The library affairs are handled by the Joint Secretary (Library and Publications). For more information regarding library, go to: www.ieor.iitb.ac.in → *User Login (LDAP ID and Password)* → *Internal* → *IEOR Library*.

○ IEOR LAB

The M. Tech. IEOR lab has 9 PCs with internet connectivity plus one Wi-Fi router and a few additional LAN ports so that people with laptops can make use it in the lab. All the PCs have both Windows and Linux operating systems. Also the PC's are connected to the OPTIMUS server of IEOR where one can login to use the software. Whatever may be the purpose (of course it should be strictly academic), the Lab is at your service 24*7. All you have to do is get a permission to issue the key from **Security room near Mechanical Engineering Department** and use the lab any time you want. The lab affairs are handled by the M. Tech. Lab TA

○ Ph. D. Lab

The Ph.D. Lab is where the brilliant research minds of IEOR are at work. The Ph.D.'s are



M. Tech. and Ph. D. Lab

no less than guides and mentors for the M. Tech. and M.Sc.-Ph.D. students, so never hesitate to drop by and get your doubts cleared from them. This lab has 20 desktops with 24 hours internet connectivity through LAN and an additional Wi-Fi router so personal laptop can be used. All the computers have both

Windows and Linux operating systems. The Lab also houses the OPTIMUS and the PASSPOLI servers of IEOR through which the software like AMPL, Scilab etc. can be accessed.

- **Computational Servers**

Total of five servers are available for the research & other academic to the faculty & students of IEOR. These servers have their names derived from the names of Mumbai suburbs, some useful info on these servers are as follows:

Machine Name	IP Address	CPU	Number of Cores	RAM (GB)
Kanjur	10.105.27.102	Intel(R) Xeon(R) CPU E5-2670 v2 @ 2.50GH	20	128
Saki	10.105.27.101	Intel(R) Xeon(R) CPU E5-2670 v2 @ 2.50GHz	20	128
Tunga	10.105.27.100	Intel(R) Xeon(R) CPU E5-2670 v2 @ 2.50GHz	20	128
Passpoli	10.105.27.99	AMD OPTERON 6212	4	32
Optimus	10.105.27.47	Intel Xeon E5506	4	64

Very soon our department will move to its new building, near Department of Biosciences and Bioengineering Building. Following are some of new facilities in new building

- Computation Lab
- Library cum discussion room
- Conference room with interactive projector
- PG and Ph. D. Lab



Seminar Room

Message from IEOB Students Association (IEORSA)

Dear All,

Welcome to IEOB family!!!

Here in our department, you will get numerous opportunities to learn new things. You will learn basics of IE & OR and in no time you will be working on advanced problems in same field. Along with your academics, you will get chance to participate in technical, sports and cultural activities also. If you are already into some cultural or sports activities, then you will love it here. If you have not participated in any of the cultural or sports activity and you wish start, then you are at right place. Here at IITB, we have plenty of resources to learn and sharpen your skills in cultural as well as sports. We hope that all of you will represent our department in upcoming competitions. Next few years will be playing a great role in your professional as well as personal development. So enjoy your stay and give your best in everything.

Few tips from our side:

- **Be social.** Interact with your batch-mates, seniors and faculty members as much as you need. If you feel that you are facing a problem that is unique and you are the only one with it, then you cannot be more wrong. Everyone in IEOB family would love to help you out in anyway possible.
- **Be informed.** Check your GPO, ASC, and MOODLE accounts regularly. You will be surprised that how many issues can be resolved just by being informed.
- **Be honest.** IITB gives freedom to its students to learn and enjoy their stay, but at the same time consequences can be severe if you try to bend the rules. Do not cheat in exams or in assignments. Do not give proxy.
- **Be awesome.**

Contact details of IEOB council members are given on the last page. Apart from IEOB, ISCP team is also there to help you out in every way possible. Feel free to contact us.

Faculty

Core Faculty

Prof. N. Hemachandra (Convener)	Research Interests – Methodologies like Markov decision models, Queuing models, Game theory, etc. Communication networks, Supply chains, Financial Engineering, Logistics and Power systems	nh[AT]iitb.ac.in
Prof. P.G. Awate (Emeritus Fellow)	Research Interests – Scheduling, Inventory Management, Neural Networks, Knowledge-based Systems	awatepg[AT]iitb.ac.in
Prof. Manjesh Hanawal	Research Interests– Communication Networks, Machine Learning, and Network Economics.	mhanawal[AT]iitb.ac.in
Prof. Veeraruna Kavitha	Research Interests – Stochastic processes, Performance Analysis, Queuing Theory, Polling systems, Optimal control, Game theory, Stochastic approximation, Wireless communications	vkavitha[AT]iitb.ac.in
Prof. Ashutosh Mahajan	Research Interests – Theory, Algorithms and Software for Mixed-Integer Linear and Nonlinear Optimization.	amahajan[AT]iitb.ac.in
Prof. Vishnu Narayanan	Research Interests – Integer Programming, Convex Optimization, and Polyhedral Theory	vishnu[AT]iitb.ac.in
Prof. Narayan Rangaraj	Research Interests – Optimization and Operations Research, Logistics and Supply Chain Management, Railway Operations, Transportation	narayan.rangaraj [AT]iitb.ac.in
Prof. K.S. Mallikarjuna Rao	Research Interests – Game theory, Stochastic Control, Probability, Partial Differential Equations, Viscosity Solutions	mallik.rao[AT]iitb.ac.in
Prof. Jayendran Venkateswaran	Research Interests – Modeling & Distributed Simulation (Discrete-event, System Dynamics), Integrated Supply Chain Analysis	jayendran[AT]iitb.ac.in

Associated Faculty (Teaching & Research)

Prof. A. Subash Babu	Research Interests – Manufacturing Systems, Quality Management, Entrepreneurship.	subash[AT]iitb.ac.in
Prof. Prasanna Chaporkar	Research Interests – Resource Allocation and scheduling in wired/wireless networks, Optimization and control of stochastic systems, Distributed systems and algorithms	chaporkar[AT]ee.iitb.ac.in
Prof. D. Manjunath	Research Interests – Computer and Communication Network Protocols, Systems and Algorithms Performance Modeling, Queuing Theory and Simulation, Stochastic Systems	dmanju [AT] ee.iitb.ac.in

Associated Faculty (Research)

Prof. G. K. Adil	adil[AT]som.iitb.ac.in	SJM School Of Management
Prof. S. A. Soman	soman[AT]ee.iitb.ac.in	Electrical Engineering
Prof. A. Subramanyam	as[AT]math.iitb.ac.in	Mathematics
Prof. K. Suresh Kumar	suresh[AT]math.iitb.ac.in	Mathematics
Prof. S. V. Sabnis	svs[AT]math.iitb.ac.in	Mathematics
Prof. A. G. Ranade	ranade[AT]cse.iitb.ac.in	Computer Science
Prof. M. Sohoni	sohoni[AT]cse.iitb.ac.in	Computer Science
Prof. R. Banerjee	rangan[AT]me.iitb.ac.in	Energy Systems Engineering
Prof. K. Moudgalya	kannan[AT]che.iitb.ac.in	Chemical Engineering
Prof. Mani Bhushan	mbhushan[AT]che.iitb.ac.in	Chemical Engineering

Some Recent Activities in IEOR

- PhD student Umakanta Pattanayak presented his work on Local Polyhedrality of Integer Hulls of Strictly Convex Sets at the Mixed-Integer Programming Workshop (poster), Miami, May 23–26, and at the SIAM Discrete Mathematics Conference (contributed talk), Atlanta, June 6–10.
- IEOR Faculty members gave talks at the Game Theory & Optimization Conference (9–10 June, IIT Madras) on the following topics:
 - Vishnu Narayanan: Local Polyhedrality of some Integer Hulls
 - N. Hemachandra: Some Aspects of Excess-Based Solution Concepts for Cooperative Games
 - K. S. Mallikarjuna Rao: PDE Approach to Nonexpansive Ergodic Control
- Manjesh K Hanawal presented his work titled 'Jamming Attack on In-band Full Duplex Communications: Detection and Countermeasures' at INFOCOM 2016 held at San Francisco, CA, USA
- K. S. Mallikarjuna Rao organized International conclave on Foundation of Decision and Game Theory, 2016 March 14–19
- N. Hemachandra gave lecture on Equilibrium sets and related aspects in network interactions in International conclave on Foundation of Decision and Game Theory, 2016 March 14–19
- A Seminar by Louis-Martin Rousseau on Packing issues and optimization models in Supply Chain
- A Seminar by T.E.S. Raghavan On Martin's Determinacy of Borel and its application to Stochastic Games
- A seminar by Hans J. Huber on India's air traffic system: network topologies, hierarchies and evolution
- A Seminar by Philippe Marie-Jeanne on How big is big data for AXA
- A Seminar by Brian Powers on An Analysis of Multi-Issue Final-Offer Arbitration
- N. Hemachandra and K. S. Mallikarjuna Rao gave lecture in Workshop on Game Theory and Mechanism Design organized by IISC Bangalore, Jan 2016
- IEOR students and faculty members participated in Mining Intelligence and Knowledge Exploration, The Third International Conference, MIKE 2015, <http://www.mike.org.in/2015/> at IIIT Hyderabad during Dec 9–11, 2015.
- Alok Patel, a research scholar, presented a poster on "Optimal Signal Control for Pre-timed Signalized Junctions with Uncertain Traffic: Simulation based Optimization Approach", a joint work with Jayendran Venkateswaran and Tom V. Mathew in the Winter Simulation Conference (WSC) 2015, Dec. 6–9, 2015 at the Hyatt Regency Resort & Spa, Huntington Beach, California, USA.
- Jayendran attended the 48th International Conference & Annual Convention of Operational Research Society of India (ORSI) organized at SOA University, Bhubaneswar, Odisha, India on December 17–19, 2015. Jayendran Venkateswaran presented a paper on "Operations Experience in Large Scale Dissemination

- of Technology Solutions in Rural India", a joint work with Chetan S. Solanki (ESE) and N.C. Narayanan (CTARA)
- IEOR students attended the XIX Annual International Conference of Society of Operations Management (SOM) organized at Indian Institute of Management Calcutta, Kolkata on December 11–13, 2015.
 - Meenarli Sharma, a research scholar presented a paper on "A Routing and Scheduling Problem in Port Operations of a Refinery ", a joint work with Krishna Rekapalli, Nitin Mehta and Ashutosh Mahajan.
 - Jayendran Venkateswaran presented a paper on "Scheduling of Alumina Shipments in a Supply Chain Network", a joint work with Mr. Raavindan G., and Mr. Abhishek Raghuvanshi.
 - Jayendran Venkateswaran, along with Chetan S. Solanki (Energy Science and Engineering), N. C. Narayanan (CTARA) and other project staff members attended the one day National level Consultation Workshop on Million Solar Urja Lamp (SoUL) Program, jointly organized by Ministry of New & Renewable Energy and IIT Bombay on 11th December 2015 at New Delhi, India. The workshop was held to discuss the concept, outcomes and pathway forward for the Million Solar Urja Lamps (SoUL) project. The workshop saw participation from various NGOs, government agencies, academic institutions, and other think-tanks.
 - K. S. Mallikarujan Rao organized International Workshop on Networks and Games organized by IIT Ropar , Dec 2015
 - IEOR students and faculty attended the 2015 IEEE International Conference on Industrial Engineering and Engineering Management (IEEM) organized at SUNTEC, Singapore on December 6–9, 2015.
 - Satishkumar L., a research scholar, presented a paper on "Impact of Input Data Parameter Uncertainty on Simulation-Based Decision Making", a joint work with Jayendran Venkateswaran.
 - Jayendran presented a paper on "Million Solar Urja Lamp Programme: A Supply Chain Experience", a joint work with Nikhil Sawal, Chetan S. Solanki and N.C. Narayanan. Jayendran also chaired a session on Supply Chain Management.
 - Ted Ralphs from Lehigh University gave a series of seminars from 3rd to 8th December 2015 on Multilevel and Multistage Optimization.

IEOR Institute Representative		
AURAA- M. Tech.	Tejas Ghorpade	trghorpade@gmail.com

Institute Student Companion Programme Team		
Department Coordinator (M. Tech.)		
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Class Representatives		
M.Sc. Ph.D. 2011	Arko Chatterjee	arkotito@iitb.ac.in
M.Sc. Ph.D. 2012	Sandhya Tripathi	sandhya.tripathi8@gmail.com
M.Sc. Ph.D. 2013	Akash PB	pradeepakash19@yahoo.co.in
M.Sc. Ph.D. 2014	Sushant Kumar	141190010@iitb.ac.in
M.Sc. Ph.D. 2015	Aanchal Panwar	15i190005@iitb.ac.in
M. Tech. 2015	Vinay Rai	vinayrai111@gmail.com

Placement Team:			
Ashish Jatav	Department Placement Coordinator	153190020@iitb.ac.in	7697502522
Akash PB	Pitching Coordinator- Institute Placement Team	pradeepakash19@yahoo.co.in	7506110943
Harshal Yeole	Company Coordinator- Institute Placement Team	153190018@iitb.ac.in	7588579152
Prakash Gawas	Company Coordinator- Institute Placement Team	153190008@iitb.ac.in	7709591327

IEOR Student Association (IEORSA)

The IEORSA was formed in 2012 with the objective of creating a sense of responsibility among the students and developing leadership qualities. It aims at creating a spirit of cooperation among the students and increasing the involvement and enthusiasm in branch through new initiatives and organizing and participating in the events. The Association has an Executive Committee with a President, Treasurer and other official posts. The President and Treasurer posts are handled by the faculty while all other official posts are handled by elected students of IEOR. For further information on draft constitution of IEOR, go to: <http://www.ieor.iitb.ac.in/> → User Login (LDAP ID and Password) → Internal → IEOR-Association.

The current members of the Executive Committee and the official posts are as below:

Post	Name	Contact Information
President	Prof. N. Hemachandra	nh@iitb.ac.in
Treasurer	Prof. Jayendran Venkateswaran	jayendran@iitb.ac.in
General Secretary	Vinay Rai	vinayrai@iitb.ac.in
Joint Secretary (Academic)	Tejas Ghorpade	153190007@iitb.ac.in
Joint Secretary (Sports)	Indrajit Saha	141190008@iitb.ac.in
Joint Secretary (Cultural)	Nibir Nath	153190014@iitb.ac.in
Joint Secretary (HR)	Ashlin Ghosh	153190024@iitb.ac.in
Joint Sec. (Lib. & Publication)	Raja Chauhan	153190005@iitb.ac.in

Students Part of Institute Bodies:		
Sharad Agrawal	PG Cult Nominee- Institute Cult Council	9769396512 Shad2728@gmail.com
Vinay Rai	Overall Coordinator- ISCP	9711664898 Vinayrai111@gmail.com

Placement @ IEOR, IIT Bombay

Many companies recruit from IEOR department. Detailed list of past recruiters of department can be found on link

<http://www.ieor.iitb.ac.in/opportunities/placements/employers> and to know more about placement at IIT Bombay please visit: <http://placements.iitb.ac.in/>

Following is summary of placement season 2015-16

	No. of Registered Student	No. of Placed Student
M. Tech	20	18
Ph. D.	1	1
M. Sc. + Ph. D.	2	0
2 Years M. Sc.	2	1
Total	25	20

Alumni Information

In past many alumni have passed out from our department. Following is some information about research topics of IEOR students.

Name	M Tech Project Topic	Guide Name
Anshika Chaurasia	Some models for influence maximization in social networks	Prof. N. Hemachandra
ANUJI C	MANAGING TECHNOLOGY CONSULTING PROJECTS USING MULTIPLE METRICS	Prof. A. Subash Babu
Nimita Shinde	Improved Formulations for Facility Layout Problem (Optimization based topic)	Prof. Vishnu Narayanan
Raghvendra Omer	Developing a Convex Quadratic Programming Solver with Warm-starting After Bound Changes	Prof. Ashutosh Mahajan
Akash Omer	Pricing Strategies for Technology based Services	Prof. A. Subash Babu
Asheesh	Game theoretic modeling in road transportation	Prof. K.S. Mallikarjuna Rao
Neeraj Sinha	Reliability study of a class of circuit breakers	Prof. A. Subash Babu
Yogesh Nailwal	Polling Systems	Prof. Veeraruna Kavitha
Rakesh Kumar Sharma	Managing Freight Traffic on Rail Networks: Analysis of Terminal Operations	Prof. Narayan Rangaraj

Ph. D. topics

Name	Ph. D. Thesis	Guide
Anusuya Ghosh	Semidefinite programming	Prof. Vishnu Narayanan
Ratnaji Vanga	Supply Chain Management of Reusable Articles	Prof. Narayan Rangaraj, Prof. Jayendran Venkateswaran

For current students in IEOR department please follow link

<http://www.ieor.iitb.ac.in/people/>