3-month Post Graduate Certificate Course

in

Infectious Disease Modelling

Department of Community Medicine

All India Institute of Medical Sciences Nagpur

COURSE COORDINATOR

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3-month Post Graduate Certificate Course in "Infectious Disease Modelling"

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(I) Goal

To build a critical mass of trained professionals in disease modelling and prediction in order to further our understanding of the spread and control of epidemics and help tackle future epidemics effectively.

(II) Objectives of the course

At the end of this program, the participants should be able to,

1. Construct valid mathematical models capturing the natural history of a disease
2. Design, optimize and build a disease model for different diseases and intervention scenarios using a software
3. Understand the strengths and limitations of a model in research and policy contexts
4. Critically assess disease models and make decisions based on model findings

Infectious diseases remain a leading cause of morbidity and mortality worldwide, with HIV, tuberculosis and malaria estimated to cause 10% of all deaths each year. Outbreaks of Ebola and COVID-19 in recent years have led to unprecedented numbers of deaths and cases. New pathogens continue to emerge in animal and human populations, as demonstrated by the emergence of SARS in 2003, of Highly Pathogenic Avian Influenza in poultry and humans in 2004/2005, swine flu in 2009, MERS CoV in 2013, Zika in 2016 and recently, SAR2-COV2 in 2019.

Mathematical models are being increasingly used to understand the transmission of infections and to evaluate the potential impact of control programs in reducing morbidity and mortality. Modelling is an integral part of many of the public health decisions made today from health screening to the development of vaccines, emerging antibiotic resistance to vector-borne disease spread. Modelling is being used increasingly to understand the complexities of infectious diseases and to help inform public health policy. Such models were widely used in the recent COVID-19 pandemic to predict future waves and thus, plan well ahead to manage the pandemic surge. However, barring a few experts, there is a lack of understanding about these models, as to how they are conceptualized, calibrated, built and presented.

This intensive course is intended to introduce professionals with an interest in infectious diseases to this exciting and expanding area. The emphasis will be on developing a conceptual understanding of the basic methods and on their practical application rather than dwelling too much into the mathematics of it. This course will also cover advanced methods of model building and optimization through hands-on experiences and software demonstrations. Finally, we will discuss how infectious disease models have shaped our understanding of the SARS-CoV-2 pandemic and influenced policy making. Besides, the participants will be introduced to other modules such as Basic Excel operations, Basic maths and R basic coding which will be helpful in understanding and building models.

There is a perceived need to create a critical mass of trained infectious disease experts and modelers within the public health and clinical domain so that they can work closely and support the district, state and national government to understand disease epidemics and predict accurately. This need was more felt during the recent COVID-19 pandemic which swept the entire globe.

Thus, we would like to propose a Post Graduate Certificate Course in "**Infectious Disease Modelling**" to build a team of infectious disease experts and modelers who can prove to be a great asset in tackling future pandemics and emerging threats.

Who will be the participants?

Minimum eligibility: Graduate in related disciplines

The participants will include regular faculty/scientists/PhD students/post-doctoral students from medical colleges and research institutes, biostatisticians, veterinarians, public health and clinical researchers from government institutes, NGOs or other organizations from India, policy makers and disease control professionals with interest and background in infectious disease modelling. Specialist mathematical training is not a prerequisite. Some familiarity with spreadsheet packages (Microsoft Excel) is desirable. It is also suitable for individuals with a more advanced background in mathematical disciplines who wish to obtain an understanding of the broad range of applications of mathematical models in disease epidemiology and who may wish to specialize in this area in the future. Each year one cycle of course will be conducted in which a total of 20 participants will be trained.

Selection of participants will be competitive and individuals who commit to take this training initiative forward in their respective institutions will be preferred. The applicant must demonstrate how they will be utilizing this skill once they go back to their parent institute during the application process. Some background in infectious disease modelling and epidemiology will be desirable. The applications will be scored by a structured scoring sheet. The scoring sheet will be used to assess applications in case we receive more than 20 applications. The top 40 applicants based on the scores obtained will be invited for an offline/online interview. All candidates with the same score will be called for interview even if number of shortlisted candidates is more than 40. The interview will carry 100 marks. Final selection will be done based on the total score (score based on the application + marks obtained during the interview). In case of same final score, graduation marks will be used as a tie breaker.

Applicant has to submit a duly filled application form (**Annexure 1).** The applicant also has to submit a NOC from his/her employer at the time of submission of application **(Annexure 2).**

Maximum age limit of the participants: 50 years as on the last date of application

Course fees: No fees will be charged to the participants for the program for five years till the funding is secured. However, the course participants have to make their

own arrangements for travel, accommodation and other incidental expenses that will be incurred during the contact program. The host institution will not cover the cost of travel, accommodation and other expenses of the participants. Hostel or guest house facility within the host institute campus may be provided depending on the availability.

Mode of program delivery: Hybrid mode (online classes, contact programme and offline exit examination)

Facilitators
This course will be conducted by the experienced and reputed faculty from the collaborating institutes namely: (i) All India Institute of Medical Sciences, Nagpur, (ii) Post Graduate Institute of Medical Education and Research, Chandigarh, (iii) Ashoka University, Haryana and (iv) Institute of Mathematical Sciences, Chennai along with other invited national and international experts in the field of disease modelling.

Course design

This course will be delivered in a 6-step process:

1. **8-week online course**: This will be delivered through daily recorded video lectures, daily online software demonstrations & exercises, reading materials, weekly live discussion forums and weekly assignments. The total duration of teaching will be around 45 hours per week.
2. **Weekly assignments**: After the completion of every two weeks, assignments will be given. All four assignments have to be submitted by 9th week of the course. (**Milestone 1)**
3. **Project work**: After the completion of the 8-week online course, a project-based assignment will be given wherein they will be practically applying the principles learnt. The final project report has to be submitted before the completion of the 10th week of the course. **(Milestone 2)**
4. Online revision and discussion classes in **Week 11.**
5. **5-day contact programme**: A 5-day contact programme will be held in the 12th week of the course to discuss and revise the key concepts, clarify doubts and give them a quick hands-on practice
6. **Exit exam**: The contact programme will be followed by an exit exam the very next day.
7. **Course evaluation and feedback**: This will include a pre-post assessment ad end of course feedback from the participants

Milestones must be achieved to remain in the programme, and to receive the course completion certificate all milestones must be completed and the exit exam has to be cleared. Please see the details of the course structure in the figure below. This course will be delivered on a web portal which will be designed as part of this program. We will also design a mobile app to facilitate easy access to the course for the participants.

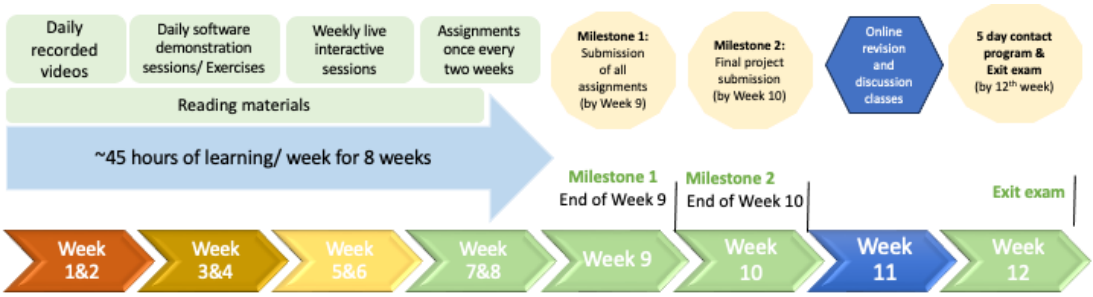


Figure 1 Design of the course

Course materials
Course materials will be developed in the form of recorded video lectures, course notes and explanations, demo datasets and exercises, tutorial videos and other resource materials. These course materials will be uploaded into an online web portal.

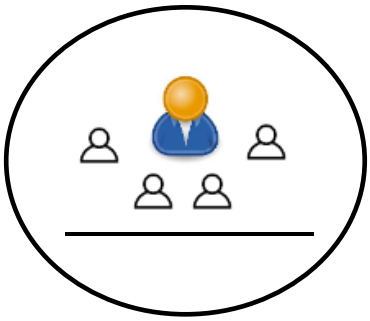
Assignments
Four assignments will be given, once every two weeks for the first 08 weeks based on the topics discussed in the previous two weeks. These will include calculation-based exercises and excel or R software-based exercises for constructing disease models and their interpretation using disease incidence data.

Course outputs/deliverables:

The course outputs are as follows:

1. Completed assignments (all four)
2. Completed project work
3. Passing the exit examination

Mentorship
Strong, hands-on mentorship is a key feature of this program, and this will be provided by the facilitators. There will be one mentor for every four participants. Thus, a total of 20 participants will be mentored by 05 course facilitators. The mentors will support in clarifying the concepts, clearing the doubts and completing the assignments. The mentors will also support the participants who are interested in writing a project and submitting to a funding agency seeking support. See **Figure 2** below.



Syllabus

Week 1&2

- Introduction to Epidemiology
- Descriptive and analytical Epidemiology
- Natural History of Disease
- Epidemic patterns
- Organizing and Displaying Data
- Public Health Surveillance
- Outbreak Investigation
- Infectious Disease Epidemiology
- Dynamics of disease transmission and spread
- History of pandemics and lessons learnt
- Epidemiology of vaccination
- Study of contact patterns
- Sero-epidemiology
- Exercises and case studies
- Weekly live discussion & Assignment 1

Week 3&4

- Excel basics
- Excel formatting
- Excel formulas and functions
- Maths basics
- Plotting functions, exponential and logarithmic functions
- Vectors, probabilities and matrices
- R basics
- Introduction to R and Rstudio
- R Data structures
- Data manipulation in R
- Data visualization in R
- Practice exercises
- Weekly live discussions
- Assignment 2

Week 5&6

- What is a model? Are all models wrong?
- Introduction to SIR model
- Model input parameters
- Final stages of model development
- Introduction to differential equations
- Predicting size of an epidemic
- Calculating R_0
- Growth rate and doubling time
- SIR model with demography
- Case studies
- Assignment 3
- Running models in Excel and R
- Weekly live discussion

Week 7&8

- Age patterns for immunizing and non-immunizing infections
- Introduction to stochastic modelling
- Incorporating contact patterns
- Sexually transmitted infections
- Transmission models of HIV/AIDS
- Fitting models to seroprevalence data
- Modelling diseases with long incubation periods
- Modelling malaria transmission and control
- Disease modelling during the COVID pandemic
- Assignment 4
- Case studies
- Weekly live discussion

Week 9

- Submission of assignments

Week 10-11

- Submission of Project work/Online revision classes

Week 12

- Exit examination

Teaching and learning methods

The teaching learning methods would consist of:

1. Online video lectures
2. Online demonstrations/software hands-on
3. Computer exercises
4. Weekly live discussions and Q&A
5. Journal clubs
6. Case studies
7. Weekly assignment
8. End-of-course project submission

Assessment

A. Formative assessment:
   - Four assignments (25 marks each)
   - End of week test (10 MCQs) each test carrying 10 marks

B. Summative assessment (100 marks):
   - Exit examination (75 marks)
   - End-of-course project submission (25 marks)

Formative assessment: Assignment will be given at the end of each week of online classes each carrying 25 marks.

Eligibility for the final exit examination:
The participant should fulfil all the following criteria to be able to appear for the exit examination:

i. Submit all the four assignments to the satisfaction of the mentor and score an overall 50% marks (out of 100 marks)
ii. End of week test (10 MCQs), 50% marks to be secured in each test
iii. 100% mandatory attendance for the contact session

Summative assessment:
Summative assessment (100 marks) will have theory, practical and end-of-course project evaluation carrying 50, 25 and 25 marks respectively.

Theory examination: One paper carrying 50 marks

Type of question	**Pattern**	**Marks**
Multiple Choice Questions (10)	10 MCQs each carrying one mark	10
Short Answer Questions (20)	05 SAQs each carrying 04 marks	20
Long Answer Questions (20)	02 LAQs each carrying 10 marks	20
Total marks		**50**

Practical examination: Computer based exercise carrying 25 marks

The End-of-course project will be evaluated out of 25 marks. Minimum 50% marks (overall) are required in the exit examination in order to successfully complete the program.

Feedback from the participants

A pre-post assessment will be done via google forms to assess whether the course was able to achieve its learning objectives. Anonymous course feedback will also be taken from the course participants at the end of the program to obtain honest feedback on the overall content of the program, teaching format, quality of course materials and slides, mentorship by the faculty, attitude of the faculty towards the participants, strengths and weaknesses of the program, any suggestions to improve the program.

Recommended books

- Centers for Disease Control and Prevention. Principles of Epidemiology in Public Health Practice.
- Johan Giesecke. Modern Infectious Disease Epidemiology
- Anderson, R and May, R. Infectious Diseases of Humans: Dynamics and Control
- Diekmann, Heesterbeek and Britton. Mathematical Tools for Understanding Infectious Disease Dynamics
- Keeling and Rohani. Modeling Infectious Diseases in Humans and Animals
- Emilia Vynnycky and Richard G White. An Introduction to Infectious Disease Modelling
- Ottar N Bjornstad. Epidemics Models and Data using R

IMPORTANT DATES in the year 2024

Publication of course advertisement: Second week of June 2024
Last date of submission of application: 01 July 2024
Selection of participants: 10 July 2024
Commencement of the course: Second week of July 2024
Final Exit examination and Declaration of result: Second week of October 2024

Instructions for submitting the application

1. Visit https://aiimsnagpur.edu.in/pages/vacancies
2. Download the course details and read it carefully
3. Download the application form, fill it, scan the filled form and prepare a pdf
4. Combine all the documents/certificates related to proof of date of birth, examination passed, work experience, relevant publications, research projects, experience in infectious disease control and prepare a single pdf
5. Get a No Objection Certificate (NOC) from your employer, scan it and prepare a pdf
6. Detailed CV in pdf format
7. Click on the application link, fill the google form, attach the four abovementioned pdfs and your CV and submit
8. Also send an email to idmodellingdhr@gmail.com stating that you have applied for the course and that you have filled the google form. Attach the four pdfs in the email as well.