Ph.D. Course Work

Curriculum and Syllabus

Cluster Innovation Centre
(Faculty of Technology)
University of Delhi

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General course structure and Evaluation criteria

A Ph.D. student has to opt for the following courses:

1. Course I: Comprising of the following compulsory courses:

   A.   Research and publication Ethics (2 credits)

   B.   Research Methodology   (4 credits)

2. Course II: Comprising of minimum 1 paper from a basket of papers as indicated in index A (4 credits)

3. Course III: Seminar Presentation (4 credits)

   Examination related to coursework

   ✓ For successful completion of the coursework, a student has to pass individually in each course.

   ✓ The passing marks and examination pattern will be as per the guidelines of the University.

Course table

Courses	Course I		Course II	Course III	Total credits earned
Details	Research and Publication Ethics	Research Methodology	One out of a basket of subject domain courses	Seminar Presentation	
Credits	2 credits	4 credits	4 credits	4 credits	14
Maximum marks and evaluation process	The passing marks and examination pattern will be as per the guidelines of the University.				

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Research and Publication Ethics

Course title	Credits
Research and Publication Ethics	2

Course objectives:

To introduce students to the ethics of research

To introduce students to plagiarism and ethics of publication of research work

Course outcome

After completion of the course, the students will

Understand about research and publication ethics

Evaluate research and publication ethics misconduct

Students will have a detailed understanding of plagiarism in thesis and manuscript writing.

Syllabus

Unit I

Philosophy and ethics

Introduction to philosophy: nature and scope, concept, branches

Ethics: definition, moral philosophy, nature of moral judgement and reactions

Unit II

Scientific conduct

Ethics concerning science and research; Intelectual honesty and research integrity; Scientific misconduct: Falsification, Fabrication and Plagiarism (FFP); Redundant publication: duplication and overlapping publications, salami slicing; Selective reporting and misrepresentation of data

Unit III

Publication Ethics: definition, introduction and importance

Best practices/standards setting initiatives and guidelines: COPE, WAME, etc. Conflict of interest.

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Publication misconduct: definition, concept, problems that lead to unethical behaviour and vice versa, types, Violation of publication ethics, authorship and contributorship

Identification of publication misconduct, complaints and appeals

Predatory publishers and journals

Practices

Open access publishing

Open access publication and initiatives

SHERPA/RoMEO online resource to check publisher copyright and self-archiving policies, software tool to identify predatory publications developed by SPPU.

Journal finder/journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer Journal Suggester etc.

Publication Misconduct:

Group discussion on subject-specific ethical issues, FFP, authorship, conflict of interest, complaints and appeals: examples and fraud from India and abroad

Software tools:

Use of plagiarism software like Turnitin, Urkund and other open-source software tools.

Database and Research Matrix

Indexing databases, citation databases: Web of Sciences, Scopus etc, Journal Impact factor as per citation report, SNIP, SJR, IPP, Cite Score, Matrices: h-index, g-index, i10 index, altmetrics

Suggested Readings:

Recent relevant papers and online literature.

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Research Methodology

Course title	Credits
Research Methodology	4

Course objectives:

- To introduce students to the concepts, methodologies and tools of research
- To introduce students to conceptualizing their research problems

Course outcome

After completion of the course, the students will:

- Understand about philosophy and methodologies of research
- Will be able to collect, analyze and visualize research data
- Develop a detailed understanding of writing a research manuscript, and review manuscript and thesis.

Syllabus

Unit 1: Philosophy and Paradigms of Research

Research paradigms: Introduction to key paradigms and their implications on research; Paradigm shifts in the social and natural sciences.

Unit 2: Research Literature and Resources

Types of publications (e.g., journals, conferences, books, reports etc.); Indexing and abstracting services; Online library systems, search engines and citation indices; Citation analysis, online searching methods.

Unit 3: Data Collection and Analysis

Nature and types of data (qualitative vs. quantitative); Visualization of Data; Sampling methods and hypothesis formulation; Designing experiments to test research hypotheses; Case studies; Planning, execution and data analysis.

Descriptive and inferential statistics; Common statistical tests, hypothesis testing, and inferences; Software tools for data analysis (e.g., SPSS, R, Python etc.).

Contextualist & Isolationist Approaches in Humanities.

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Unit 4: Thesis Writing and Presentation Skills

Structure and language of research articles, review articles and thesis; Using documentation software (e.g. Latex, Beamer, etc); Oral and poster presentation techniques.

Selecting research topics and formulating research problems; literature review; Studying, reviewing and publishing research papers; Research proposals for funding.

References:

Booth, W.C., Colomb, G.G., Williams, J.M and Bizup, J., *The Craft of Research* (2016), 4th Edition, University of Chicago Press (ISBN 13: 978-0226239736)

Creswell, J.W. and Creswell, J.D., *Research Design: Qualitative, Quantitative and Mixed Method Approaches* (2022), 6th Edition, Sage Publication (ISBN-13: 978-1071817940)

Gastel, B and Day, R.A., *How to Write and Publish a Scientific Paper* (2016) 8th Edition, Greenwood Publishing Group (ISBN-13: 978-1440842801)

Harmon, E and Montagnes, I., *The Thesis and the Book: A Guide for First-Time Academic Authors* (2003), 2nd Edition, University of Toronto Press (ISBN- 13: 978-0802085887)

Hayot, E., *The Elements of Academic Style: Writing for the Humanities* (2014), Columbia University Press (ISBN-13: 978-0231168014)

Kothari, C.R., *Research Methodology: Methods and Techniques* (2004), New Age International (ISBN-13: 978-812241522)

Kumar, R., *Research Methodology: A Step by Step Guide for Beginners* (2010) 3rd ed., Pearson Education. (ISBN-13: 978-1849203012)

Lamport, L., *LaTeX: A Document Preparation System* (1994), 2nd Edition, Addison Wesley (ISBN-13: 978-0201529838)

Locharoenrat, K., *Research Methodologies for Beginners* (2017), Pan Stanford Publishing Pte. Ltd., Singapore (ISBN-13: 978-9814745390)

Publication Manual Of The American Psychological Association (2019), 7th Edition, American Psychological Association (ISBN-13: 978-1433832161)

Reynolds, G., *Presentation Zen: Simple Ideas on Presentation Design and Delivery (Voices That Matter)* (2011), 2nd Edition, New Riders (ISBN-13: 978-0321811981)

Salkiend, N.J., *Statistics for People who (Think They) Hate Statistics* (2013), 5th Edition, SAGE Publication (ISBN-13: 978-1452277714)

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Finite Difference Methods for Differential Equations

Course title	Credits	Credit distribution		
		Lecture	Tutorial	Practical
Finite Difference Methods for Differential Equations	4	2	0.	2

Course Objectives

This course is designed to introduce the students about

- various Finite Difference Methods for Differential Equations.
- their convergence, consistency and stability
- implementation of the techniques on MATLAB/ MATHEMATICA

The theoretical sections will be covered in the lecture classes and the students are expected to implement the methods in the practical classes

Syllabus

Unit I

Introductory Theoretical Concepts:

Derivation of difference equations with Neumann Boundary Conditions, Cell Average Equations, Cell Centered Grids and Non-uniform Grids; Convergence, Consistency and Stability of IVPs and BVPs; Lax theorem; Finite Fourier series and Stability; Gerschgorin Circle Theorem

Unit II

Finite Difference Schemes for Parabolic Equations:

Derivation of difference equations for 2D parabolic equations; Convergence, consistency and stability of IVPs and BVPs; Peaceman Rachford scheme; Douglas Rachford scheme; Nonhomogeneous ADI schemes, 3D Schemes; Difference equations in polar coordinates

Unit III

Finite Difference Schemes for Hyperbolic equations:

Numerical solutions for IVPs: One-sided schemes, Centered scheme, Lax wendroff scheme; Crank Nicholson scheme; Numerical solutions of IBVPs; Courant Friedrichs Lewy condition; 2D hyperbolic equations.

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Practical

Implementation of the schemes covered on MATLAB/ MATHEMATICA

Essential/recommended readings

- Numerical Partial Differential Equations: Finite Difference Methods (1998) by J.W. Thomas; Published by Springer (ISBN-13: 978-0387979991; ISBN-10: 038797999)

- Numerical Solution of Partial Differential Equation (2008) by K.W. Morton and D.F. Mayers. Cambridge University Press (ISBN-13: 978-0521607933; ISBN-10: 0521607930)

- Introductory Finite Difference Methods for PDEs (2012) by D.M. Causon and C.G. Mingham. BookBoon.

- Finite Difference Schemes and Partial Differential Equations (2004) by J.C. Strikwerda. SIAM

Information Retrieval

Course title	Credits	Credit distribution		
		Lecture	Tutorial	Practical
Information Retrieval	4	3	1	0

Learning Objectives

- This course will discuss the techniques for information retrieval which is the process through which a computer system can respond to a user's query for text-based information on a specific topic.

- This course will teach the students techniques for efficient text indexing, Boolean and vector-space retrieval models, evaluation and interface issues, IR techniques for the web, including crawling, link-based algorithms, and metadata usage, Document clustering and classification and Traditional and machine learning-based ranking approaches.

Learning outcomes

At the end of the course, a student will be able to:

- Develop broad knowledge of the field of information retrieval.
- Understand techniques to efficiently index text-based data and retrieve based on user queries.
- Learn how to perform performance evaluation of systems.
- Apply various tasks like text filtering, categorization, clustering etc. to text corpus.
- Learn information retrieval techniques for web content, crawling, how to rank it etc.
- Develop an application or perform a case study as a course project.

Syllabus

Unit I

Introduction to Information retrieval; Document Indexing, Storage and Compression, Retrieval Models, Performance Evaluation, Metrics

Unit II

Text Categorization and Filtering, Text Clustering

Unit III

Web Information Retrieval, learning to rank, Web crawling & near duplicate pages

Unit IV

Advanced Topics (Text Summarization or Question answering or Recommender Systems)

Essential/recommended readings

Text Books:

- "Introduction to Information Retrieval" by Manning, Raghavan and Schutze, Cambridge University Press, 2008.
- "Search Engines: Information Retrieval in Practice" by W. Bruce Croft, D. Metzler, T. Strohman, Pearson, 2009.
- "Information Retrieval: Implementing and Evaluating Search Engines" by Stefan Büttcher, Charles L. A. Clarke and Gordon V. Cormack, MIT Press, 2010.

References:

- List of research papers prescribed by the instructor

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Machine Learning

Course title	Credits	Credit distribution		
		Lecture	Tutorial	Practical
Machine Learning	4	3	1	0

Learning Objectives

The course is designed to make the

- Research scholars skilled in machine learning techniques and applications.
- Courses will help them to formulate machine learning problems corresponding to different applications and
- Make them understand a range of machine learning algorithms along with their strengths and weaknesses.

Learning Outcomes

After compilation of the course, students will have an understanding of

- Machine learning and its algorithms
- Will understand the applications in real-world domains
- Will have an understanding of how to decide and select the algorithms for particular problems
- Mathematical Foundation of machine learning algorithms and feature engineering.

Course Syllabus

UNIT I: Introduction to machine intelligence and machine learning, types of learning algorithms, Supervised Learning, Unsupervised learning, Semi-supervised learning, Reinforcement Learning,

UNIT II: Supervised learning algorithms: Linear Regression, Logistic Regression, Support vector Machine, Naive Bayes, Artificial Neural Networks, Overfitting and techniques.

UNIT III: Generative Vs. Discriminative Models. Unsupervised learning algorithms: K-Means clustering,

UNIT IV: Feature Engineering, Dimensionality reduction, Learnability, and Application of machine learning in real-world domains.

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Essential/recommended readings

1. Géron, Aurélien. *Hands-on machine learning with Scikit-Learn, Keras, and TensorFlow: Concepts, tools, and techniques to build intelligent systems.* " O'Reilly Media, Inc.", 2019.

2. Bishop, C. M., & Nasrabadi, N. M. (2006). *Pattern recognition and machine learning* (Vol. 4, No. 4, p. 738). New York: Springer.

3. Shalev-Shwartz, S., & Ben-David, S. (2014). *Understanding machine learning: From theory to algorithms.* Cambridge University Press.

4. Mooney, R. J. (1994). A MULTISTRATEGY APPROACH. *Machine Learning: A Multistrategy Approach, Volume IV*, 4, 141.

5. Müller, A. C., & Guido, S. (2016). *Introduction to machine learning with Python: a guide for data scientists.* " O'Reilly Media, Inc.".

6. Bird, S., Klein, E., & Loper, E. (2009). Natural language processing with Python: analysing text with the natural language toolkit. " O'Reilly Media, Inc.".

Internet of Things and IT Security

Course Title	Credits	Credit Distribution		
		Lecture	Tutorial	Practical
Internet of Things & IT Security	4	3	1	0

Learning Objectives:

- To introduce students to the Internet of Things (IoT) and IT security.
- Make them understand the fundamental principles of IoT and the various technologies used in IoT.
- Make students aware of potential security risks and challenges with IoT.
- They will also learn about the measures that can be taken to ensure the security of IoT devices and networks.

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Learning Outcomes:

After the completion of this course, students will be able to:

- Define and explain the concept of IoT
- Identify the various components of an IoT system
- Describe the various technologies used in IoT
- Understand the potential security risks and challenges associated with IoT
- Evaluate and apply various security measures to ensure the security of IoT devices and networks

Syllabus:

Unit 1: Introduction to IoT

Basics of IoT and its applications, Definition and overview of IoT and devices, IoT architecture, components of an IoT system, connected device ecosystem.

Unit 2: IoT Technologies

Sensors and actuators, IoT data formats, IoT communication protocols (MQTT, CoAP, etc.) Network topologies, IoT platforms, middleware, wired and wireless devices.

Unit 3: IoT Security Threats

Overview of IT security and its importance in IoT, IoT device security, Network Security

- Privacy concerns, Data breaches, DDoS attacks and other security threats, IoT and Blockchain, Case studies on IoT security incidents.

Unit 4: IoT Security Measures

Cryptography and encryption, Access control, secure communication protocols in IoT, Security testing and auditing, Designing secure IoT systems, IoT security standards and certifications, Machine learning-based security in IoT

Suggested Readings

1. Security and Privacy in Internet of Things (IoTs): Models, Algorithms, and Implementations, by Fei Hu, 2016, CRC Press, ISBN 9780367574925.
2. Internet of Things Security: Advances, Challenges, and Performance Analysis, by Chintan Patel, Nishant Doshi, 2019, CRC Press, ISBN 9781138318632
3. Internet of Things Security: Principles and Practice by Qinghao Tang and Fan Du, 2021, ISBN 978-981-15-9941-5

4. Internet of Things: A Hands-On Approach, by Arshdeep Bahga and Vijay Madisetti. 2014 ISBN 978-0996025515

5. "Securing the Internet of Things: Concepts, Methodologies, Tools, and Applications," edited by Brij B. Gupta and Dharma P. Agrawal, (Information Resources Management Association) 2019 IGI Global, ISBN 9781522598671

6. Introduction to IoT Security by Jurcut, Anca D. and Ranaweera, Pasika and Xu, Lina, 202, John Wiley & Sons, Ltd, ISBN: 9781119527978.

Robotics, Optimization and Control

Course title	Credits	Credit distribution		
		Lecture	Tutorial	Practical
Robotics, Optimization and Control		2	0	2

Learning Objectives

The course will be structured with theory and practical classes. The theory classes will be used to present basic concepts of robotics, robot vision, nature-inspired algorithms, and control schemes for the course topics. The practical classes will be used to develop and implement the course challenge project.

Learning outcomes

After completing this course, students should be able to;

- Understand the integrated dynamics of the robot model and object.
- Understand the basic concepts of robot vision.
- Understand the application of optimization algorithms in robotics.
- Learn how to use software packages to solve robotics problems.

SYLLABUS

Unit I: History of Robotics, Challenges of designing robot architecture, Modelling the robot, Holonomic and nonholonomic constraints, Mobile manipulator, Coordinated mobile manipulators, Manipulator with actuator dynamics, Kinematics and dynamics of coordinated robots.

Unit II: Dynamics of an object, Integrated dynamics model of manipulator and object, Image plane modelling, Visual servo: Position-based and Image-based, Nature-inspired optimization algorithms and their applications in robotics.

Unit III: Intelligent control schemes, LQR steady state optimal control, Time varying optimal control, Fuzzy control scheme, Neural network-based control scheme, Neuro-Fuzzy control scheme, Application examples, Simulations using software packages.

Essential/recommended readings

1. Fundamentals in Modeling and Control of Mobile Manipulators, Z. Li, S. S. Ge, CRC Press, 2013.

2. Robotics, Vision and Control: Fundamental Algorithms in MATLAB, P. Corke, Springer Cham, 2017.

3. Manipulation Robots: Dynamics, Control and Optimization, F. L. Chernousko, N. N. Bolotnik, V. Gradetsky, CRC Press, 1994.

4. Robot Manipulator Control: Theory and Practice, F. L. Lewis, D. M. Dawson, C. T. Abdallah, CRC Press, 2003.

5. High-Level feedback control with neural networks, Y. H. Kim, F. L. Lewis, World Scientific, Singapore, 1998.

Biomolecules: Interactions and Characterization techniques

Course title	Credits	Credit distribution		
		Lecture	Tutorial	Practical
Biomolecules: Interactions and Characterization Techniques	4	3	1	0

Learning Objectives

This course is designed to introduce students about:

- Structure and functions of biomolecules (nucleic acids, proteins, carbohydrates)
- Interaction studies of biomolecules with various ligands (metal ions, drugs etc.)
- Characterization techniques for understanding about structure and interaction between biomolecules and ligands

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Learning outcomes

After studying this course, the students will be able to:

- Understand about biomolecules, their structure, function and interactions with various ligands
- Analyze and interpret the experimental data related to studied techniques for their work and also for the published research work from other labs.

Syllabus

Unit I: Biomolecules

Structure and functions of Nucleic acids (DNA and RNA), Proteins, Carbohydrates, Fats

Unit II: Biomolecules and their interactions with various ligands

Interactions of nucleic acids with ligands (metal ions, drugs, proteins etc.), Interaction of proteins with metal ions, drugs and nucleic acids etc.

Unit III: Characterization techniques

To study the structure of biomolecules and their interaction with ligands using various biochemical, biophysical and physicochemical techniques like Gel electrophoresis, UV-visible spectroscopy, UV-thermal melting, Circular Dichroism spectroscopy, Fluorescence spectroscopy, IR spectroscopy, NMR spectroscopy, and X-ray diffraction etc.

Essential/recommended readings

- Nucleic Acid Structure and Recognition; Stephen Neidle; Oxford University Press (2002)
- Nucleic Acids (Structure, Properties, and Functions); Victor A. Bloomfield, Donald M. Crothers, Ignacio Tinoco; Academic University Press (2000)
- Protein-Nucleic Acid Interactions (Structural Biology); Carl C. Correll, Phoebe A. Rice; Royal Society of Chemistry (2008)
- Introduction to Biophysical Methods for Protein and Nucleic Acid Research; Jay A. Glasel, Murray P. Deutscher; Elsevier Science (1995)

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Nanotechnology: An interdisciplinary approach

Course title	Credits	Credit distribution		
		Lecture	Tutorial	Practical
Nanotechnology: An Interdisciplinary Approach	4	3	1	0

Learning Objectives

This course is designed to introduce students about:

- Chemical and green synthesis of nanostructures
- Structure and functions of various types of nanostructures
- Characterization techniques for understanding about size, structure, charge etc. of nanostructures

Learning outcomes

After studying this course, the students will be able to:

- Understand about nanostructures, their synthesis, function and characterization
- Correlate the interdisciplinary aspects of different disciplines of science through nanotechnology
- Analyze and interpret the experimental data related to the studied techniques

Syllabus

Unit I: Various types of nanostructures

Understanding about chemical and green synthesis of nanostructures; Structure, physical and chemical properties of nanostructures like Nanoparticles, Nanoclusters, Nanorods, Quantum dots, Nanospheres, Nanoshells, Nanobots etc.

Unit II: Characterization Techniques of Nanostructures

UV-visible spectroscopy, Infra-red spectroscopy, X-ray diffraction, Thermo-gravimetric Analysis (TGA), Scanning Electron microscopy (SEM), FESEM, Transmission electron microscopy (TEM),

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Atomic Force microscopy (AFM), Zetasizer etc.

Unit III: Applications of Nanotechnology

An interdisciplinary approach to study various applications of nanotechnology in biosensing, biotechnology, gene delivery, drug delivery, dye degradation, environmental remediation, electronics, textile industry, food industry, defence and agriculture etc.

Essential/recommended readings

- Introduction to Nanoscience and Nanotechnology; Gabor L. Homyak, H.F. Tibbals. Joydeep Dutta, John J. Moore; CRC Press (2008)
- Nanotechnology (An Introduction); Jeemy Ramsden; Elsevier Science (2011)
- Recent Advances in Nanotechnology; Changhong Ke; Apple Academic press (2011)

Organisation and function of the chromatin

Course title	Credits	Credit distribution		
		Lecture	Tutorial	Practical
Organization and function of the Chromatin	4	3	0	1

Learning Objectives

This course is designed to introduce students about:

- Eukaryotic genome organization and function.
- Epigenetic basis of inheritance
- Chromatin remodelling mechanisms and remodelling complexes
- Histone modifications and modifying enzymes
- Model organisms for studying chromatin

Learning outcomes

After studying this course, the students will be able to:

- Understand the epigenetic basis of transgenerational inheritance.
- Comprehend the chromatin remodeling and histone modification
- Will be able to visualize the nucleosome and higher-order chromatin structure and function.

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Syllabus

Unit I

Organization of the chromatin:

Structure of histones and histone variants, eukaryotic chromatin, nucleosomes, 10 nm, 30 nm fibre and higher order chromatin, euchromatin and heterochromatin

Unit II

Chromatin remodeling:

ATP-dependent and ATP-independent chromatin remodelling, remodelling complexes, mechanism of remodelling, histone modifications, histone modifying enzymes, DNA modification.

Unit III

Model organisms and tools for studying chromatin:

Yeast, *Tetrahymena*, *C elegens*, mouse, Rat, *Drosophila*, *Arabidopsis*, cell lines and others, ChIP, Microarrray and ChIP-Seq assays, Microscopy techniques for chromatin studies.

Unit IV

Epigenetic inheritance:

Epigenetics and epigenome, epigenetic inheritance, role of protamins and TPs

Practical

1. Isolation of nuclei and analysis of chromatin through MNase and DNase I digestion
2. Isolation, purification and analysis of histones
3. Western blotting of histones using anti-histone antibodies
4. Expression of histone clones in bacteria and purification of bacterially expressed reconstituted histones
5. Study of Chromatin Immunoprecipitation and downstream methods: Microarray, ChIP-on-chip and ChIP-Seq
6. Collection, visualization and analysis of epigenetic data
7. Handling ChIP-Seq data: visualization and modelling.

Essential/recommended readings

- Epigenetics (2014) by Lyle Armstrong; Published by Garland Science, Taylor & Francis Group (ISBN-13: 978-0815365112; ISBN-10: 081536511X)
- Epigenetics a reference Manual by Jeffrey M. Craig and Nicholas C. Wong (2011),

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Caister Academic Press DOI: https://doi.org/10.21775/9781910190494

- Banister CE. Review of *Epigenetics: A Reference Manual*: A book edited by Jeffrey M. Craig and Nicholas C. Wong. Epigenetics. 2012 Aug 1;7(8):963–4. doi: 10.4161/epi.21137. PMCID: PMC3427292

Infectious Disease and Public Health

Course title	Credits	Credit distribution		
		Lecture	Tutorial	Practical
Infectious Disease and Public Health	4	3	0	1

Learning Objectives

This course is designed to give a brief overview of the prevalent and emerging Infectious Diseases and create awareness about the Public Health system and policy. The course will have components.

- Emerging and Neglected Infectious Diseases, Zoonotic Diseases, Lifestyle Diseases
- Outbreak, Endemic, Epidemic, Pandemic, Pathogen and Pathogenesis
- Public Health and Community: Family Welfare, Mental Health, Reproductive Health, Maternal Health; Disaster Management.
- Pathogens and Infection Process, Drugs and Vaccine, Survey and Clinical Trials

Learning outcomes

After studying this course, the students will be able to:

- understand Public Health System and Disaster Management responses
- differentiate Outbreak, Endemic, Epidemic and Pandemic
- learn about the threat of Zoonotic Diseases and Emerging Diseases
- learn how Medicines and Vaccines are made (fundamentals of drug designing)

Syllabus

Unit I: Infectious Disease

Emerging and Neglected Infectious Disease, Aetiology of Infectious and Lifestyle Disease, Threat of Zoonotic Disease. Defining Outbreak, Endemic, Epidemic, Pandemic.

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Unit II: Pathogens, Drugs and Vaccines

Pathogen and Pathogenesis, Drug design, Vaccine, Clinical Trial, Drug-resistant Pathogens.

Unit III: Public Health

Introduction to Public Health, Policies in Urban and Rural India, Family Welfare, Mental Health, Reproductive Health, Maternal Health, Community Medicine, Disaster Management, Policies on Public Health.

Unit IV (Practical): Survey, Clinical Trial, Community Medicine

- Collection and analysis of public health data using statistical software and econometrics techniques
- Preparing Survey Questionnaires and conducting pilot surveys on various aspects of the Public Health system in India.
- *in silico* bio-modelling and drug designing
- Introduction to pathogens, Bacterial culture techniques.
- Case studies: Community Medicine, Public Health Emergency, Outbreaks.

Essential/recommended readings

- *Introduction.To Public Health* Mary Jane Schneider, Jones and Bartlett Publishers, Inc; 6th edition, 2020.
- Oxford Handbook of Infectious Diseases and Microbiology (Oxford Medical Handbooks) OUP Oxford; 2nd edition, 2016.
- *Spillover – Animal Infections and the Next Human Pandemic.*David Quammen, W. W. Norton & Company; 2012.
- *Emergence of Zoonotic Diseases in India: A Systematic Review.* Dhiman RC, Tiwari A *Med Rep Case Stud* 3: 163. doi: 10.4172/2572-5130.1000163, 2018.
- *Manual on Zoonotic Diseases of Public Health Importance.* National Centre for Disease Control (https://ncdc.gov.in/WriteReadData/l892s/File618.pdf), 2016.

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Geographical Information System and Remote Sensing

Course title	Credits	Credit distribution		
		Lecture	Tutorial	Practical
Geographical Information System and Remote Sensing.	4	3	0	1

Learning Objectives

This course is designed to introduce students about:

- Geographical information science (GIS) database, Spatial and non-spatial database.
- Satellite remote sensing database and interpretation of satellite images.
- Spatial functionality of GIS and its application

Learning outcomes

After studying this course, the students will be able to:

- Acquire skills in storing, and managing spatial data for planning and development.
- Acquire skills in advanced techniques such as multi-spectral, topographical and historical data for mapping, modelling and monitoring the earth's surface and environment.

Syllabus

Unit I-

Remote Sensing and GIS: Definition and Components, Development, Platforms and Types. Aerial Photography and Satellite Remote Sensing: Principles, Types and Geometry of Aerial Photograph; Principles of Remote Sensing, EMR Interaction with Atmosphere and Earth Surface; Satellites (Landsat and IRS) and Sensors.

Unit II

GIS Data Structures: Types (spatial and Non-spatial), Raster and Vector Data Structure.

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Unit III

Image Processing (Digital and Manual) and Data Analysis: Pre-processing (Radiometric and Geometric Correction), Enhancement (Filtering); Classification (Supervised and Un-supervised), Geo-Referencing; Editing and Output; Overlays.

Unit IV

Interpretation and Application of Remote Sensing and GIS: Land use/ Land Cover, Urban Sprawl Analysis; Forests Monitoring.

Practical:

- Satellite image processing
- Topographical data analysis
- Vector data analysis.

Essential/recommended readings

1. Campbell J. B., 2007: Introduction to Remote Sensing, Guildford Press.
2. Jensen J. R., 2004: Introductory Digital Image Processing: A Remote Sensing Perspective, Prentice Hall.
3. Joseph, G. 2005: Fundamentals of Remote Sensing, United Press India.
4. Lillesand T. M., Kiefer R. W. and Chipman J. W., 2004: Remote Sensing and Image Interpretation, Wiley. (Wiley Student Edition

Tourism Geography

Course title	Credits	Credit distribution		
		Lecture	Tutorial	Practical
Tourism Geography	4	3	1	0

Learning Objectives

This course is designed to introduce students to:

1. The nature and concept of tourism geography.
2. Methods and tools of research used in tourism.
3. New and emerging trends in tourism.

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Learning Outcomes

After studying this course. the students will be able to:

1. Appreciate the relationship between geography and tourism.
2. Use methods and tools to collect and analyze tourism data for research.
3. Understand the new emerging forms of tourism and develop a skill set to conceptualize new and innovative forms of tourism.

Syllabus

Unit I

Conceptualizing tourism geographies: tourism and space: international patterns of travel and tourism.

Unit II

Production and consumption of geographic space: economic landscape of tourism: tourism spaces and cultures

Unit III

Sustainable tourism. virtual tourism; tourism technologies: tourism and gender: tourism and environment

Unit IV

Foundations of tourism research: methods and tools of research in tourism geography – spatial analysis. mixed methods research. cross-cultural research

Essential/Recommended Readings:

Julie Wilson (Ed.) 2012. The Routledge Handbook of Tourism Geographies. Routledge.

Larry Dwyer. Alison Gill and Neelu Sitaram. 2014. Handbook of Research Methods in Tourism: Quantitative and Qualitative Approaches. Edward Elgar Publishing.

Stephen Smith. 2014. Tourism Analysis: A Handbook. Routledge.

Stephen Willaims & Alan A. Lew. 2014. Tourism Geography: Critical Understandings of Place, Space and Experience. Routledge.

Velvet Nelson. 2013. An Introduction to Geography of Tourism. Rowman and Littlefield Publishers.

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Strategy and Innovation

Course title	Credits	Credit distribution		
		Lecture	Tutorial	Practical
STRATEGIC MANAGEMENT	4	3	1	0

Course Objectives:

The course is designed to cover fundamental issues with regard to corporate and business strategy, and the implementation and process aspects of strategic management.

Course Learning Outcomes:

1. Understand the relationship between strategic analysis and strategic implementation
2. Comprehend the distinction between firms and markets
3. Apply strategy principles to understand the benefits and costs of diversification
4. Understand the dimensions of strategic management & Innovation
5. Study the major contemporary trends in strategic management

Syllabus:

Unit I: From Strategic Analysis to strategic management: The strategic design of organisational structures, processes and management systems, The role of culture, Strategic performance management, Innovation as strategy.

Unit II: Firms versus markets: The nature of firms, When are firms superior to markets? Vertical and horizontal integration, The scope of the firm. Innovation Management.

Unit III: Diversification strategy: Economies of scale and scope, Risk management, Related versus unrelated diversification, Costs and benefits of diversification, Mergers and acquisitions, Franchising, alliances, joint ventures and networks.

Unit IV: Global strategy: Analysing competitive advantage in an international context, Global value chains, Global integration versus national differentiation. Current trends in strategic management: The rise of online retail, The networked organization, Artificial intelligence and strategic management.

Suggested Readings:

1. Besanko, D., Dranove, D., Shanley, M., & Schaefer, S. (2016). *Economics of strategy* (6th ed.), John Wiley

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2. Grant, R. M. (2015). *Contemporary strategy analysis: Text and Cases, Eighth Edition.* Wiley

3. Porter, M. E. (2004). *Competitive strategy.* (2004). New York: Simon & Schuster

4. Porter, M. E. (1998). *Competitive advantage of nations.* London: Macmillan Press

5. Prahalad, C. K., & Krishnan, M. S. (2008). *The New Age of innovation: Driving co created value through global networks.* New York: McGraw Hill.

Note: The list of cases and other relevant references including the latest articles and papers will be announced by the teacher at the time of starting the course.

> ## Curriculum Development: Issues, Challenges & Perspectives

Course title	Credits	Credit distribution		
		Lecture	Tutorial	Practical
Curriculum Development: Issues, Challenges & Perspectives	4	3	1	0

Learning Objectives:

- To develop a conceptual understanding of Curriculum Development
- To develop the capacity to interpret the fundamental issues related to Curriculum Development
- To develop the capacity to interpret the fundamental issues related to School Science Curriculum Development
- To develop critical reflection on issues of curriculum related to school science education.

Syllabus

Unit I

- Different types of curriculum
- Process of curriculum development
- Process of curriculum assessment, curriculum evaluation
- Impact of social influences on curriculum planning and implementation with a focus on school Science Curriculum.

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Unit II

- Problems related to objectives.
- Problems related to content.
- Problem-related to methodology
- Problems related to evaluation.

Unit III

- International influences on the aims of science education and its impact on the curriculum planning and implementation with a focus on school science Curriculum.
- The context of science education development in developing and developed countries
- International trends in science education curriculum and standards development
- Identifying strategies for providing science education more effectively and measuring the impact of science education on human resource development
- Global view of science education curriculum

Suggested Reading

- *The Curriculum: Theory and Practice* by A.K. Valley, Sage Publication (2009).
- *Curriculum: From Theory to Practice* by Wesley Null Rowman & Littlefield, Rowman & Littlefield Publishers (2011)
- *Contemporary Issues in Curriculum* (6th Edition) by Allan C. Ornstein, Edward F. Pajak, Stacey B. Ornstein, Published by Pearson (2014).
- *Curriculum Change and Innovation* by Shirley S. Y. Yeung, John T. S Lam, Anthony W. L. Leung and Yiu Chun Lo Hong Kong University Press, (2012).
- *Deciding What to Teach and Test: developing, aligning, and auditing the curriculum* by by Fenwick English; foreword by Larry E. Frase.
- *International Handbook of Curriculum Research* by William Pinar (Editor); Angel Diaz Barriga (Contribution by); Silvina Feeney (Contribution by); Noel Gough
- Etta, R. Hollins (1996): *Transforming Curriculum for a Culturally Diverse Society*.
- Slattory (1995): *Curriculum Development in Postmodern Era*. (Critical Education & Practice).
- Tilak, Jandhyala B.G. (2003). *Education, Society and Development*. New Delhi: APH Publishing Corporation for NUEPA, Victoria, Australia.

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- Wiles, Jon (2004). *Curriculum Essentials- A Resource for Educators.* Allyn & Bacon
- National Research Council (NRC). 1996. National science education standards. Washington, DC: National Academy Press.
- *A Practical Guide to Teaching Science in the Secondary School* www.routledge.com/education.
- QCA (Qualifications and Curriculum Authority) (2001) Science: planning, teaching and assessing the curriculum for pupils with learning difficulties. London: QCA.
- Wellington, J. And Osborne, J. (2001) *Language and Literacy in Science Education.* Buckingham: Open University Press.
- Frost, J. And Turner, T. (eds) (2005) *Learning to Teach Science in the Secondary School: a companion to school experience,* Abingdon: Routledge Falmer.
- Amos, S. And Boohan, R. (eds) (2002) *Aspects of Teaching Secondary Science,* London:Routledge Falmer.
- Position Paper National Focus Group Curriculum, Syllabus and Textbooks. New Delhi: National Council of Educational Research and Training, 2006
- Dhankar, R. (n.d.). AIMS OF EDUCATION: DO TEACHERS NEED TO BOTHER ABOUT THEM?
- Center for Education Statistics, N. (n.d.). Trends in International Mathematics and Science Study (TIMSS). Retrieved July 18, 2021, from https://nces.ed.gov/timss/countries.asp.
- *Learning: From Speculation to Science | How People Learn: Brain, Mind, Experience, and School: Expanded Edition* | The National Academies Press. (n.d.).

Education Policy: Analysis and Impact

Course title	Credits	Credit distribution		
		Lecture	Tutorial	Practical
Education Policy: Analysis and Impact	4	3	0	1

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Learning Objectives

This is course is designed to introduce students about:

- Approaches to design education policy
- Relationship between policy and practices
- International trends in education policy

Learning outcomes

After studying this course, the students will be able to:

- explore various theories and models of education policy;
- critically analyze education policy within social, political and economic frameworks;
- review the contemporary development in education policy in institutional, national and international contexts
- Assess the impact of education policies by drawing inferences from recent research.

Syllabus

Unit I

Theories and models of education policy

Structures and designs of education policy; education policy as a public policy: national education policy and decentralization of education policy; factors determining the vision, aims and design of education policy; relationships between education policy and society

Unit II

Education Policy Analysis

Various approaches to analyze education policy, relationships between education policy and implementation partners, assessing the impact of education policy

Unit III

International developments and trends in education policy

Critical engagement with theoretical perspectives, international trends and changing paradigms in education policy

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Unit IV

Research and practices in education policy

Understanding the role of research in bringing desired change in education policy and meeting the demands of future education

Practical

8. Conceptual/theoretical analysis of a public policy document
9. Critical analysis of any education policy document
10. Tools development for assessing the impact of an education policy
11. A case study of the implementation plan of an education policy at institutional level
12. Teachers' readiness for policy level reforms in an educational institution
13. Comparative analysis of education policy of different regions/states/countries

Recommended readings

Cobb, P. & Jackson, K. (2012): Analyzing educational policies: A learning design perspective. *Journal of the Learning Sciences*, 21(4), 487-521.

Fan, G.& Popkewitz, T.S. (Eds.). (2020). *Handbook of education policy studies*. Singapore: Springer Publishers.

Levinson, M. (2012). *No citizen left behind*. Harvard University Press.

Ministry of Education. (2020). *National education policy-2020*. Government of India.

UNESCO. (2013). *Handbook on education policy analysis and programming* (vol 1). UNESCO Publication.

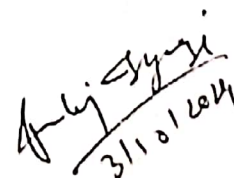## Educational Technology and Learning Designs

Course title	Credits	Credit distribution		
		Lecture	Tutorial	Practical
Educational Technology and Learning Designs	4	3	0	1

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Learning Objectives

This is course is designed to introduce students about:

- Conceptual understanding of new technologies and education;
- Technology as a positive disruption for education reforms;
- Digital inclusion and issues of equity and excellence.

Learning outcomes

After studying this course, the students will be able to:

- understand the conceptual underpinnings of technology-driven education;
- understand the fundamentals of new media and technology in education;
- make theoretically informed choices for the design and practice of technology embedded classroom;
- discuss the role of teacher, learner and technology in an inclusive classroom;
- raise and debate the ethical issues about the dominance of technology, social divide and education reforms.

Unit I

Conceptual and Theoretical frameworks of technology and education

Role and scope of technology in education, Cognitive, social and cultural issues in introducing technology in the classroom

Unit II

Technologies for curriculum design and learning-teaching resource

LMS, MOOCs, Online learning, Open education resources, VR & AR, Artificial intelligence, ICT tools for designing creative learning resources

Unit III

Principles of designing a technology-centric learning space

Instructional design and technology, economics and aesthetics in designing ICT-based learning tools

Unit IV

Equity, excellence & ethical issues in technology-driven education reforms

Technology for an inclusive classroom, Assistive technology for differently-abled learners, technology for education for all, technology and social, cultural and economic divide

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Practical

Empirical-based action research for an ICT intervention in classroom;

Design a new learning resource using technology and media;

Design an assistive learning tool for differently able learners;

Research-driven analysis of socio-cultural issues and use of technology;

Review of technology-embedded curriculum.

Recommended readings

Edwards, B.I., Shukor, N.A. & Cheok, A.D. (2021). *Emerging technologies for next generation learning spaces*. Springer.

Newby, T.J., Stepich, D., Lehman, J., Russell, J.D. & Leftwich, A.T. (2010). *Education technology for teaching and learning*, (4th ed.). Pearson.

Rushby, N. & Surry, D. (Eds.). (2016). *The Wiley handbook of learning technology*. Wiley-Blackwell.

Giftedness, Creativity and Human Excellence

Course title	Credits	Credit distribution		
		Lecture	Tutorial	Practical
Giftedness, Creativity and Human Excellence	4	3	0	1

Learning Objectives

This course is designed to introduce students about:

- Conceptions, theories and models in giftedness
- Intelligence, Creativity and Giftedness
- Cognitive, affective and social needs of gifted people
- Curriculum provisions for gifted learners

Learning outcomes

After studying this course, the students will be able to:

- explore various theories and models of giftedness and human excellence
- understand giftedness from the perspective of inclusion and diversity

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- explain the relationship between intelligence, creativity and giftedness
- design curriculum and teaching modules for gifted learners

Syllabus

Unit I

Conceptions and Theories of Giftedness

Understanding the notion of giftedness from diversity and inclusion, Theories and models of giftedness, nomenclature dilemma in giftedness, locating range of giftedness, Myths about giftedness

Unit II

Constructs of Giftedness

Theories of intelligence, Creativity and giftedness, Nature-nurture theories of giftedness, Myths about giftedness, Identification tools for gifted learners

Unit III

Curriculum and teaching strategies for academically gifted learners

Enrichment, Acceleration, Differentiation, Compacting and Individual learning plan, Student portfolio, Underachievers and twice-exceptional, Guidance and counselling

Unit IV

Giftedness as an academic and research field

International developments and perspectives in gifted education, Education policies and legislative support for gifted students

Practical

- Case Study of a Gifted Child (academic/non-academic domain);
- Preparing thematic enrichment activities for a gifted child;
- Developing an accelerated module for a gifted child;
- Developing an identification tool to identify gifted children;
- Policy review in the light of gifted learners;
- Empirical data analysis on myths about gifted learners.

Recommended readings

Colangelo, N. & Davis, G.A. (2002), *Handbook of gifted education* (3rd ed.), Pearson Ltd.

Clark. B. (2007). *Growing up gifted: Developing the potential of children at home and at school* (7th ed.). Prentice Hall Publishers.

Johnsen. S. (2004). *Identifying gifted students: A practical guide*. Prufrock Press.

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Whitley, M.D. (2001). *Bright minds, poor grades: Understanding and motivating your underachieving child.* Berkley Publishing House.

Winner, E. (1996). *Gifted children: Myths and realities.* New York: Basic Books.

Media, Communication and Culture Studies: an Introduction

Course title	Credits	Credit distribution		
		Lecture	Tutorial	Practical
Media, Communication and Culture Studies: an Introduction	4	3	0	1

Learning Objectives

The course will introduce students to some of the notable works in Media, Communication and Cultural Studies.
1. The course will map the gamut of the Media, Communication and Cultural Studies.
2. The course will critically evaluate this research field at the intersection of Humanities and Social Science traditions.

Learning Outcomes

1. The candidates will be able to critically evaluate the development of the media, communication and cultural studies in the context of modern history and society.
2. The candidates will be able to make connections and find similarities and distinctions, between the three strands of this humanities and social science field, namely media, communication and cultural studies.

SYLLABUS

Unit 1

Development Communication / Broadcast Media / Newspapers / New Media / Film / Photography / Advertising / Public Relations / Literature: notable concepts and theories

Unit 2

Cultural Studies: notable concepts and theories

Unit 3

Decolonising the field: Scholarly work from Asia, Africa and South America

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Suggested Reading List

(Kindly note that this reading list is not exhaustive. Depending on the area of research, within Media and Communication Studies, chosen by the candidate the readings will be suggested in the classroom.)

- Barker, C. 2003. Cultural Studies: Theory and Practice. Sage Publications.
- Benjamin, W. 1969. "The Work of Art in the Age of Mechanical Reproduction." In Illuminations, Orlando: Harcourt Brace.
- Bourdieu, P. (1993) *The field of cultural production*. New York: Columbia University Press.
- Butler, J. (2015) *Gender trouble: Feminism and the subversion of identity*. New York: Routledge.
- Foucault, M. (2012) "What is an Author?" London: The Open University.
- Gramsci, A., Hoare, Q. and Nowell-Smith, G. (2014) *Selections from the prison notebooks of Antonio Gramsci*. New York, NY: International Publishers.
- McQuail, D. and Deuze, M. 2020, McQuail's Media and Mass Communication Theory. Sage Publications.
- McLuhan, M. 1994. Understanding Media: The Extension of Man by Marshall McLuhan. MIT Press.
- Peters J. D. 1999. Speaking into the Air: A History of the Idea of Communication. The University of Chicago Press.
- Said, E.W. (2021) *Orientalism*. London, UK: Penguin.
- Scannel, P. 2007. Media and Communication. Sage Publications.
- Singhal, A. M. 2006. Communication of Innovations: A Journey with Ev Rogers by M Arvind Singhal. Sage Publications.
- Spivak, G.C. *et al.* (2020) *Can the subaltern speak?* London: Afterall Books.
- Thussu, D. K. 2018 International Communication: Continuity and Change. Sage Publications.
- Williams, R. 2017. Culture and Society. Vintage Publishing.
- Fiske, J. 2011. Understanding Popular Culture. Routledge.