# Ph.D. Course Work Common Syllabus

| Paper Name: Research Methodology | Paper Code: PHD-101/RM | Credits: 4 (4-0-0) |
|---|---|---|
| **Evaluation (Maximum Marks = 100)** | **Internal = 30** | **External = 70** |

**Course Objectives**

1. To introduce the fundamental concepts, methods, and ethics of scientific research.
2. To develop skills in research design, data collection, analysis, and interpretation.
3. To enable students to formulate research problems and communicate findings effectively.

| Unit | Contents | Lectures |
|---|---|---|
| **I** | Foundations of Research: Meaning, Objectives, Motivation, Utility. Concept of theory, empiricism, deductive and inductive theory. Characteristics of scientific method – Understanding the language of research – Concept, Construct, Definition, Variable. Research Process. Problem Identification & Formulation – Research Question – Investigation Question – Measurement Issues – Hypothesis – Qualities of a good Hypothesis –Null Hypothesis & Alternative Hypothesis. Hypothesis Testing – Logic & Importance. | **10** |
| **II** | Research Design: Concept and Importance in Research – Features of a good research design – Exploratory Research Design – concept, types and uses, Descriptive Research Designs – concept, types and uses. Experimental Design: Concept of Independent & Dependent variables.<br>Qualitative and Quantitative Research: Qualitative research – Quantitative research – Concept of measurement, causality, generalization, replication. Merging the two approaches. | **10** |
| **III** | Sampling: Concepts of Statistical approach, Sample, Sampling Frame, Sampling Error, Sample Size. Characteristics of a good sample. Probability Sample – Simple Random Sample, Systematic Sample, Stratified Random Sample & Multi-stage sampling. Determining size of the sample – Practical considerations in sampling and sample size.<br>Data Analysis: Data Preparation – Univariate analysis (frequency tables, bar charts, pie charts, percentages), Bivariate analysis – Cross tabulations and Chi-square test including testing hypothesis of association. | **15** |
| **IV** | Measurement: Concept of measurement– what is measured? Problems in measurement in research – Validity and Reliability. Techniques of Scientific Measurement.<br>Interpretation of Data and Paper Writing – Layout of a Research Paper, Journals in Computer Science, Impact factor of Journals, When and where to publish? Ethical issues related to publishing, Plagiarism and Self-Plagiarism. Use of Encyclopedias, The art of Scientific Communication. | **12** |

| | | |
|---|---|---|
| **V** | Use of tools/techniques for Research: methods to search required information effectively, Reference Management Software like Endnote/Zotero/Mendeley, Software for paper formatting like LaTeX/MS Office, Software for detection of Plagiarism. Presentation in Seminars and Conferences, Sponsored Research-basics, Major funding bodies for research, National- DST, UGC, CSIR, ICMR, DBT, SERB, ISRO, and DRDO, International- NSF, NIH, Horizon Europe and UNESCO. | **13** |
| | **Total** | **60** |

## Suggested Readings


1. Kothari, C. R., and Gaurav Garg. Research Methodology: Methods and Techniques. 4th ed., New Age International Publishers, 2019.
2. Creswell, John W., and J. David Creswell. Research Design: Qualitative, Quantitative, and Mixed Methods Approaches. 5th ed., SAGE Publications, 2018. https://us.sagepub.com/en-us/nam/research-design/book255675
3. Saunders, Mark, Philip Lewis, and Adrian Thornhill. Research Methods for Business Students. 8th ed., Pearson Education, 2019.
4. Bryman, Alan. Social Research Methods. 5th ed., Oxford University Press, 2016. https://global.oup.com/ukhe/product/social-research-methods-9780199689453
5. Flick, Uwe. An Introduction to Qualitative Research. 6th ed., SAGE Publications, 2018.
6. Walliman, Nicholas. Research Methods: The Basics. 2nd ed., Routledge, 2017. https://www.routledge.com/Research-Methods-The-Basics/Walliman/p/book/9781138693981
7. Kumar, Ranjit. Research Methodology: A Step-by-Step Guide for Beginners. 5th ed., SAGE Publications, 2022.
8. Neuman, W. Lawrence. Social Research Methods: Qualitative and Quantitative Approaches. 8th ed., Pearson, 2014.
9. Research Methods in Psychology. https://www.saylor.org/courses/psych301/
10. https://onlinecourses.nptel.ac.in/noc23_ge36/preview
11. https://onlinecourses.nptel.ac.in/noc22_ge08/preview

# Ph.D. Course Work Common Syllabus

| Paper Name: Research and Publication Ethics | Paper Code: PHD-102/RPE | Credits: 2 (2-0-0) |
|---|---|---|
| **Evaluation (Maximum Marks = 100)** | Active participation, group discussion and quizzes (25%); Practical: 40%; and End Semester written examination: 35 % | |

**Introduction:**

This course is designed to create awareness among doctoral students about research and publication ethics and different types of unethical practices and misconduct in publications. This course has total 6 units focusing on basics of philosophy of science and ethics, research integrity, publication ethics. Hands-on-sessions are designed to identify research misconduct and predatory publications. Indexing and citation databases, Open Access publications, research metrics (citations, h-index, Impact Factor, etc.) and Plagiarism tools will be introduced in this course.

## Course Structure

The course comprises of six modules listed in table below. Each module has 4-5 units.

| Modules | Unit title | Teaching hours |
|---|---|---|
| **Theory** | | |
| RPE 01 | Philosophy and Ethics | 4 |
| RPE 02 | Scientific Conduct | 4 |
| RPE 03 | Publication Ethics | 7 |
| **Practice** | | |
| RPE 04 | Open Access Publishing | 4 |
| RPE05 | Publications Misconduct | 4 |
| RPE 06 | Databases and Research Metrics | 7 |
| | **Total** | **30** |

## THEORY

### RPE 01: PHILOSOPHY AND ETHICS (3 hrs.)

1. Introduction to philosophy: definition, nature and scope, concept, branches
2. Ethics: definition, moral philosophy, nature of moral judgements and reactions

### RPE 02: SCIENTIFIC CONDUCT (5hrs.)

1. Ethics with respect to science and research.
2. Intellectual honesty and research integrity.
3. Scientific misconducts: Falsification, Fabrication, and Plagiarism (FFP)
4. Redundant publications: duplicate and overlapping publications, salami slicing
5. Selective reporting and misrepresentations of data.

### RPE 03: PUBLICATION ETHICS (7 hrs.)

1. Publication ethics: definition, introduction and importance
2. Best practices/standards setting initiatives and guidelines: CARE, COPE, WAME, etc.
3. Conflicts of interest
4. Publication misconduct: definition, concept, problems that lead to unethical behavior and vice versa, types
5. Violation of publication ethics, authorship and contributorship
6. Identification of publication misconduct, complaints and appeals
7. Predatory publishers and journals

## PRACTICE

### RPE 04: OPEN ACCESS PUBLISHING (4 hrs.)

1. Open Access Publications and Initiatives
2. SHERPA/RoMEO online resource to check publisher copyright & self- archiving policies
3. Software Tools to Identify Predatory Publications
4. Journal Finder/Journal Suggestion Tools viz. JANE, Elsevier Journal Finder, Springer Journal Suggester, etc.

## RPE 05: PUBLICATION MISCONDUCT (4 hrs.)

### A. Group Discussions (2 hrs.)

1. Subject specific ethical issues, falsification, fabrication, and plagiarism (FFP), authorship
2. Conflicts of interest
3. Complaints and appeals: examples and fraud from India and abroad

### B. Software tools (2hrs.)

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

## RPE 06: DATABASES AND RESEARCH METRICS (7 hrs.)

### A. Databases (4 hrs.)

1. Indexing Databases
2. Citation Databases: Web of Science, Scopus, etc.

### B. Research Metrics (3hrs.)

1 Impact Factor of journal as per Journal Citation Report, SNIP, SJR, IPR, Cite Score

2 Metrics: h-index, g-index, i10 index, altmetrics

## Essential Readings


- Suber, P. (2012). *Open Access*. Cambridge, MA, USA: MIT Press.
- Resnik, D.B. (2011). What Is Ethics in Research & Why Is it Important. National Institute of Environmental Health Sciences, I-10.
- National Academy of Sciences, National academy of Engineering and Institute of Medicine (2009). *On Being a Scientist: A Guide of Responsible Conduct in Research*: Third Edition, National Academies Press.
- Madalli, D.P. (2015). *Concepts of Openness and Open Access*. UNESCO Curriculum for Researchers, Module 2. Paris: UNESCO.
- MacIntyre, Alasdair (1967). A Short History of Ethics. London.
- Kanjilal, U. & Das, A.K. (2015). *Introduction to Open Access*. UNESCO Curriculum for Library Schools, Module 1. Paris: UNESCO.
- INSA (2019). Ethics in Science Education, Research and Governance, Edited by K. Muralidhar, A. Ghosh, & A.K. Singhvi. New Delhi: Indian National Science Academy. ISBN: 9788193948217.
- Das, A.K. (2015). *Research Evaluation Metrics*. UNESCO Curriculum for Researchers, Module 4. Paris: UNESCO.

- Das, A.K. & Mishra, S. (2014). Genesis of Altmetrics or Article-level Metrics for Measuring Efficacy of Scholarly Communications: Current Perspectives. *Journal of Scientometric Research*, 3(2): 82-92.
- Chaudhari, N. & Baliga, V. (2015). *Intellectual Property Rights*. UNESCO Curriculum for Researchers, Module 3. Paris: UNESCO.
- Chaddah, P. (2018). Ethics in Competitive Research: Do Not Get Scooped; To Not Plagiarized. ISBN: 9789387480865
- Bird, A. (2006). Philosophy of Science. Routledge.


Supplementary Readings


- ICMR (2017). *National Ethical Guidelines for Biomedical and Health Research Involving Human Participants*. New Delhi: Indian Council of Medical Research.
- Indian Sociological Society (2020). *ISS Code of Ethics*. New Delhi: Indian Sociological Society.
- PSA (2019). *Draft National Policy on Academic Ethics*. New Delhi: Principal Scientific Adviser (PSA) to the Government of India.
- The InterAcademy Partnership (2022). *Report: Combatting Predatory Academic Journals and Conferences*. Trieste: The InterAcademy Partnership.
- UGC (2019). *Consortium for Academic Research and Ethics (CARE)*. New Delhi: University Grants Commission.
- UGC (2020). *Good Academic Research Practices*. New Delhi: University Grants Commission.
- UNESCO (2021). *UNESCO Recommendation on Open Science*. Paris: UNESCO.
- Das, A.K. (2008). *Open Access to Knowledge and Information: Scholarly Literature and Digital Library Initiatives - the South Asian Scenario*. New Delhi: UNESCO, ISBN 9788189218218.
- Das, A.K. (2015). *Scholarly Communications*. UNESCO Curriculum for Researchers, Module 1. Paris: UNESCO.
- Das, A.K. (2019). Research Integrity in the Context of Responsible Research and Innovation Framework. *DESIDOC Journal of Library & Information Technology*, 39(2): 82-86.
- Das, A.K. (2020). UNESCO Recommendation on Open Science: An Upcoming Milestone in Global Science. *Science Diplomacy Review*, 2(3): 39- 43.
- Mishra, S. & Das, A.K. (2015). *Sharing your Work in Open Access*. UNESCO Curriculum for Researchers, Module 5. Paris: UNESCO.

- Nisha, F., Das, A.K. & Tripathi, M. (2020). Stemming the Rising Tide of Predatory Journals and Conferences: A Selective Review of Literature. *Annals of Library and Information Studies*, 67(3): 173-182.
- Smith, I. (2015). *Open Access Infrastructure*. UNESCO Curriculum for Library Schools, Module 2. Paris: UNESCO.
- Bealt, J. (2012). Predatory Publishers Are Corrupting Open Access. *Nature*, 489(7415),179-179.

# Ph.D. Course Work Common Syllabus

| Paper Name: Computer Application | Paper Code: PHD-103/CA | Credits: 4 (4-0-0) |
|---|---|---|
| **Evaluation (Maximum Marks = 100)** | **Internal = 30** | **External = 70** |

**Course Objectives**

1. To introduce the fundamental concepts, architecture, and classifications of computers along with operating systems like Windows and Linux.
2. To develop proficiency in using Microsoft Office tools (Word, Excel, PowerPoint) for document preparation, data analysis, and presentations.
3. To familiarize students with internet usage, email communication, and basic networking concepts for effective digital connectivity and communication.

| Unit | Contents | Lectures |
|---|---|---|
| **I** | Definition and Characteristics of systems-Hardware & Software, Windows and Linux (Latest Version) Microsoft Tools- Definition and Characteristics of Computers: Classification of Computers; Application of Computers; Hardware; Software; Functional Units of a Computer System; Computer Architecture; Bit, Nibble and Byte. Windows: Introduction to Windows Operating System; Windows Features; Starting Windows; Parts of Windows Screen; Shortcuts in Winodows; Windows Applets; Windows : My Computer; Working with files and Folders; what is MS-DOS? Booting Process; The DOS Directory Structure; Referencing Group of files; Command Syntax; Types of Commands; Microsoft Word (Latest Version): Introduction to Microsoft Tools; Starting Word; Mail Merge. | **15** |
| **II** | Microsoft Excel; (Latest Version) Excel Features; Entering data into a Cell; Entering Numbers; Spreadsheets Operations; Freezing Window Panes; Excel Offers Several Methods for Selecting Cells; Erasing the Content of A Cell; Formatting Cells from the Home Tab; The Format Painter; Formulas and Functions; Using Logical Functions; Date and Time Functions; Math and Trigonometric Functions; Statistical Functions; Copying Formulas; Charts; Creating a New Embedded Chart; Type of Charts; Formatting Chart Elements from the Format tab. | **15** |
| **III** | Microsoft PowerPoint (Latest Version) What is Presentation? Introduction to PowerPoint; Starting PowerPoint; PowerPoint Views; Save a Presentation; Exiting PowerPoint; Working with Slides. | **10** |
| **IV** | Introduction to Internet and E-Mail Hardware requirement; to connect to the Internet; Types of Connections; Internet Service Providers; Internet Addressing; Resource Addressing; The World Wide Web; E-Mail. | **10** |
| **V** | Networking Concepts What is a Networks?; Uses of Computer Networks; Network Topologies; Network Hardware and Software. | **10** |

| | | |
|---|---|---|
| | **Total** | **60** |

**Suggested Readings**


1. Rajaraman, V. Fundamentals of Computers. 6th ed., PHI Learning, 2018.
2. Sinha, P. K., and Priti Sinha. Computer Fundamentals. BPB Publications, 2010.
3. Balagurusamy, E. Programming in ANSI C. 8th ed., McGraw Hill Education, 2019.
4. Forouzan, Behrouz A. Data Communications and Networking. 5th ed., McGraw Hill Education, 2017.
5. Tanenbaum, Andrew S., and Herbert Bos. Modern Operating Systems. 4th ed., Pearson, 2014.
6. Stallings, William. Computer Organization and Architecture: Designing for Performance. 10th ed., Pearson, 2016.
7. Riley, David, and Kenny Hunt. Computational Thinking for the Modern Problem Solver. CRC Press, 2014.
8. Rouse, Margaret Z. Information Technology for Management. Wiley, 2020.
9. Evans, Alan, Kendall Martin, and Mary Anne Poatsy. Technology in Action: Introductory. 15th ed., Pearson, 2019.
10. NPTEL. Computer Science and Engineering, https://nptel.ac.in/course.html
11. GeeksforGeeks. Computer Science Portal for Geeks, https://www.geeksforgeeks.org/
12. Coursera. Computer Science Courses, https://www.coursera.org/browse/computer-science
13. TutorialsPoint. Computer Programming and IT Tutorials, https://www.tutorialspoint.com/index.htm
14. https://nptel.ac.in/courses/106106092

# School of Science and Technology
## Ph.D. Course Work Computer Science Eng.- Elective

| Paper Name: Trends in Machine Learning | Paper Code: PHD-104/CS (I) | Credits: 4 (4-0-0) |
|---|---|---|
| **Evaluation (Maximum Marks = 100)** | **Internal = 30** | **External = 70** |

**Course Objectives**

1. To understand the basic building blocks and general principles that allow one to design machine learning algorithms.
2. To become familiar with specific, widely used machine learning algorithms.
3. To learn methodology and tools to apply machine learning algorithms to real data and evaluate their performance.

| Unit | Contents | Lectures |
|---|---|---|
| **I** | Introduction: Defining learning systems, Goals and applications of machine learning. Aspects of developing a learning system: training data, concept representation, function approximation, supervised learning, unsupervised learning, Reinforcement learning, learning algorithms. | **10** |
| **II** | Decision Tree Learning: Representing concepts as decision trees. Recursive induction of decision trees. Picking the best splitting attribute: entropy and information gain. Searching for simple trees and computational complexity, Overfitting, noisy data, and pruning | **10** |
| **III** | Ensemble Learning: Bagging, boosting, and Ada-Boost. Experimental Evaluation of Learning Algorithms, Measuring the accuracy of learned hypotheses. Comparing learning algorithms: cross-validation, learning curves, and statistical hypothesis testing. | **10** |
| **IV** | Rule Learning: Translating decision trees into rules. Artificial Neural Networks: Neurons and biological motivation. Linear threshold units. Perceptrons: representational limitation and gradient descent training. Multilayer networks and back propagation. Hidden layers and constructing intermediate, distributed representations. Overfitting, learning network structure, recurrent networks. | **15** |
| **V** | Support Vector Machines: Maximum margin linear separators. Kernels for learning non-linear functions. Bayesian Learning: theory and Bayes rule. Naive Bayes learning algorithm. Parameter smoothing. Generative vs. discriminative training. Logisitic regression. Bayes nets and Markov nets for representing dependencies. Instance-Based Learning: Constructing explicit generalizations versus comparing to past specific examples. k-Nearest-neighbor algorithm, Case-based learning.v | **15** |
| | **Total** | **60** |

**Suggested Readings**


1. Tom M. Mitchell. Machine Learning, - MGH, 2000.
2. Stephen Marsland. Machine Learning: An Algorithmic Perspective, Taylor & Francis (CRC), 2010.
3. Goodfellow, I., Bengio, Y., & Courville, A. (2016). *Deep learning*. MIT Press.
4. Géron, A. (2022). *Hands-on machine learning with Scikit-Learn, Keras, and TensorFlow: Concepts, tools, and techniques to build intelligent systems* (3rd ed.). O'Reilly Media.
5. Russell, S. J., & Norvig, P. (2021). *Artificial intelligence: A modern approach* (4th ed.). Pearson.
6. Aggarwal, C. C. (2018). *Neural networks and deep learning: A textbook*. Springer.
7. https://onlinecourses.nptel.ac.in/noc25_ee181/preview
8. https://www.geeksforgeeks.org/machine-learning/machine-learning/

# School of Science and Technology
## Ph.D. Course Work Computer Science Eng.- Elective

| Paper Name: Advanced Computer Networks | Paper Code: PHD-104/CS(II) | Credits: 4 (3-0-0) |
|---|---|---|
| **Evaluation (Maximum Marks = 100)** | **Internal = 30** | **External = 70** |

**Course Objectives**

1. To provide a broad coverage of introductory and advanced topics in the field of computer networks.
2. To have depth knowledge of computer networks.
3. To recognize the different internetworking devices and their functions.

| Unit | Contents | Lectures |
|---|---|---|
| **I** | Requirements, Network architecture, Networking principles, Network services and Layered architecture, Network services and Layered architecture, Future networks (Internet, ATM, Cable TV, Wireless – Bluetooth, Wi-Fi, WiMax, Cell phone). | **10** |
| **II** | Virtual circuits, Fixed size packets, Small size packets, Integrated service, History, Challenges, ATM Network protocols, IP over ATM, Wireless networks: Wireless communication basics, architecture, mobility management, wireless network protocols. Ad-hoc networks Basic concepts, routing; Bluetooth (802.15.1), Wi-Fi (802.11), WiMAX (802.16), Optical Network: links, WDM system, Optical LANs, Optical paths and networks. | **10** |
| **III** | Control of networks: objectives and methods of control, Circuit switched networks, ATM networks. Mathematical background for control of networks like Circuit switched networks, Datagram and ATM networks. | **10** |
| **IV** | Routing architecture, Routing between peers ( BGP) , IP switching and Multi-Protocol Label Switching (MPLS), MPLS Architecture and related protocols, Traffic Engineering (TE) and TE with MPLS, NAT and Virtual Private Networks (L2, L3, and Hybrid), CIDR –Introduction, CIDR addressing, CIDR address blocks and Bit masks. | **15** |
| **V** | Mobile IP- characteristics, Mobile IP operation, Security related issues. Mobility in networks, Voice and Video over IP (RTP, RSVP, QoS) IPv6: Why IPv6, basic protocol, extensions and options, support for QoS, security, etc., neighbour discovery, auto-configuration, routing. Application Programming Interface for IPv6. | **15** |
| | **Total** | **60** |

**Suggested Readings**

1. Tanenenbaum, “ Computer Network”,PHI, 2005.
2. Srinivasan Keshav” An Engineering Approach To Computer Networking “,Pearson, 2010.
3. D. Bertsekas , R Gallagar ,”Data Networks and Internets” PHI, 2000.
4. https://onlinecourses.nptel.ac.in/noc23_cs35/preview
5. http://digimat.in/nptel/courses/video/106106243/L01.html
6. Hagen S, (2006). IPv6 Essentials. O'Reilly.
7. https://shorturl.at/djNAO

# School of Science and Technology
## Ph.D. Course Work Computer Science Eng.- Elective

| Paper Name: Information Security and Cyber Laws | Paper Code: PHD-104/CS(III) | Credits: 4 (3-0-0) |
|---|---|---|
| **Evaluation (Maximum Marks = 100)** | **Internal = 30** | **External = 70** |

**Course Objectives**

1. To develop the skills to imbibe the Information Security issues at technological ground and then relate it to complex cyber world legal problems.
2. To give a detailed understanding of national and international regulatory paradigms and its mechanics regarding Cyber Law.
3. To study of cyber-security and the regulation of the Internet and the Internet of Things.

| Unit | Contents | Lectures |
|---|---|---|
| **I** | Changing Nature of Information Systems, Need of Distributed Information Systems, Role of Internet and Web Services, Information System Threats and attacks, Classification of Threats and Assessing Damages 18 Security in Mobile and Wireless Computing- Security Challenges in Mobile Devices, authentication Service Security, Security Implication for organizations, Principles of Information Security: Confidentiality, Integrity Availability and other terms in Information Security. | **10** |
| **II** | Security Threats to E Commerce, Virtual Organization, Business Transactions on Web, E Governance and EDI, Concepts in Electronics payment systems, E Cash, Credit/Debit Cards. Biometrics, Factors in Biometrics Systems, Benefits, Criteria for selection of biometrics, Design Issues in Biometric Systems. | **10** |
| **III** | Model of Cryptographic Systems, Issues in Documents Security, System of Keys, Public Key Cryptography, Digital Signature, Requirement of Digital Signature System, Finger Prints, Firewalls: Design and Implementation Issues, Policies. | **10** |
| **IV** | IT Act; The rights the various parties have with respect to creating, modifying, using distribution. Computer Software and Intellectual Property-Objective, Copyright Protection, Reproducing, Defenses, Patent Protection. Database and Data Protection-Objective. | **15** |
| **V** | Introduction to Trade mark – Trade mark Registration Process – Post registration Procedures – Trade mark maintenance. Introduction to Copyrights – Principles of Copyright Principles -The subjects Matter of Copy right – The Rights Afforded by Copyright Law – Copy right Ownership. Introduction to Trade Secret – Maintaining Trade Secret. | **15** |
| | **Total** | **60** |

**Suggested Readings**

1. Godbole,“ Information Systems Security”, Willey, 2008.
2. Merkov, Breithaupt,“ Information Security”, Pearson Education, 2005.
3. Sood,“Cyber Laws Simplified”, Mc Graw Hill, 2000.
4. Furnell, “Computer Insecurity”, Springer, 2005.
5. Schou, Shoemaker, “ Information Assurance for the Enterprise”, Tata McGraw Hill, 2010.
6. https://www.wileyindia.com/introduction-to-information-security-and-cyber-laws.html
7. https://onlinecourses.swayam2.ac.in/cec24_cs14/preview
8. https://onlinecourses.nptel.ac.in/noc23_cs127/preview

# School of Science and Technology
## Ph.D. Course Work Computer Science Eng.- Elective

| Paper Name: Advanced Operating System | Paper Code: PHD-104/CS(IV) | Credits: 4 (3-0-0) |
|---|---|---|
| **Evaluation (Maximum Marks = 100)** | **Internal = 30** | **External = 70** |

**Course Objectives**

1. To read classic systems papers that shaped the field.
2. To present technical materials to others both orally and in written form.
3. To improve the accuracy and precision with which you express ideas.

| Unit | Contents | Lectures |
|---|---|---|
| **I** | Introduction: Operating system concept - processes and threads, process model, process creation, process termination, process hierarchies, and process states, Implementation of processes, Threads- Thread model, thread usage, Implementation of threads in user space and kernel, Hybrid implementations. | **10** |
| **II** | Inter Process Communication: Race conditions, critical regions, Mutual Exclusion with busy waiting, sleep and wakeup, Semaphores, Mutexes, Monitors, Message passing; Scheduling- scheduling in batch systems, Interactive systems, Real time systems. | **10** |
| **III** | Deadlocks: Introduction, Deadlock Detection and Recovery – Deadlock Detection with one resource of each type, with multiple resource of each type, recovery from deadlock; Deadlock Avoidance, Deadlock Prevention. | **10** |
| **IV** | Memory and Device Management: Introduction, Swapping, Paging, Virtual memory – Demand paging, page replacement Algorithms; File System Management- Organization of File System, File Permissions, MS DOS and UNIX file system case studies, NTFS; Device Management- I/O Channels, Interrupts and Interrupt Handling, Types of device allocation. | **15** |
| **V** | Distributed Operating Systems: Distributed operating system concept – Architectures of Distributed Systems, Distributed Mutual Exclusion, Distributed Deadlock detection, Agreement protocols, Threads, processor Allocation, Allocation algorithms , Distributed File system design; Real Time Operating Systems: Introduction to Real Time Operating Systems, Concepts of scheduling , Real time Memory Management. | **15** |
| | **Total** | **60** |

**Suggested Readings**


1. Singhal, M., & Shivaratri, N. G. (1994). *Advanced concepts in operating systems: Distributed, database, and multiprocessor operating systems*. McGraw-Hill.
2. Arpaci-Dusseau, R. H., & Arpaci-Dusseau, A. C. (2020). *Operating systems: Three easy pieces* (1.0 ed.). Arpaci-Dusseau Books. http://pages.cs.wisc.edu/~remzi/OSTEP/
3. Tanenbaum, A. S., & Bos, H. (2015). *Modern operating systems* (4th ed.). Pearson.
4. Tanenbaum, A. S., & van Steen, M. (2007). *Distributed systems: Principles and paradigms* (2nd ed.). Pearson Prentice Hall.
5. Silberschatz, A., Galvin, P. B., & Gagne, G. (2022). *Operating system concepts* (10th ed.). Wiley.
6. Sinha, P. K. (1997). *Distributed operating systems: Concepts and design*. Prentice Hall of India.
7. McKusick, M. K., Neville-Neil, G. V., & Watson, R. N. M. (2014). *The design and implementation of the FreeBSD operating system* (2nd ed.). Addison-Wesley.
8. Vahalia, U. (1996). *UNIX internals: The new frontiers*. Prentice Hall.
9. https://onlinecourses.nptel.ac.in/noc20_cs04/preview
10. https://www.youtube.com/playlist?list=PLF2K2xZjNEf97A_uBCwEl61sdxWVP7VWC